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FINAL
HISTORICAL SITE ASSESSMENT
SANTA SUSANA FIELD LABORATORY SITE
AREA IV RADIOLOGICAL STUDY
VENTURA COUNTY, CALIFORNIA

Volumes I through III

(Binder 1 of 3)

Prepared for:

EPA Contract Number: EP-S7-05-05
Task Order Number: 0038

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October 2012

HGL

PREFACE

In preparing this Historical Site Assessment (HSA) for the Santa Susana Field Laboratory Site Area IV Radiological Study, the U.S. Environmental Protection Agency (EPA) sought to provide the most comprehensive and far-reaching HSA possible. Among the voluminous amount of documents reviewed and ultimately used in preparing the HSA, several documents were used that have been identified as containing information potentially restricted by U.S. export control laws, including the Arms Export Control Act (22 U.S.C. section 2751 et seq.), the International Traffic in Arms Regulations (22 C.F.R. Part 120), the U.S. Department of Commerce's Export Administration Regulations (15 C.F.R. Parts 730-774), and the U.S. Department of Energy's Foreign Atomic Energy Activities Regulations (10 C.F.R. Part 810). These documents may only be reviewed by U.S. persons. U.S. persons are U.S. citizens, U.S. nationals, lawful permanent residents of the U.S., or persons who are protected individuals as defined by 8 U.S.C. section 1324(b)(a)(3) (certain refugees and grantees of asylum). Transfer of controlled information by any means to a non U.S. person, whether in the U.S. or abroad, without a valid export license or prior written approval from the Department of State, Department of Commerce, or other relevant federal agency, is prohibited.

In order to provide the HSA to the broadest audience possible without encumbrances, EPA has chosen to prepare a redacted version of the HSA to comply with U.S. law. This means that certain passages within this version of the HSA containing information potentially restricted by U.S. export control laws have been made illegible in order to protect this sensitive information while maintaining the original flow and organization of the HSA. It should be noted that as a percentage of the total HSA, the passages that have been redacted comprise less than 1 percent of the HSA.

Per agreement with EPA's interagency partner at the Santa Susana Field Laboratory Site, the California Department of Toxic Substances Control (DTSC), EPA has provided an unredacted version of this HSA, with all parts made legible, for public review should a member of the public wish to review the entire HSA. Members of the general public who wish to review the entire HSA without redactions should contact the DTSC and make an appointment to do so. At the time of the appointment, DTSC will verify whether the individual requesting the review is a U.S. person and only U.S. persons will be permitted to read the passages that have been redacted. However, the information presented in those passages will remain under the purview of U.S. export control laws and cannot be removed from the DTSC office or copied or transmitted in any form.

To make arrangements to review the full version of the HSA report, including information restricted under the export control laws of the U.S., members of the public should contact the following DTSC office:

California Department of Toxic Substances Control
9211 Oakdale Avenue
Chatsworth, CA 91311
Phone: (818) 717-6500

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VOLUME I

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Appendix A Aerial Photographic Analysis of Santa Susana Field Laboratory, Area IV, Ventura County, California, March 2010

Appendix B Final Former Employee Interview Report, Santa Susana Field Laboratory Site, Area IV Radiological Study, Ventura County, California, November 2011

Volume II Final Technical Memorandum, Subarea HSA-5A, Historical Site Assessment, Santa Susana Field Laboratory Site, Area IV Radiological Study, Ventura County, California

Volume III Final Technical Memorandum, Subarea HSA-5B, Historical Site Assessment, Santa Susana Field Laboratory Site, Area IV Radiological Study, Ventura County, California

Volume IV Final Technical Memorandum, Subarea HSA-5C, Historical Site Assessment, Santa Susana Field Laboratory Site, Area IV Radiological Study, Ventura County, California

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Volume VI	Final Technical Memorandum, Subarea HSA-6, Historical Site Assessment, Santa Susana Field Laboratory Site, Area IV Radiological Study, Ventura County, California
Volume VII	Final Technical Memorandum, Subarea HSA-7/3/NBZ, Historical Site Assessment, Santa Susana Field Laboratory Site, Area IV Radiological Study, Ventura County, California
Volume VIII	Final Technical Memorandum, Subarea HSA-8, Historical Site Assessment, Santa Susana Field Laboratory Site, Area IV Radiological Study, Ventura County, California

LIST OF ACRONYMS AND ABBREVIATIONS

AETR	Advanced Epithermal Thorium Reactor
AOC	Administrative Order on Consent
CD	compact disc
CDPH	California Department of Public Health
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
Ci	Curie
D&D	decontamination and decommissioning
DOE	Department of Energy
DTSC	Department of Toxic Substances Control
USEPA	U.S. Environmental Protection Agency
EPIC	Environmental Photographic Interpretation Center
ETEC	Energy Technology Engineering Center
HGL	HydroGeoLogic, Inc.
HEPA	high-efficiency particulate air
HSA	Historical Site Assessment
kW	kilowatt
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
mR/hr	milli roentgens per hour
MWd	megawatt days
NASA	National Aeronautics and Space Administration
NBZ	Northern Buffer Zone
NRC	Nuclear Regulatory Commission
RMHF	Radioactive Materials Handling Facility
SBZ	Southern Buffer Zone
SCA	SNAP critical assembly
SNAP	Systems for Nuclear Auxiliary Power
SSFL	Santa Susana Field Laboratory
TM	technical memorandum

FINAL
HISTORICAL SITE ASSESSMENT
SANTA SUSANA FIELD LABORATORY SITE
AREA IV RADIOLOGICAL STUDY
VENTURA COUNTY, CALIFORNIA

1.0 INTRODUCTION

This Historical Site Assessment (HSA) was prepared by HydroGeoLogic, Inc. (HGL) as one of a series of tasks assigned by the U.S. Environmental Protection Agency (EPA) for conducting a radiological characterization study within the area of the Santa Susana Field Laboratory (SSFL) known as Area IV and the Northern Buffer Zone (NBZ). This combined study area is hereafter called the "Area IV Study".

EPA's study consisted of an HSA, gamma scanning of accessible areas, geophysical surveys, and evaluation of past soil sampling results. The HSA therefore provides one line of evidence to be used along with the gamma scanning, geophysical surveys, and results of past soil analyses in EPA's overall Area IV Study.

The objective of the HSA component of the radiological study was to provide a comprehensive investigation that identifies, collects, organizes, and evaluates historical information relevant to nuclear research operations as it pertains to radiological contamination in the Area IV Study Area. Once these areas were identified, potential areas where radiological contamination may exist at the site were identified for sampling.

EPA's Area IV Study was divided into nine subareas, which were addressed in seven Technical Memoranda (TMs). Historical aerial photographic analysis and process history obtained from former employee interviews were also considered during this study. The comprehensive HSA is presented in a series of eight volumes on eight compact discs (CDs) as follows:

- Volume I: Final Historical Site Assessment
  - Appendix A: Aerial Photographic Analysis
  - Appendix B: Final Former Employee Interview Report
- Volume II: Final Technical Memorandum, Subarea HSA-5A
- Volume III: Final Technical Memorandum, Subarea HSA-5B
- Volume IV: Final Technical Memorandum, Subarea HSA-5C
- Volume V: Final Technical Memorandum, Subarea HSA-5D
- Volume VI: Final Technical Memorandum, Subarea HSA-6
- Volume VII: Final Technical Memorandum, Subarea HSA-7/3/NBZ
- Volume VIII: Final Technical Memorandum, Subarea HSA-8

1.1 EPA HSA Process Overview

The following sections provide an overview of the overall HSA process implemented at the SSFL Area IV Study area.

1.1.1 HSA Preparation

The overall HSA process for the Area IV study area included development of the following distinct reports, which were produced independently and then integrated in eight volumes into this single, combined HSA:

- Final HSA, which includes an overview of the HSA process employed at the site.
- Aerial Photographic Analysis of Santa Susana Field Laboratory, Area IV, Ventura County, California, March 2010.
- Final Former Employee Interview Report, Santa Susana Field Laboratory Site, Area IV Radiological Study, Ventura County, California, February 2012.
- Seven Final TMs, which pertain to the nine subareas comprising the Area IV Study area.

In order to facilitate rapid communication of HSA findings to the HGL field teams, while also ensuring that the project's stakeholders had the opportunity to provide insight and comments to the process, the TMs were completed using an ongoing schedule. Thus the findings of each TM could be rolled out for field team use in determining sampling locations while completion of other TMs continued.

The development of the seven TMs served as the primary basis for valuable SSFL stakeholder involvement and participation in planning the Area IV radiological investigation. The process of preparing draft TMs, soliciting stakeholder comments, presenting findings at stakeholder meetings, preparing responses to stakeholder comments, and preparing final versions of each TM has ensured that this final HSA is as complete as possible in addressing stakeholder concerns at the site.

Each TM provided recommended locations for soil/sediment sampling based on an evaluation of the information obtained for each subarea discussed. These recommendations were based solely on historical information and not on-the-ground evaluation. Rather, the TM recommendations were analyzed by field personnel who would be engaged in gamma scanning, geophysical surveys, and soil and water testing.

The stakeholders were also engaged in the process of analyzing HSA recommendations and determining appropriate sampling locations at two points in the information analysis process. First, stakeholders participated in general public visits to the site, normally held once or twice a month. During these visits, the stakeholders viewed the sites identified in the TMs and discussed them with field personnel. Second, during stakeholder technical meetings, the stakeholders and field personnel discussed and decided upon specific sampling points. Thus the stakeholders were able to actively work with EPA to determine the best possible sampling locations to ensure a complete radiological study. The methodology for determining sampling locations, as well as the findings of the various field investigation efforts, are presented in separate reports of findings.

The HSA and the Former Employee Interview Report, presented in Volume I, were prepared by HGL on behalf of EPA. The Aerial Photographic Analysis, also presented in Volume I, was prepared by EPA. The TMs, presented in Volumes II through VIII, were prepared by HGL on behalf of EPA.

The HGL HSA team consisted of four staff members: a team leader and three primary authors. Each primary author was assisted on a rotational basis, when possible, by other members of the HSA team. After a TM was submitted for stakeholder review, that TM's primary author was then assigned either to another TM or to assist another primary author with their assigned TM. Together, the HSA team represented nearly 55 years of experience at HGL performing environmental research and investigations. Therefore, a relatively small HSA team was utilized. The HGL HSA team worked under the direction and oversight of several HGL senior technical staff members, as well as EPA senior technical staff members and project managers.

The HGL HSA team leader was Mr. Eric Dambaugh. The three primary HGL HSA authors were as follows:

- Ms. Jessica Berg: HSA-5A and HSA-5D TMs.
- Ms. Kimberly Clower: HSA-5B and HSA-7/3/NBZ TMs; Former Employee Interview Report.
- Ms. Victoria Guvanasen: HSA-5C, HSA-6, and HSA-8 TMs.

The content of each TM was based on guidance provided in the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM, Revision 1, August 2000). MARSSIM is used as an investigative tool used to gain an understanding of the nature and extent of radiological contamination left at a site. The TMs provide preliminary recommendations for MARSSIM classifications based solely on historical information that may be updated once additional information is available pertaining to the presence of radiological contamination at these various areas and facilities within Area IV.

Each of the seven TMs presents a summary of the identified environmental concerns associated with past radiological operations within the Area IV Study portion of the SSFL site, which consists of four areas: Areas I, II, III, and IV; and two buffer zones: the NBZ and the Southern Buffer Zone (SBZ). With the exception of 452 acres owned by the U.S. Government in Areas I and II, which are outside of the Area IV Study area, the entire SSFL site, including the NBZ, is owned and operated by the Boeing Company.

EPA divided the Area IV Study Area into subareas, which were addressed in the following TMs: HSA-5A, HSA-5B, HSA-5C, HSA-5D, HSA-6, HSA-7/3/NBZ, and HSA-8.

1.1.2 Technical Memorandum (TM) Contributions to Sampling Approach

Preliminary findings based on historical documentation only (i.e., before EPA's field investigation activities) were presented in the TMs and include:

- Descriptions and locations of potential, likely, or known activities that involved radioactive material, radioactive waste, or mixed waste;
- Initial MARSSIM classifications (e.g., Class 1, 2, 3) of potentially impacted areas;
- A site-by-site assessment of the likelihood or "weight of evidence" of radiologically contaminated media;
- An assessment of the likelihood of potential migration pathways; and,
- Identification of, confirmation of, and, if appropriate, addition or subtraction to, the list of the potential radiological contaminants of concern.

The information provided in each TM together with comments and recommendations provided by SSFL stakeholders and the general public was used in the EPA's investigation strategy for sampling and analysis for residual radiological contamination in surface and subsurface soil within each subarea.

Each TM (found in Volumes II through VIII of this HSA) presents findings relative to the above-stated criteria. Nuclear facilities at the U.S. Department of Energy's (DOE) Energy Technology Engineering Center (ETEC), parts of which were located within subareas HSA-5A, HSA-5B, HSA-5C, HSA-6, HSA-7, and HSA-8, included 10 nuclear research reactors over the period July 1956 through February 1980. These research reactors are listed in Table 1.1, below, and depicted on Plate 1.

Table 1.1
Research Reactors Located at the Santa Susana Field Laboratory[1]

Reactor Acronym	Building No.	Facility Name	Power Level (kW)	Period of Operation	Power Generated (MWd)	Radioactivity at End of Operation (10^3 Ci)
KEWB	4073	Kinetics Experiment Water Boiler	1	7/1956 to 11/1966	1	6
L-85/AE-6	4093	L-85 Nuclear Experimentation Reactor	3	11/1956 to 2/1980	2	18
SRE	4143	Sodium Reactor Experiment	20,000	4/1957 to 2/1964	6,700	120,000
SER	4010	Systems for Nuclear Auxiliary Power (SNAP) Experimental Reactor Facility	50	9/1959 to 12/1960	13	300
S2DR	4024	SNAP Environmental Test Facility	65	4/1961 to 12/1962	13	390
STR	4028	Shield Test Irradiation Facility	50	12/1961 to 7/1964	1	300
S8ER	4010	S8ER Test Facility	600	5/1963 to 4/1965	215	3,600
STIR	4028	Shield Test Irradiation Facility	1,000	8/1964 to /1974	28	3,714
S10FS3	4024	SNAP Environmental Test Facility	37	1/1965 to 3/1966	16	6,000
S8DR	4059	SNAP Development Reactor Facility	619	5/1968 to 12/1969	182	220

Seven criticality test facilities (i.e., facilities housing operations involving masses of fissionable material capable of sustaining a nuclear chain reaction) were also located on Area IV.[2] These are listed in Table 1.2, below, and on Plate 1. Other nuclear facilities within Area IV, in subareas HSA-7/3/NBZ, HSA-5D, and HSA-8, respectively, included the Radioactive Materials Disposal Facility (Building 4021), the Hot Laboratory (Building 4020), and the Sodium Disposal Facility, or Area IV burn pit, (Building 4886). Each of these facilities is addressed as a site within the appropriate TM along with supporting buildings and open areas.

[1] Oldenkamp, R.D. and Mills, J. C., *Nuclear Operations at Rockwell's Santa Susana Field Laboratory – A Factual Perspective*, Rockwell International; Report No. N001ER000017, September 6, 1991, p. 23.
[2] Atomics International, A Division of North American Aviation, Inc., *Atomics International,* December 1959

Table 1.2
Criticality Test Facilities at the Santa Susana Field Laboratory[3]

Facility Name	Building No.	Period of Operation	Notes
SNAP Critical Test	4373	1957 to 1963	First SNAP-2 criticality tests
Organic Moderated Reactor	4009	1958 to 1967	Basic tests of reactor concept
Sodium Graphite Reactor	4009	1958 to 1967	Basic tests of reactor concept
SNAP Critical Equipment	4012	1961 to 1971	Later SNAP criticality tests
Fast Critical Experiment	4100	1961 to 1972	Started as Advanced Epithermal Thorium Reactor (AETR)
SNAP Flight Systems	4019	1962	SNAP flight system criticality
SNAP Transient Test	4024	1967 to 1969	SNAP transient response tests

1.1.3 TM Site Summary Methodology

In preparing the TMs, the following types of documents and information sources were reviewed:

- radiological characterization reports;
- previous radiological surveys;
- D&D reports;
- environmental monitoring reports;
- license termination reports;
- aerial photographs dating back 50 years;
- building floor plans;
- piping diagrams and construction drawings;
- RFI reports;
- unusual occurrence reports;
- incident reports;
- plant operating reports and logs;
- safety analyses reports;
- facility surveillance and maintenance reports; and
- information obtained from interviews with former workers or other persons.

Numerous documents were obtained through information requests sent to Boeing, DOE, and other parties including the National Aeronautics and Space Administration (NASA). EPA sent formal information requests to Boeing, DOE, the Nuclear Regulatory Commission (NRC) and the California Department of Public Health (CDPH) under § 104(e) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). In addition, EPA directed Boeing to identify and provide pertinent documents within a number of document databases comprising approximately 1.4 million documents relating to all areas of the SSFL site, including Area IV, as well as some off-site facilities.

[3] Oldenkamp, R.D. and Mills, J. C., *Nuclear Operations at Rockwell's Santa Susana Field Laboratory – A Factual Perspective*, Rockwell International; Report No. N001ER000017, September 6, 1991, p. 25.

Additional details regarding the execution of these information requests can be found in each TM (Volumes II through VIII of this HSA).

1.1.4 TMs and the Radiological HSA

The subject areas considered and addressed for each site discussed in Section 2 of each TM are presented below. For each subject area, the list of criteria evaluated and the associated parameters for the evaluation are described. The most complete available information was used to evaluate the site; no known information was omitted from the description. In the event that known information did not conform to one of the listed subject areas, it was included in the most logical place.

Site Description
A physical description of the site including, at a minimum, the following data elements: building numbers of all buildings within the site; date of construction of building(s); buildings in the vicinity not associated with the site; location of site relative to street(s); site plan(s); and floor plan(s) from as-built or plan drawings, if available.

Building Features
Information related to dimensions or size of building(s), below-ground structures, vaults, pipelines, sumps, condensation lines, sewers, drains, swales, and leach fields. If none of these features were identified, the text "no information was located" was inserted.

Former Use(s)
Details of past use(s) of the site, including dates of activities.

Information from Interviewee(s)
This category includes information about the site provided by interviewee(s). If no information was obtained for a particular site, the text "none to date" was inserted. Individuals who have been interviewed include:

- Former SSFL Employees (e.g., health physicists, electricians, mechanics, construction inspectors, nuclear technicians, etc.);
- Survivors of Former Employees;
- Former Contractors (and one survivor of a former Contractor);
- Community Stakeholders; and
- Residents in surrounding areas.

At the discretion of the Interviewee, each interview is conducted either by representatives of the EPA only, representatives of the DOE only, or jointly by EPA and DOE representatives. EPA's primary objective of the interview program was to help direct the soil sampling crews to potential source areas of radiological contamination identified during the course of each interview. All information on potential source areas, corroborated or not, was recorded in EPA's HSA process.

Details regarding the interviews conducted by EPA are presented in Appendix B (found in Volume I) of this HSA.

Radiological Incident Reports
Reports on any documented incidents at the site with the potential for release of radioactivity into the environment. If no incident reports were found, the text "none found" was inserted.

Current Use
Current use of the site, or date of demolition of building/structure.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s)
Previous radiological investigations such as surveys, decontamination activities, and cleanup activities were evaluated. The evaluation of previous investigations and cleanups addressed, at a minimum, the following elements:

- agency conducting the investigation;
- purpose of the investigation;
- dates of the investigation;
- details of releases inside building, to air, to soil, and to surface water, as applicable;
- decontamination/cleanup activities; and
- final survey results.

Radiological Use Authorizations
Use authorizations have been defined as issuance of a license for radioactive material(s) from an appropriate regulatory agency. All known licenses issued for the site were included; if none were found, the text "none found" was inserted.

Former Radiological Burial or Disposal Locations
A description of known burials and/or disposals of radiological materials on the site, including applicable dates, if known. If no documented burials and/or disposals were identified, the text "none found" was inserted.

Aerial Photographs
The applicable photographic analyses from the report prepared by the EPA's Environmental Photographic Interpretation Center (EPIC) in March 2010 were included for each site. These analyses include photographs from the following dates:

- December 22, 1952;
- August 19, 1957;
- August 21, 1959;
- Approximately 1960 plus or minus a year;
- March 1, 1965;
- August 13, 1967;
- April 20, 1972;
- May 16, 1978;
- October 21, 1980;

- August 21, 1983;
- October 10, 1988;
- June 19, 1995; and
- June 8, 2005.

Aerial photograph anomalies were interpreted as a trigger for assigning a higher scrutiny to a particular site than other information (such as historical documents) would indicate.

Details regarding EPA's aerial photographic analysis can be found in Appendix A (found in Volume I) of this HSA.

Radionuclides of Concern
Radionuclides used/generated at the site. This description includes, at a minimum, the types of radiological material(s) managed at the site; radionuclides known or suspected to have been handled or generated on the site; and how the identified radionuclides impact the list of radionuclides of concern in the background study. If no information was available, the text "none found" was inserted. It is important to note that not every radionuclide listed in this HSA will have a sample analysis. The radionuclides are listed for completeness, indicating that they have been mentioned or discussed in a cited document or report. However, many of the facility and site reports reflect the conditions at the time, thus every mention of a specific radionuclide does not mean it would be present now, due to decay. For this reason, the Radionuclides of Concern sections described for each facility or site list those found in historical records. The Radionuclides of Concern tables list radionuclides that will be analyzed and does not include those that would have decayed in the years since operations ceased.

Drainage Pathways
This category includes information on the direction of surface water flow on the site and the presence of sanitary drains, storm drains, channels/ditches, septic systems, or leach fields on or near the site.

Radiological Contamination Potential
The potential for radiological contamination was evaluated for each site. Evaluations included consideration of the completeness of past cleanup and remedial operations. Many past clean-up efforts likely did not achieve the requirements of the California Department of Toxic Substances Control (DTSC)/DOE AOC dated December 2010 that generally requires a cleanup to background levels for both radiological and chemical contaminants. Background studies for the site were completed with EPA leading the radiological background study and the DTSC leading the chemical background study. The potential for radiological contamination is quantified in the TMs by assigning a preliminary MARSSIM class describing the possibility for residual radiological contamination at the site based on all information collected to date. The basis for assigning the preliminary MARSSIM classification includes an examination of the following data elements:

- historical site operations;
- previous radiological investigations;
- reported incidents of releases;
- decontamination and remediation operations at the site;

- interviews with former workers;
- drainage pathways on or near the site;
- aerial photograph interpretation; and
- site reconnaissance.

1.1.5 HSA Goals and Methodology

As previously stated, the objective of the HSA component of the radiological study was to provide a comprehensive investigation that identifies, organizes, and evaluates historical information relevant to nuclear research operations as it pertains to radiological contamination in the Area IV Study area. Once these areas were identified, potential areas where radiological contamination may exist were identified for sampling.

Each TM provided recommended locations for soil/sediment sampling based on an evaluation of the information obtained for each subject area discussed. The criteria evaluated are presented below. These recommendations were analyzed by EPA field personnel who would be engaged in gamma scanning, geophysical surveys, and soil and water testing. As an integral part of the process of choosing sampling locations, field personnel, along with several stakeholders who participated in numerous site reconnaissance and planning meetings, used the TM recommendations to determine the best possible sampling locations to ensure a complete radiological study.

Recommended Locations for Soil/Sediment Sampling
For each site, recommendations were made for possible targeted soil/sediment sampling locations. The selection of potential sampling locations was based on locations with the highest potential for radiological contamination as well as at the particular site based on all known information collected to date. The criteria evaluated for developing recommended soil/sediment sampling locations include the following:

- topography of the site;
- historical site operations;
- radiological investigations;
- reported incidents of releases;
- decontamination/cleanup operations at the site;
- interviews with former workers;
- storm drains on or near the site;
- sewer lines on or near the site;
- aerial photograph interpretation; and
- site reconnaissance.

1.2 TM Key Findings Pertaining to Sampling Approach

The key findings of each TM as they pertain to determining appropriate sampling locations are depicted on each of the plates corresponding to the nine subareas within the Area IV Study Area.

These plates are presented in the seven TMs that address the nine subareas (Volumes II through VIII of this HSA).

The annotations on these plates, as well as the recommendations for soil/sediment sampling made that the end of the discussion of each site, were analyzed by EPA field personnel who would be engaged in gamma scanning, geophysical surveys, and soil and water testing, as well as numerous stakeholders who participated in site reconnaissance and planning meetings.

A summary of the key findings as presented in each TM's respective plates is as follows:

1.2.1 HSA-5A

Building 4024

Plate 1 and Figure 2.1 of the HSA-5A TM (found in Volume II of this HSA) provide a convenient reference for the following recommendations.

Based on the available information, soil sampling is recommended in the Building 4024 area. There were radiological incidents at Building 4024 and documented evidence of radiological releases. Significant information is lacking regarding the excavation activities at Building 4024.

In addition, previous characterization studies for the Building 4024 area were focused on delineating the extent of contamination to standards that were applicable at the time. Therefore, additional characterization is recommended for the Building 4024 area. This includes the following Building 4024 areas and appurtenances:

- The locations of the two August 1996 Area IV Radiological Characterization Survey samples northeast of Building 4024 and west of Building 4024 in a dirt area. Elevated soil activity was located in Sample ID 95-0105 located northeast of Building 4024 where Cs-137 measured at 0.37 pCi/g. Sample ID 95-0106 also contained Cs-137 at 0.34 pCi/g and was located west of Building 4024 in a dirt area.[4]
- The location of the gas holdup tanks and liquid waste tanks. Interviewee 255 made reference to the removal of tanks that were "potentially holding radioactive gases at one time"; however, it is unclear whether the tanks being referred to include those identified as possible sampling locations.
- The outside storage area west of Building 4024. In 1967 and 1972, an open storage area is visible just west of Building 4024 with drainage trending west, southwest. The open storage area is no longer present in 1978 and the drainage channel has been replaced by an escarpment. In 1980, the open storage area west of the building has returned and dark-toned material is visible at the southeast corner of the building. Possible leakage is visible on the west side of the building in the 1983 aerial photographs. In 1988, an open storage area is again present on the west side of the building but is no longer visible in 1995.[5]

[4] Rocketdyne, A4CM-ZR-0011, Area IV Radiological Characterization Survey, Final Report, Volume I, August 15, 1996. pgs. 39, 108, 109.
[5] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.

- The Cooling Tower 4928 sump and the footprint of Site 4927 (nitrogen storage tank) should be sampled due to limited information on cooling tower operation and sump use during building operations.
- The area east of the building where reactors were brought in and removed from the facility. This area also includes the waste storage tanks. Below-ground radioactive waste storage facilities are located under asphalt in the yard. The buried tanks include three radioactive gas holdup tanks 6 feet in diameter and 40 feet long, eight solid radioactive waste storage vaults 3 feet in diameter and 4 feet deep, and two liquid radioactive waste holdup tanks. These tanks were placed on top of a concrete box filled with gravel designed to contain any accidental leakage.[6,7]
- The former location of the apparent leakage of an unknown container at Building 4024 that appears to leak north-northeast toward the northwest corner of Building 4027 in 1980 aerial photographs. In the 1983 aerial photographs two possible stains are visible on the northeast corner of the building where the previous probable container leakage had been visible.[8]

Building 4073

Plate 1 and Figure 2.1 provide a convenient reference for the following recommendations.

Extensive soil sampling is recommended in the Building 4073 area. Previous investigation found radiological contamination in Building 4073. In addition, previous characterization studies for the Building 4073 area were focused on delineating the extent of contamination to standards that were applicable at the time. Therefore, additional characterization is recommended for the Building 4073 area. This includes the following Building 4073 areas and appurtenances:

- The former locations of the underground storage tanks and their drain lines associated with building operations. Located west of Building 4073, the tanks comprised three underground tanks and a 60-foot exhaust stack with a 2,000-cubic foot per minute blower system. A 300-gallon collection tank was used to collect gas directly from the reactor system. A 1,000-gallon storage tank buried beneath floor level and adjacent to the test building retained all liquid waste from the facility. The tank was equipped with pump-out connections for removal of the liquid waste when necessary. Another 1,000-gallon tank was originally used to retain the reactor cooling water so that it could be checked for activity prior to release. That tank appears to have drained through a 2-inch line to the west and then south of the KEWB facility.[9,10,11] Removal of the tanks and lines, as well as their operation, may have left residual contamination above background values in the area.

[6] Atomics International Document, N704FDP990006 Rev. A., "Building T024 (SETF) Facilities Dismantling Plan," July 31, 1981.
[7] Remley, M.E., Atomics International, Letter Re: Comments on Draft Reactor Safety Survey Report for Building 024, July 21, 1965.
[8] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[9] Rockwell International Report, AI-ERDA-13159, "KEWB Facilities Decontamination and Disposition Final Report," February 25, 1976.
[10] Flora, J.W., Atomics International, *KEWB Radiological Emergency Plan*, January 14, 1960. HDMSP01637672
[11] Atomics International, FDP-704-990-002, *Dismantling Plan for KEWB Facility (Bldgs 073,123 and 793)*, October 17, 1974.

- The former Building 4073 footprint. Asphalt and concrete from decontamination and decommissioning (D&D) activities were used as backfill at the site in 1975. While the concrete was decontaminated to levels presented above that were defined "as low as practicable" in 1975, these levels are not in compliance with the requirements of the Administrative Order on Consent (AOC). These samples should be taken at depths greater than 6 feet below ground surface.
- The ditch adjacent to the former dirt road. The ditch leads to 12th Street where the flow of drainage proceeds southeast along 12th Street to G Street and continues southwest to 17th Street.[12] . If radioactive materials were released the ground surface near Building 4073, residual contamination above background values may exist in the materials surrounding the ditch.

Building 4093

Plate 1 and Figure 2.2 provide a convenient reference for the following recommendations.

Extensive soil sampling is recommended in the Building 4093 area. Building 4093 served as the AE-6 and L-85 reactor facility. Consequently, potential radioactive material migration via surface water flow or airborne release from this facility may affect the Building 4093 area. Previous characterization studies for the Building 4093 area were focused on delineating the extent of contamination to standards that were applicable at the time. Therefore, additional characterization is recommended for the Building 4093 area. This includes the following Building 4093 areas:

- The location of the sanitary leach field. Building 4093 was connected to a sanitary leach field that was removed in 1999.[13] If radioactive materials were released into the septic system, residual contamination above background values may exist in the materials surrounding the former leach field. The sampling should include the former location of the 4-inch diameter clay pipe supplying the leach field at a depth of approximately 4 feet below ground surface.[14] The leach field was reported to comprise 234 total linear feet, receiving flow from a 750-gallon septic tank associated with Building 4093. The leach field was located approximately 100 feet south of Building 4093.[15]
- The former location of the 4-inch vitrified clay pipe leading from the west corner of the building to the sanitary sewer. It is possible this line is part of the line that led to the former leach field. If radioactive materials were released into the septic system, residual contamination above background values may exist in the materials surrounding the former pipe.
- The drainage area on the northeast side of the building. Surface drainage extends from the northeast side of the building next to the retaining wall to southeast and then flows southwest toward the paved area southwest of the building.[16] If radioactive materials

[12] Atomics International, Drawing 303-00C-C2, "Misc. Paving, Patching & Drainage Improvements – KEWB," Date illegible, circa 1969. HDMSE00457545.
[13] Boeing Radiation Survey Reports, L-85 Facility Septic Tank Area, July and September 1999.
[14] Rockwell International, *Area IV Radiological Characterization Survey, Final Report, Volume 1*, A4CM-ZR-0011, August 15, 1996.
[15] MWH, *DOE Leach fields (Area IV AOC) RCRA Facility Investigation Report, Santa Susana Field Laboratory, Ventura County, California, Draft*, October 2003.
[16] Atomics International, Santa Susana Facility Plot Plan, Drawing 303-GEN-C38, Sheet 4 of 14, June 4, 1964.

were released to surface at or around Building 4093, residual contamination above background values may exist in the soils surrounding the surface drainage areas within the Building 4093 area.

- The east side of the building where gamma radiation was found to be 1,000 milli roentgens per hour (mR/hr) on the east side of the building directly opposite the core. In order to determine the need for access restrictions in the area surrounding Building 4093, a radiation survey of the perimeter of the AE-6 reactor was conducted on August 13, 1970. The reactor was at a power level of 2 kW, and was operating with the shield doors on the east side open and a plastic Lucite rod, approximately 6 feet long, inserted in the one-inch diameter beam hole. Gamma radiation measured 1,000 mR/hr on the east side of the building directly opposite the core.[17] The research team has been unable to determine if the building operated with the shield doors open frequently. If the shield doors were opened frequently during reactor operations, it is possible that residual contamination above background values may exist on the east side of the former building.
- The location of the former 750-gallon septic tank. If radioactive materials were released into the septic system, residual contamination above background values may exist in materials surrounding the former septic tank.

1.2.2 HSA-5B

Building 4010

Plate 1 and Figure 2.1 of the HSA-5B TM (found in Volume II of this HSA) provide a convenient reference for the following recommendations.

Extensive soil sampling is recommended in the Building 4010 area. There were several radiological incidents at Building 4010 and documented evidence of radiological releases. Significant information is lacking regarding the excavation activities at Building 4010. In addition, previous characterization studies for the Building 4010 area were focused on delineating the extent of contamination to standards that were applicable at the time. Previous characterization studies for the Building 4010 area were focused on delineating the extent of contamination to standards that were applicable at the time and not to the standard required by the December 2010 AOC. Therefore, additional characterization is recommended for the Building 4010 area. This includes the following Building 4010 areas and appurtenances:

- Former vault locations in the southern portion of the Building 4010 footprint. Leaks in the reactor and shield cooling lines may have left residual contamination in the area.
- Former radioactive gas holdup tank location exterior and northeast of the Building 4010 footprint. The known radioactive waste holdup tank may have left residual contamination in the area.
- Former septic tank location presumably located west of the Building 4010 footprint. If radioactive materials were released into the septic system, residual contamination may exist in the materials surrounding the former septic tank.
- Former leach field located west of the Building 4010 footprint. If radioactive materials were released into the septic system, residual contamination exist in the materials surrounding the former leach field.

[17] Johnson, B.I., Internal Letter Re: Radiation Survey of the AE-6 Reactor, Building 093, August 13, 1970.

- Former pipewell sump located east of the Building 4010 footprint. Groundwater for the entire Building 4010 vault complex drained into a pipewell sump where it could be monitored. Leaks in the reactor and shield cooling lines may have left residual contamination in the area.
- Former UST located at north corner of the Building 4010 footprint. It is possible that this tank contained radioactive material and left residual contamination in the area.
- Sewer lines located north and west of the Building 4010 footprint. If radioactive materials were released into the sewer system, residual contamination may exist in the materials inside and surrounding the sewer lines.
- Drainage area east of Building 4010 depicted in aerial photograph from OS-2 in Subarea HSA-7 to former Building 4010 location. If radioactive materials were released from OS-2 and drained into the Building 4010 area, residual contamination may exist to the east of the building.
- Drainage pathways associated with the Building 4010 area and outside Area IV as proposed by the field sampling plan. Residual contamination may exist in drainages outside of Area IV.

Building 4012

Plate 1 and Figure 2.1 provide a convenient reference for the following recommendations.

Extensive soil sampling is recommended in the Building 4012 area. Previous investigation found radiological contamination in Building 4012 and significant information is lacking regarding the excavation activities at Building 4012. In addition, previous characterization studies for the Building 4012 area were focused on delineating the extent of contamination to standards that were applicable at the time and not to the standard required by the December 2010 AOC. Therefore, additional characterization is recommended for the Building 4012 area. This includes the following Building 4012 areas and appurtenances:

- Former critical cell (Room 110) and fuel storage room (Room 109) in the northern Building 4012 footprint. Past contamination of these rooms may have left residual contamination in the area.
- Former radioactive waste holdup tank outside Room 104 on the southwest side of the Building 4012 footprint. The known radioactive waste holdup tank may have left residual contamination in the area.
- Sanitary sewer line located south of the Building 4012 footprint. If radioactive materials were released into the sewer system, residual contamination may exist in the materials inside and surrounding the sewer lines.
- Former OS-7 (open storage area) and possible WDA-6 (waste disposal area) identified on aerial photographs north of the Building 4012 footprint. If radioactive materials were stored or disposed in OS-7 or WDA-6, contamination could migrate and/or drain into the Building 4010 area, residual contamination may exist to the east of the building footprint.
- Drainage pathways associated with the Building 4012 area and outside Area IV as proposed by the field sampling plan. Residual contamination may exist in drainages outside of Area IV.

Building 4019

Plate 1 and Figure 2.1 provide a convenient reference for the following recommendations.

Extensive soil sampling is recommended in the Building 4019 area. Previous investigation found radiological contamination in Building 4019 and characterization studies for the Building 4019 area were focused on delineating the extent of contamination to standards that were applicable at the time. Previous characterization studies for the Building 4019 area were focused on delineating the extent of contamination to standards that were applicable at the time and not to the standard required by the December 2010 AOC. Therefore, additional characterization is recommended for the Building 4019 area. This includes the following Building 4019 areas and appurtenances:

- Former test vault location in the central portion of Building 4019. Past use of the vault may have left residual contamination in the area.
- Former waste holdup tank and vault located under Room 107 at south end of Building 4019. The known radioactive waste holdup tank may have left residual contamination in the area.
- Drain and pump locations identified in the as-built plumbing plan of Building 4019. If radioactive materials were released into the building drains, residual contamination may be in the area.
- Sanitary sewer line south of Building 4019. If radioactive materials were released into the sewer system, residual contamination may exist in the materials inside and surrounding the sewer lines.
- Storm drainage south of the Building 4019. Storm water originating from Building 4019 discharges into this storm drain. Consequently, this storm drain may provide a pathway for the migration of radionuclides from Building 4019 and residual contamination may be in the area.
- Area north and west of Building 4019 where staining from unknown source was noted in aerial photograph.
- Area between Building 4013 footprint and Building 4019 where leakage from an unknown source was noted in aerial photographs.
- The area between Building 4019 and the Building 4059 footprint. Radionuclides originating from either building may have migrated to the area between buildings via surface water flow or airborne releases.
- Drainage pathways associated with the Building 4019 area and outside Area IV as proposed by the field sampling plan. Residual contamination may exist in drainages outside of Area IV.

1.2.3 HSA-5C

Building 4059

Plate 1 and Figure 2.1 of the HSA-5C TM (found in Volume IV of this HSA) provide a convenient reference for the following recommendations.

Previous characterization studies for the Building 4059 area were focused on delineating the extent of contamination to standards that were applicable at the time. Therefore, additional characterization is recommended for the Building 4059 area. This includes the following Building 4059 areas and appurtenances:

- The area at the north end of the site where possible open storage was identified in the 1965 aerial photograph. Radionuclides originating from Building 4059 may have migrated to this area via surface water flow or airborne releases.
- The storm drains located on the northwest and southern sides of the site. If radiological materials were released from Building 4059, they may have migrated to the storm drain network during precipitation events.
- The sanitary sewer lines located on the northern and southern sides of the site. If radioactive materials were released into the sanitary sewer system, residual contamination may exist in the materials surrounding the sewer lines.

Building 4100

Plate 1 and Figure 2.3 provide a convenient reference for the following recommendations.

Previous characterization studies for the Building 4100 area were focused on delineating the extent of contamination to standards that were applicable at the time. Therefore, additional characterization is recommended for the Building 4100 area. This includes the following Building 4100 areas and appurtenances:

- The drainage channel surrounding the site may provide a pathway for the migration of radionuclides originating from Building 4100.
- The sanitary sewer lines located on the eastern and southern sides of the site. If radioactive materials were released into the sanitary sewer system, residual contamination may exist in the materials surrounding the sewer lines.
- The septic tank area and associated leach field may contain residual radioactive contamination.
- The Building 4100 storage yard/debris field between Building 4100 and 24th Street has no documented remediation. If radioactive materials were released here, residual contamination may exist in this area.
- The Building 4100 trench may contain residual radioactive contamination because the depth of remediation and backfilling are not documented.
- The areas of the exterior waste storage tank for Building 4100 may contain residual radioactive contamination.

1.2.4 HSA-5D

Building 4020

Plate 1 and Figure 2.2 of the HSA05D TM (found in Volume V of this HSA) provide a convenient reference for the following recommendations.

Based on the available information, soil sampling is recommended in the Building 4020 area. There were numerous radiological incidents at Building 4020 and documented evidence of radiological releases. In addition, previous characterization studies for the Building 4020 area were focused on delineating the extent of contamination to standards that were applicable at the time. Additionally, characterization was not conducted to delineate the extent of contamination consistent with the DTSC/DOE December 2010 AOC. Therefore, additional characterization is recommended for the Building 4020 area. This includes the following Building 4020 areas and appurtenances:

- The former Building 4020 footprint is recommended for sampling to characterize the existing fill material and the underlying soil (>18 feet below ground surface). Specifically, sampling locations should be focused to areas with the greatest potential for release such as in the vicinity of former hold up tanks, sumps, and drain lines.
- The former location of the leach field and septic tanks are recommended for sampling.
- The western boundary of the Building 4020 footprint and the boundary of the paved areas to the west of the building are recommended for sampling. These areas were known to be contaminated as a result of the handling of casks and other storage containers that were transported into and out of Building 4020.
- The alignment of the former pipeline leading from the Building 4020 basement through the transfer tunnel to Building 4468 should be sampled for potential residual contamination. Like the Building 4020 footprint, the transfer tunnel was removed during demolition of the building and the area was excavated to a depth of between 10 and 18 feet. The area was subsequently backfilled.
- Aerial photographs indicate the presence of stains at the northwest corner of the Building 4020 area boundary. This area, if not disturbed during demolition activities, may show elevated levels of contamination.
- As a result of documented releases of radioactive materials outside of the building, the drainage channels along G, J, and 24th Streets are recommended for sampling. Surface water run-off from Building 4020 flowed either into the ditch on the south side of G Street or into the ditch on the south side of J Street.
- The former paved areas to the north of the former building are recommended for sampling. As was documented in incident report A0016, on May 31, 1962, a portable radioactive liquid holdup tank was being filled from the radioactive holdup tank inside Building 4020 when the portable tank overflowed and a maximum of 50 gallons of liquid was spilled. The spilled liquid flowed down slope to the road and then to a drainage ditch. A similar incident occurred on November 24, 1964, when a radioactive spill resulting from the overflow of a 500-gallon portable liquid holdup tank occurred in the north loading dock area of Building 4020. A maximum of 25 gallons of liquid was lost at the north loading dock area and resulted in contamination of the immediate area.

Building 4373

Plate 1 and Figure 2.2 provide a convenient reference for the following recommendations.

Based on the available information, soil sampling is recommended in the Building 4373 area. Building 4373 included a SNAP critical assembly (SCA) that had a pseudo spherical shape with a fixed hydrogen moderator, highly enriched U-235 fuel, and a beryllium and graphite reflector.[18]

There were radiological incidents at Building 4055 and documented evidence of radiological releases. Significant information is lacking regarding the excavation activities of the drainage lines leading to the Building 4055 liquid waste holdup system.

In addition, previous characterization studies for the Building 4373 area were focused on delineating the extent of contamination to standards that were applicable at the time. In additional, characterization was not conducted to delineate the extent of contamination consistent with the DTSC/DOE December 2010 AOC. Therefore, additional characterization is recommended for the Building 4373 area. This includes the following Building 4373 areas and appurtenances:

- Sampling is recommended in the drainage channels surrounding Building 4373. This includes drainage channels to the north and south of the building. A 1964 plot plan shows a drainage channel located at the northeast corner of the fence boundary that leads north along 22nd Street to the parking lot entrance, flows under the parking lot entrance through an 18-inch corrugated metal pipe, and continues to a catch basin located at the intersection of G Street and 22nd Street. The flow from the catch basin is directed through a 36-inch corrugated metal pipe under 22nd Street and into a natural drainage ditch that flows east-southeast toward Area III. Drainage from the southern portion of the building appears to have been directed to a 24-inch corrugated metal pipe near the southeast corner of the building, under 22nd Street, and eastward along J Street toward Area III.[19]
- Sampling is also recommended at the former Building 4373 leach field located southeast of the building. Limited information regarding the abandonment of the leach field has been located.
- The former Building 4373 footprint is recommended for sampling, including the former location of the SCA.

The underground drainage lines of Building 4055 were located to the west of Building 4373 within the facility's fenced boundary. The sampling of these lines is recommended under Building 4055.

[18] ETEC Document, GEN-ZR-0012, *Radiological Survey of Buildings T373 and T375*, August 8, 1988.
[19] Atomics International, Drawing No. 303-GEN-C41, Sheet 7 of 14, Santa Susana Facility Plot Plan,

1.2.5 HSA-6

Building 4143

Plate 1 and Figure 2.1 of the HSA-6 TM (found in Volume VI of this HSA) provide a convenient reference for the following recommendations.

Previous characterization studies for the Building 4143 area were focused on delineating the extent of contamination to standards that were applicable at the time. Characterization was not conducted to delineate the extent of contamination consistent with the DTSC/DOE December 2010 AOC. Therefore, additional characterization is recommended for the Building 4143 area. This includes the following Building 4143 areas and appurtenances:

- The flat and low-lying areas surrounding Building 4143. Radionuclides originating from Building 4143 may have migrated to these areas via surface water flow or airborne releases.
- The northeast corner of Building 4143 where open storage was identified in aerial photographs and where spills occurred from sumps and underground vaults.
- The north side of Building 4143 where approximately 3,550 gallons of water were dumped from two radioactive liquid waste storage tanks in 1964, and another spill occurred in 1977.
- The area of the fuel cleaning cells (also known as wash cells) where an explosion caused damage to system components in June 1959.
- The north and east sides of Building 4143 where possible debris and stains were identified in aerial photographs.
- The former septic tank and leach field area that also serviced Buildings 4003 and 4163. Boeing excavated, removed, and survey these items in 2000, but it is not clear that this area was thoroughly investigated and decontaminated.
- The storm drain system located south of the site that connected to the SRE retention pond. The pond initially drained to the NBZ and Brandeis-Bardin Institute land, but was later connected through an overland pipe to a channel/ditch connecting to the Area II ponds.
- The drainage channel/ditch located north of the site that connected to the SRE retention pond. Accidental spills of contaminated water drained into this channel.
- The sanitary sewer line located east of the site. If radionuclides were released into the sanitary sewer system, residual contamination may exist in the materials surrounding the sewer lines.

1.2.6 HSA-7/3/NBZ

Building 4021

Plate 1 of the HSA-7/3/NBZ TM (found in Volume VII of this HSA) provides a convenient reference for the following recommendations.

Extensive soil sampling is recommended in the Building 4021 area. There were several radiological incidents at Building 4021 and documented evidence of radiological releases. Previous characterization studies for the Building 4021 area were focused on delineating the extent of contamination to standards that were applicable at the time and not to the standard required by the December 2010 AOC. Therefore, additional characterization is recommended for the Building 4021 area. This includes the following Building 4021 areas and appurtenances:

- Under the abandoned in place Building 4021 septic tank located below grade north of the asphalt swale. Documented releases to the Radioactive Materials Handling Facility (RMHF) leach field indicate the septic tank may have left residual contamination in the area.
- Under the sumps and floor drains inside Building 4021. The sumps and floor drains carried contaminated waste from the Building 4021 decontamination and packaging rooms. Residual radioactive contamination is likely in this area.
- Under the Building 4021 sump, sump tank (UT-16) and former radioactive liquid storage tank (T-1) located outside and west of the building. These features are considered to be radiologically contaminated, having received contaminated waste from the Building 4021 floor drains and Building 4022 vaults. This area is also the location of a radioactive liquid spill (A0070). Residual radioactive contamination is likely in this area.
- Under the electrical substation sump and drainage discharge point located on the western side of Building 4021. Although the sump and drainage was designed for stormwater, this water could contain airborne contamination and the discharge point may present an area where water can pool. Residual radioactive contamination could be present.
- Under the subsurface pipeline that connects the sump tanks in Building 4021 with the vaults in Building 4022 vaults with the sump tanks in Building 4021. This pipeline carried radioactive liquids. Leaks in the pipeline could have contributed to contamination and the pipeline itself could have provided a pathway for contaminant migration. Residual radioactive contamination is likely in this area.
- Filter/blower area between Building 4021 and Building 4022. This area contained the high-efficiency particulate air (HEPA) filter exhaust system, trenches to drain water from the area, and a below-grade pipeline to the RMHF northern slope. The trenches and pipeline may have also provided pathways for contaminant migration. Residual radioactive contamination is associated with some of these features and may be present in this area.
- Safety shower located on the north central side of Building 4021. The shower could have provided a drainage area for residual contamination.
- Pad and asphalt behind the decontamination room where a radiological incident (A0448) occurred and contaminated the area. Residual contamination may be present.
- Lower parking lot area where contaminated blocks were found according to a radiological incident report (A0680). The contamination was removed at the time of the incident, but residual contamination may still exist.
- Paved area from the former 5,000-gallon radioactive liquid waste storage tank (T-1) to a point 40 yards south and west of the tank and ranging between 2 and 10 feet where a spill of 40 to 50 gallons of contaminated water occurred according to a radiological incident

report (A0070). Contamination from the incident was fixed in place and residual contamination may still exist.

- Possible stained area west of Building 4021 depicted in 1967 aerial photograph. If radioactive materials were spilled in this stained area, residual contamination may be present.
- Aboveground pipeline depicted in aerial photographs from 1967 through 1980 that extends from north end of Building 4021 to the northern perimeter of RMHF site. This pipeline could have leaked radioactively contaminated liquid onto the asphalt below. Residual radioactive material may be present on the ground below the pipeline.
- Area of dark-toned material west of Building 4021 identified in a 1980 aerial photograph. If radioactive materials were spilled in this dark-toned material, residual contamination may be present.
- Under the sewer lines located north and west of Building 4021. If radioactive materials were released into the sewer system, residual contamination may exist in the materials surrounding the sewer lines.
- Surface drainage areas around the Building 4021 area. Radiological incident A0080 noted that contaminated liquid flowed from Building 4021 to the RMHF 4614 Holdup Pond. Any releases of radioactive materials would have followed drainage pathways from the building and could leave residual contamination.

Building 4028

Plate 1 provides a convenient reference for the following recommendations.

Extensive soil sampling is recommended in the Building 4028 area. There were several radiological incidents at Building 4028 and documented evidence of radiological releases. Previous characterization studies for the Building 4028 area were focused on delineating the extent of contamination to standards that were applicable at the time and not to the standard required by the December 2010 AOC. Therefore, additional characterization is recommended for the Building 4028 area. This includes the following Building 4028 areas and appurtenances:

- Former reactor, test vault, and fuel storage locations in the west portion of the Building 4028 site. Leaks in the reactor and shield cooling lines may have left residual contamination in the area.
- Former radioactive sink for liquid waste disposal in the east portion of the Building 4028 footprint. The known radioactive sink may have left residual contamination in the area.
- Former holding reservoir [RMHF 4614 Holdup Pond] located at the edge of the asphalt driveway leading to the Building 4028 footprint that accumulated cooling tower water and rainwater. If radioactive materials were released or accumulated in the holding reservoir, residual contamination may be present.
- Former trench outside the reactor room that contained the water purification system and a primary side circulating pump as part of the cooling tower system. The trench could provide a drainage area for surface water and could collect any residual contamination.
- Former sump pump located at the northwest corner of the Building 4028 test vault accessway [RMHF 4614 Holdup Pond pump] that pumped water from the holding

reservoir to Rocketdyne. If radioactive materials were released or accumulated in water, residual contamination may be present.

- Former spill areas on the bank above the former Building 4028 area noted in a 1975 letter. These known areas of contamination were thought to have followed drainage pathways down the bank. Residual contamination may be present.
- Open storage area (OS-13) west of Building 4028 depicted in a 1980 aerial photograph. Possible stains were noted in this area. If radioactive materials were released from OS-13, residual contamination may exist.
- Drainage areas north and south of Building 4028. Aerial photographs and other documents note stormwater drainage pathways on the north and south sides of the building. Residual contamination may exist in these drainages.

1.2.7 HSA-8

Building 4009

Plate 1 and Figure 2.2 of the HSA-8 TM (found on Volume VIII of this HSA) provide a convenient reference for the following recommendations.

Information is lacking regarding the excavation activities for the leach field, hold-up tanks, and septic tanks at Building 4009, particularly in late 1989 and early 1990. The characterization studies for the Building 4009 area were focused on delineating the extent of contamination to previous standards. Characterization was not conducted to delineate the extent of contamination consistent with the DTSC/DOE December 2010 AOC. Therefore, additional characterization is recommended for the Building 4009 area. This includes the following Building 4009 areas and appurtenances:

- The flat and low-lying areas surrounding Building 4009, particularly on the north, south and west sides where open storage was identified in aerial photographs. Radionuclides originating from Building 4009 may have migrated to these areas via surface water flow or airborne releases.
- The waste hold-up tank, pit, and septic tank located northwest of the OMR, as shown in Figure 2.2.1d. It is unclear whether this area was thoroughly investigated and decontaminated in 2002.
- The waste hold-up tank, pit, and septic tank located northeast of the SGR, as shown in Figure 2.2.1d. It is unclear whether this area was thoroughly investigated and decontaminated in late 1989 and early 1990.
- The fuel oil tank located on the southeast side of the OMR, as shown in Figure 2.2.1d. It is unclear whether this area was thoroughly investigated and decontaminated in 1998.
- Within and downgradient of the former 6-line 300-linear-foot leach field area and approximately 50-foot drain line located northwest of Building 4009. It is unclear whether this area was thoroughly investigated and decontaminated.
- The liquid collection area identified in the 1980 aerial photograph. A drainage pathway directs liquid north through a vegetated area. This pathway then appears to be blocked by rock outcrops, resulting in a liquid collection area.

- The storm drain located west of the site that extends onto the NBZ and Brandeis-Bardin Institute land. It is unclear whether this storm drain was thoroughly investigated and decontaminated.
- All surface water drainage pathways including the storm water culvert located southeast of Building 4009, which carries water past Building 4100. It is unclear whether these drainage pathways were thoroughly investigated and decontaminated.
- The main sanitary sewer lines located north of Building 4009. If radionuclides were released into the sanitary sewer system, residual contamination may exist in the materials surrounding the sewer lines.

Building 4886

Plate 1 and Figure 2.2 provide a convenient reference for the following recommendations.

Extensive soil sampling is recommended in the Site 4886 area. For many years this was a radiological disposal area, there were several radiological incidents at Site 4886, and documented evidence of radiological releases. In addition, previous characterization studies for the site 4886 area were focused on delineating the extent of contamination to standards that were applicable at the time. Characterization efforts likely did not achieve the requirements of the DTSC/DOE December 2010 AOC. Therefore, additional characterization is recommended for the Site 4886 area. This includes the following Site 4886 areas and appurtenances:

- The flat land and low lying areas on Site 4886. Radionuclides originating from items of radiologically contaminated equipment disposed of at the site may have been deposited on soil via explosion, wind, and precipitation events. Rockwell reported that material was dispersed onto surrounding land by explosions that extended to Building 4009, so the radius of impact was about 600 feet. The gamma-scan results may prove helpful for selecting soil sampling locations.
- The locations of the former western, lower, and upper ponds and the concrete-lined pit that were notable features of Site 4886.
- The location of the former barrel open storage area in the southwest corner of the site that was identified in the 1978 and 1980 aerial photographs.
- The land on the far west side of the site between two rock ridges. This may have been a dumping area that has not been fully characterized.
- The drainage channels located on the west and south sides of the site that transport surface water northward to the NBZ. If radionuclides were released at the site, they may have migrated to the drainage channels during precipitation events.
- The drainage channels that extend into and traverse the NBZ. If radionuclides were released at the site, they may have migrated outside the SSFL along these drainage channels during precipitation events.

1.3 Radionuclide List to be Used in Soil and Groundwater Sampling

From a review of historical documents and radioactive material licenses issued for the SSFL, all of the radionuclides selected for radiochemical analysis of soil samples are likely to have been used or generated on the SSFL. Table 1.3, below, presents a summary of potential radiological contaminants of concern for each subarea of the Area IV Study area. Certain radionuclides mentioned in source documents, and thus included in Table 1.3, will not be analyzed. These have undergone radioactive decay in excess of 10 half-lives, such that they could no longer be present. These radionuclides include: Na-22, Fe-55, Sb-125, Cs-134, Ce-144, and Po-210. The September 23, 2010, Stakeholder Technical Meeting Action Items Memorandum describes the radionuclides contained in soil analytical suites, the sample analytical approach, and provides explanations for deleting certain radionuclides from analysis.

Table 1.3a
Summary of Subarea HSA-5A Sites
Potential Radiological Contaminants of Concern

Site No.	Use(s)	Current Status	Potential Radiological Contaminants of Concern	MARSSIM Class
4005	Uranium Carbide Fuel Pilot Plant	Demolished	Potential radioactive contaminants include natural and enriched uranium (U-238, U-234, U-235), activation products (iron-59 (Fe-59), cobalt-60 (Co-60)), isotopes of thorium (Th-231, Th-234), carbon-14 (C-14), manganese-54 (Mn-54), sulfur-35 (S-35), phosphorous-32 (P-32).	1
4023	Liquid Metals Component Test Building	Demolished	Potential radioactive contaminants include natural and enriched uranium (U-234, U-238 and U-235), isotopes of thorium (Th-228, TH-232), isotopes of plutonium (Pu-238, Pu-239, Pu-240, Pu-241, Pu-242), Ne-237, Am-241, fission products (Cs-134, Cs-137, Sr-90), and activation products (Co-60, Fe-55, Eu-152, Eu-154, Ni-59, Ni-63, Ta-182, Mn-54).	1
4024	SNAP Environmental Test Facility	Partially Standing	Potential radioactive contaminants include natural and enriched uranium (U-238 and U-235), isotopes of thorium (Th-232), isotopes of plutonium (Pu-238, Pu-239, Pu-240, Pu-241, Pu-242), Am-241, fission products (Cs-137, Sr-90), and activation products (Co-60, H-3, Fe-55, Eu-152, Eu-154, Ni-59, Ni-63, Mn-54), K-40, Na-22.	1
4027	SNAP Engineering Development Laboratory	Demolished	Radionuclides of concern include all radionuclides that are included in the background study plus any additional radionuclides identified during the HSA.	2
4029	Radiation Measurement Facility	Standing	Potential radioactive contaminants include fission products (Cs-137) and activation products (Co-60), Ra-226	1
4030/ 4035	AE-6 Counting Room and Workshop	Demolished	Potential radioactive contaminants include H-3.	1
4032	Space Environmental Test Facility	Demolished	Potential radioactive contaminants include activation product Co-60.	2
4036	Non-Nuclear Office Building	Demolished	None specifically identified; however, direct radiation and skyshine from RMHF may affect ambient radiation conditions in the area.	1
4042	SNAP Shield Casting Facility	Demolished	Potential radioactive contaminants include natural and enriched uranium (U-238 and U-235).	1
4046	Material Office Annex	Demolished	None specifically identified.	2
4048	Plant Development Unit Instrumentation Building	Demolished	None specifically identified.	1
4049	Hydraulic Test Control Center	Demolished	Potential radioactive contaminants include activation products (Co-60, Mn-54, Ni-59, Ni-63, Fe-55, Fe-59), C-14, S-35, P-32.	1

Table 1.3a (continued)
Summary of Subarea HSA-5A Sites
Potential Radiological Contaminants of Concern

Site No.	Use(s)	Current Status	Potential Radiological Contaminants of Concern	MARSSIM Class
4073	Kinetic Experiment Water Boiler Reactor	Demolished	Potential radioactive contaminants include natural and enriched uranium (U-238 and U-235), fission products (Cs-137, Sr-90), and activation products (Co-60, Eu-152, Eu-154).	1
4074	Storage and Film Processing Building	Demolished	Potential radioactive contaminants include natural and enriched uranium (U-238 and U-235), fission products (Cs-137, Sr-90), and activation products (Co-60, Eu-152, Eu-154).	1
4083/ 4103	Control Building	Demolished	None specifically identified.	1
4093	AE-6 Reactor Building	Demolished	Potential radioactive contaminants include natural and enriched uranium (U-238 and U-235), fission products (Cs-137, Sr-90), and activation products (Co-60, Eu-152, Eu-154).	1
4123	KEWB Waste Storage Building	Demolished	Potential radioactive contaminants include natural and enriched uranium (U-238 and U-235), fission products (Cs-137, Sr-90), and activation products (Co-60, Eu-152, Eu-154).	1
4185	Unknown	Demolished	None specifically identified.	1
4453	Fuel Handling Building	Demolished	Potential radioactive contaminants include natural and enriched uranium (U-238 and U-235), fission products (Cs-137, Sr-90), and activation products (Co-60, Eu-152, Eu-154).	1
4501	Parking Lot	Vegetated	None specifically identified.	2
4536	Parking Lot	Evidence remains	None specifically identified.	2
4633	Reactor Cooling Water Pad	Demolished	None specifically identified.	1
4641	Shipping and Receiving	Demolished	Regulated radioactive material handled in the building; however, a complete list of materials handled in Building 4641 could not be located. As a result, the potential radioactive contaminants include natural and enriched uranium (U-238, U-234, U-235), isotopes of plutonium (Pu-238, Pu-239, Pu-240, Pu-241), Am-241, fission products (primarily Cs-137, Sr-90), and activation products (H-3, Fe-55, Co-58, Co-60, Ni-63, Ba-133, Eu-152, Eu-154, Eu-155, Pm-147, Ta-182).	2
4643	KEWB Exhaust Building	Demolished	Potential radioactive contaminants include natural and enriched uranium (U-238 and U-235), fission products (Cs-137, Sr-90), and activation products (Co-60, Eu-152, Eu-154).	1
4793	KEWB Heating and Air Conditioning	Demolished	Potential radioactive contaminants include natural and enriched uranium (U-238 and U-235), fission products (Cs-137, Sr-90), and activation products (Co-60, Eu-152, Eu-154).	1
4927	Nitrogen Storage Tank	Demolished	None specifically identified.	1

Table 1.3b
Summary of Subarea HSA-5B Sites
Potential Radiological Contaminants of Concern

Site No.	Use(s)	Current Status	Potential Radiological Contaminants of Concern	Preliminary MARSSIM Class
4006	Sodium Laboratory	Standing	Potential radioactive contaminants include: Cs-137, H-3, U-234, U-235, U-238, and UO_2. Radionuclides associated with potential SNAP drainage include: Sb-125, Am-241, Cs-134, Cs-137, Co-60, Eu-152, Eu-154, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, H-3, U-234, U-235, and U-238.	2
4007	Sodium Storage Building	Demolished	Radionuclides associated with drainage from Buildings 4005, 4006, 4010, 4012, and 4024 include: Sb-125, Am-241, Cs-134, Cs-137, Co-60, Eu-152, Eu-154, Mn-54, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, H-3, U-234, U-235, U-238, and UO_2.	2
4008	Flammable Material Storage Building	Demolished	Radionuclides associated with nearby Building 4011 include: Am-241, Cs-137, Co-60, Eu-152, Eu-154, Ir-192, Pb-210, K-40, Pu-238, Pu-239, Pu-240, Pu-241, Ra-226, Sr-90, Tc-99, Th-230, Th-232, H-3, U-234, U-235, and U-238.	2
4010	Systems for Nuclear Auxiliary Power (SNAP) Experimental Reactor (SER), SNAP 8 Experimental Reactor (S8ER)	Demolished	Potential radioactive contaminants include: Sb-125, Am-241, Be-10, Ca-134, Cs-137, Co-60, Eu-152, Eu-154, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, H-3, U-234, U-235, and U-238.	1
4011	Administration and Services Building, Development Support Shop, Manufacturing Support Shop, Machine Shop, Radiation Instrument Calibration Laboratory	Standing	Potential radioactive contaminants include: Am-241, Cs-137, Co-60, Eu-152, Eu-154, Pb-210, K-40, Pu-238, Pu-239, Pu-240, Pu-241, Ra-226, Sr-90, Tc-99, Th-230, Th-232, H-3, U-234, U-235, and U-238.	1
4012	SNAP Critical Test Facility, Heavy Metal Reflected Fast Spectrum Reactor (HMRFSR), Energy Technology Engineering Center (ETEC) X-Ray Facility/Storage	Demolished	Potential radioactive contaminants include: Sb-125, Am-241, Cs-137, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, U-234, U-235, and U-238.	1

Table 1.3b (continued)
Summary of Subarea HSA-5B Sites
Potential Radiological Contaminants of Concern

Site No.	Use(s)	Current Status	Potential Radiological Contaminants of Concern	Preliminary MARSSIM Class
4013	SNAP Non-Nuclear Component Assembly and Performance Test Building, ETEC Thermal Transient Test Facility	Demolished	Radionuclides associated with nearby Buildings 4012 and 4019 include: Am-241, Cs-137, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, U-234, U-235, and U-238.	1
4019	SNAP Flight System Nuclear Qualification Test Building, ETEC Construction Staging and Computer Facility	Standing	Potential radioactive contaminants include: Am-241, Cs-137, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, U-234, U-235, and U-238.	1
4025	Remote Handling Mock-Up Building, ETEC Instrumentation and Inventory Building	Demolished	A potential radioactive contaminant is Co-60. Radionuclides associated with potential drainage from Building 4075 include: isotopes of thorium, plutonium, and uranium, and mixed fission products. Radionuclides associated with nearby Building 4024 include: Am-241, Cs-137, Co-60, Eu-152, Eu-154, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, H-3, U-234, U-235, and U-238.	1
4026	Large Component Test Loop (LCTL) Control Building, Small Component Test Loop (SCTL) Control Building	Demolished	Radionuclides associated with nearby Building 4006 include: Cs-137, H-3, U-234, U-235, and U-238. Radionuclides associated with potential drainage from Buildings 4010 and 4012 include: Sb-125, Am-241, Cs-134, Cs-137, Co-60, Eu-152, Eu-154, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, H-3, U-234, U-235, and U-238.	2
4171	X-Ray Building	Demolished	Radionuclides associated with nearby Building 4011 include: Am-241, Cs-137, Co-60, Eu-152, Eu-154, Pb-210, K-40, Pu-238, Pu-239, Pu-240, Pu-241, Ra-226, Sr-90, Tc-99, Th-230, Th-232, H-3, U-234, U-235, and U-238.	1
4172	X-Ray Building	Demolished	Radionuclides associated with nearby Building 4011 include: Am-241, Cs-137, Co-60, Eu-152, Eu-154, Pb-210, K-40, Pu-238, Pu-239, Pu-240, Pu-241, Ra-226, Sr-90, Tc-99, Th-230, Th-232, H-3, U-234, U-235, and U-238.	2

Table 1.3b (continued)
Summary of Subarea HSA-5B Sites
Potential Radiological Contaminants of Concern

Site No.	Use(s)	Current Status	Potential Radiological Contaminants of Concern	Preliminary MARSSIM Class
4226	SCTL Motor Generator Building	Demolished	Radionuclides associated with potential drainage from Buildings 4010 and 4012 include: Sb-125, Am-241, Cs-134, Cs-137, Co-60, Eu-152, Eu-154, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, H-3, U-234, U-235, and U-238.	2
4228	Sodium Component Test Installation (SCTI) Power Pak Building, SCTI Co-Generation Plant	Demolished	Radionuclides associated with Building 4012 include: Sb-125, Am-241, Cs-137, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, U-234, U-235, and U-238.	1
4293	Time Clock	Demolished	Radionuclides associated with potential drainage from Buildings 4010 and 4012 include: Sb-125, Am-241, Cs-134, Cs-137, Co-60, Eu-152, Eu-154, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, H-3, U-234, U-235, and U-238.	2
4310	Portable Change Room	Demolished	Radionuclides associated with potential drainage from Buildings 4010 and 4012 include: Sb-125, Am-241, Cs-134, Cs-137, Co-60, Eu-152, Eu-154, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, H-3, U-234, U-235, and U-238.	1 for original location near SNAP building / 2 for final location near SCTL building
4334	Kalina Cycle Demonstration Power Plant Control Room	Demolished	Radionuclides associated with potential drainage from Building 4019 include: Am-241, Cs-137, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, U-234, U-235, and U-238.	2
4335	Kalina Cycle Demonstration Power Plant Turbine Generator Room	Demolished	Radionuclides associated with potential drainage from Building 4019 include: Am-241, Cs-137, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, U-234, U-235, and U-238.	2
4354	SCTI Control Element Test Structure	Demolished	Radionuclides associated with nearby Building 4006 include: Cs-137, H-3, U-234, U-235, and U-238. Radionuclides associated with potential drainage from Buildings 4010 and 4012 include: Sb-125, Am-241, Cs-134, Cs-137, Co-60, Eu-152, Eu-154, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, H-3, U-234, U-235, and U-238.	2

Table 1.3b (continued)
Summary of Subarea HSA-5B Sites
Potential Radiological Contaminants of Concern

Site No.	Use(s)	Current Status	Potential Radiological Contaminants of Concern	Preliminary MARSSIM Class
4355	SCTI Control Center	Demolished	Potential radioactive contaminants include Co-60 and Cs-137. Radionuclides associated with potential drainage from Buildings 4010 and 4012 include: Sb-125, Am-241, Cs-134, Cs-137, Co-60, Eu-152, Eu-154, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, H-3, U-234, U-235, and U-238.	1
4356	SCTI High Bay	Demolished	A potential radioactive contaminant is Cs-137. Radionuclides associated with potential drainage from Buildings 4010 and 4012 include: Sb-125, Am-241, Cs-134, Cs-137, Co-60, Eu-152, Eu-154, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, H-3, U-234, U-235, and U-238.	1
4357	Heat Transfer Loop Control Building, Liquid Metal Engineering Center (LMEC) and ETEC Pump Bearing Test Facility Control Building	Demolished	Radionuclides associated with potential drainage from Buildings 4010 and 4012 include: Sb-125, Am-241, Cs-134, Cs-137, Co-60, Eu-152, Eu-154, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, H-3, U-234, U-235, and U-238.	2
4358	Chemical Storage Building Supporting SCTL, SCTI, and Kalina	Demolished	Radionuclides associated with potential drainage from Buildings 4010, 4012, and 4019 include: Sb-125, Am-241, Cs-134, Cs-137, Co-60, Eu-152, Eu-154, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, H-3, U-234, U-235, and U-238.	2
4359	SCTI Atomizing Air Building	Demolished	Radionuclides associated with potential drainage from Buildings 4010 and 4012 include: Sb-125, Am-241, Cs-134, Cs-137, Co-60, Eu-152, Eu-154, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, H-3, U-234, U-235, and U-238.	2
4360	SCTI Chemical Storage Building	Demolished	Radionuclides associated with potential drainage from Building 4019 include: Am-241, Cs-137, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, U-234, U-235, and U-238.	2
4361	SCTI Hazardous Material Storage Building	Demolished	Radionuclides associated with potential drainage from Building 4019 include: Am-241, Cs-137, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, U-234, U-235, and U-238.	2

Table 1.3b (continued)
Summary of Subarea HSA-5B Sites
Potential Radiological Contaminants of Concern

Site No.	Use(s)	Current Status	Potential Radiological Contaminants of Concern	Preliminary MARSSIM Class
4362	SCTI Water Sampling Building	Demolished	Radionuclides associated with potential drainage from Buildings 4010 and 4012 include: Sb-125, Am-241, Cs-134, Cs-137, Co-60, Eu-152, Eu-154, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, H-3, U-234, U-235, and U-238.	2
4392	SCTI Electrical Equipment Building	Demolished	Radionuclides associated with potential drainage from Buildings 4010 and 4012 include: Sb-125, Am-241, Cs-134, Cs-137, Co-60, Eu-152, Eu-154, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, H-3, U-234, U-235, and U-238.	2
4402	MHD Experiment Building	Demolished	Radionuclides associated with nearby Building 4006 include: Cs-137, H-3, U-234, U-235, and U-238. Radionuclides associated with potential drainage from Buildings 4010 and 4012 include: Sb-125, Am-241, Cs-134, Cs-137, Co-60, Eu-152, Eu-154, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, H-3, U-234, U-235, and U-238.	2
4457	SCTI Pump Bearing Test Structure	Demolished	Radionuclides associated with potential drainage from Buildings 4010 and 4012 include: Sb-125, Am-241, Cs-134, Cs-137, Co-60, Eu-152, Eu-154, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, H-3, U-234, U-235, and U-238.	2
4478	SCTI Support Trailer	Demolished	Radionuclides associated with potential drainage from Buildings 4010 and 4012 include: Sb-125, Am-241, Cs-134, Cs-137, Co-60, Eu-152, Eu-154, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, H-3, U-234, U-235, and U-238.	2
4500	Gas Bottle Dock	Demolished	Radionuclides associated with nearby Building 4011 include: Am-241, Cs-137, Co-60, Eu-152, Eu-154, Ir-192, Pb-210, K-40, Pu-238, Pu-239, Pu-240, Pu-241, Ra-226, Sr-90, Tc-99, Th-230, Th-232, H-3, U-234, U-235, and U-238.	2

Table 1.3b (continued)
Summary of Subarea HSA-5B Sites
Potential Radiological Contaminants of Concern

Site No.	Use(s)	Current Status	Potential Radiological Contaminants of Concern	Preliminary MARSSIM Class
4502	Parking Lot	Demolished	Radionuclides associated with potential drainage from Building 4019 include: Am-241, Cs-137, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, U-234, U-235, and U-238.	2
4506	Parking Lot	Demolished	Radionuclides associated with nearby Building 4006 include: Cs-137, H-3, U-234, U-235, and U-238. Radionuclides associated with potential drainage from Buildings 4010 and 4012 include: Sb-125, Am-241, Cs-134, Cs-137, Co-60, Eu-152, Eu-154, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, H-3, U-234, U-235, and U-238.	2
4521	Parking Lot	Demolished	Radionuclides associated with nearby Building 4011 include: Am-241, Cs-137, Co-60, Eu-152, Eu-154, Ir-192, Pb-210, K-40, Pu-238, Pu-239, Pu-240, Pu-241, Ra-226, Sr-90, Tc-99, Th-230, Th-232, H-3, U-234, U-235, and U-238.	2
4606	Sodium Lab Instrument Building A, MHD Support Building, Hydrogen Recombiner Test Building	Demolished	Radionuclides associated with nearby Building 4006 include: Cs-137, H-3, U-234, U-235, and U-238. Radionuclides associated with potential drainage from Buildings 4010 and 4012 include: Sb-125, Am-241, Cs-134, Cs-137, Co-60, Eu-152, Eu-154, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, H-3, U-234, U-235, and U-238.	2
4607	Sodium Lab Instrument Building B	Demolished	Radionuclides associated with nearby Building 4006 include: Cs-137, H-3, U-234, U-235, and U-238. Radionuclides associated with potential drainage from Buildings 4010 and 4012 include: Sb-125, Am-241, Cs-134, Cs-137, Co-60, Eu-152, Eu-154, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, H-3, U-234, U-235, and U-238.	2

Table 1.3b (continued)
Summary of Subarea HSA-5B Sites
Potential Radiological Contaminants of Concern

Site No.	Use(s)	Current Status	Potential Radiological Contaminants of Concern	Preliminary MARSSIM Class
4611	Paint Spray Booth Canopy	Demolished	Radionuclides associated with nearby Building 4011 include: Am-241, Cs-137, Co-60, Eu-152, Eu-154, Ir-192, Pb-210, K-40, Pu-238, Pu-239, Pu-240, Pu-241, Ra-226, Sr-90, Tc-99, Th-230, Th-232, H-3, U-234, U-235, and U-238.	2
4612	Maintenance Building	Demolished	Radionuclides associated with nearby Building 4011 include: Am-241, Cs-137, Co-60, Eu-152, Eu-154, Ir-192, Pb-210, K-40, Pu-238, Pu-239, Pu-240, Pu-241, Ra-226, Sr-90, Tc-99, Th-230, Th-232, H-3, U-234, U-235, and U-238.	2
4615	Combustion Test Facility	Demolished	Radionuclides associated with nearby Building 4006 include: Cs-137, H-3, U-234, U-235, and U-238. Radionuclides associated with potential drainage from Buildings 4010, 4012, and 4024 include: Sb-125, Am-241, Cs-134, Cs-137, Co-60, Eu-152, Eu-154, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, H-3, U-234, U-235, and U-238.	2
4639	Industrial Engineering Office Trailer Complex	Demolished/ May Not Have Been Built	Radionuclides associated with nearby Building 4011 include: Am-241, Cs-137, Co-60, Eu-152, Eu-154, Ir-192, Pb-210, K-40, Pu-238, Pu-239, Pu-240, Pu-241, Ra-226, Sr-90, Tc-99, Th-230, Th-232, H-3, U-234, U-235, and U-238.	2
4704	Electrical Substation	Standing	Radionuclides associated with drainage from Buildings 4005, 4006, 4010, 4012, and 4024 include: Sb-125, Am-241, Cs-134, Cs-137, Co-60, Eu-152, Eu-154, Mn-54, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, H-3, U-234, U-235, U-238, and UO_2.	2

Table 1.3b (continued)
Summary of Subarea HSA-5B Sites
Potential Radiological Contaminants of Concern

Site No.	Use(s)	Current Status	Potential Radiological Contaminants of Concern	Preliminary MARSSIM Class
4714	Power Pak Interconnecting Facility	Demolished	Radionuclides associated with nearby Building 4006 include: Cs-137, H-3, U-234, U-235, and U-238. Radionuclides associated with potential drainage from Buildings 4010 and 4012 include: Sb-125, Am-241, Cs-134, Cs-137, Co-60, Eu-152, Eu-154, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, H-3, U-234, U-235, and U-238.	2
4735	Fuel Tank	Demolished	Radionuclides associated with nearby Building 4011 include: Am-241, Cs-137, Co-60, Eu-152, Eu-154, Ir-192, Pb-210, K-40, Pu-238, Pu-239, Pu-240, Pu-241, Ra-226, Sr-90, Tc-99, Th-230, Th-232, H-3, U-234, U-235, and U-238.	2
4826	Large Component Test Loop Facility	Demolished	Radionuclides associated with nearby Building 4006 include: Cs-137, H-3, U-234, U-235, and U-238. Radionuclides associated with potential drainage from Buildings 4010 and 4012 include: Sb-125, Am-241, Cs-134, Cs-137, Co-60, Eu-152, Eu-154, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, H-3, U-234, U-235, and U-238.	2
17th Street Drainage	Natural Drainage Area Bermed to Create Holding Pond	Dry, Overgrown	Potential radioactive contaminants include: Am-241, Cs-137, Pu-238, Pu-239, Pu-240, Sr-90, Th-228, Th-230, Th-232, U-234, U-235, U-236, and U-238.	1

Table 1.3c
Summary of Subarea HSA-5C Sites
Potential Radiological Contaminants of Concern

Site No.	Use(s)	Current Status	Potential Radiological Contaminants of Concern	Preliminary MARSSIM Class
4015	Construction Material Storage	Standing	Radionuclides associated with SNAP criticality test Building 4373. Radionuclides associated with Building 4373 will be discussed in TM HSA-5D.	1
4038	SNAP Office Building	Standing	U-238, U-234, U-235, Pu-238, Pu-239, Pu-240, Pu-241, Am-241, Cs-137, Sr-90, H-3, Fe-55, Co-58, Co-60, Ni-63, Ba-133, Eu-152, Eu-154, Eu-155, Pm-147, Ta-182.	1
4039	SNAP Administration Building, LMEC Office Building, Health Physics Counting Laboratory	Demolished	U-238, U-234, U-235, Pu-238, Pu-239, Pu-240, Pu-241, Am-241, Cs-137, Sr-90, H-3, Fe-55, Co-58, Co-60, Ni-63, Ba-133, Eu-152, Eu-154, Eu-155, Pm-147, Ta-182.	1
4057	Launch Handling and Mobile Equipment Development Building, LMEC Laboratory	Boeing Records Room	U-238, U-234, U-235, Pu-238, Pu-239, Pu-240, Pu-241, Am-241, Cs-137, Sr-90, H-3, Fe-55, Co-58, Co-60, Ni-63, Ba-133, Eu-152, Eu-154, Eu-155, Pm-147, Ta-182.	1
4059	SNAP 8 Development Reactor, Large leak Test Rig, Ground Prototype Test Facility	Demolished	U-238, U-234, U-235, Pu-238, Pu-239, Pu-240, Pu-241, Am-241, Cs-137, Sr-90, H-3, Fe-55, Co-58, Co-60, Ni-63, Ba-133, Eu-152, Eu-154, Eu-155, Pm-147, Ta-182.	1
4062	ETEC Instrumentation Operations Building, Storage Facility for Instrument Calibration	Demolished	U-238, U-234, U-235, Pu-238, Pu-239, Pu-240, Pu-241, Am-241, Cs-137, Sr-90, H-3, Fe-55, Co-58, Co-60, Ni-63, Ba-133, Eu-152, Eu-154, Eu-155, Pm-147, Ta-182.	1
4065	SNAP Thermoelectric Converter Test Building, LMEC Chemical Laboratory	Demolished	U-238, U-234, U-235, Pu-238, Pu-239, Pu-240, Pu-241, Am-241, Cs-137, Sr-90, H-3, Fe-55, Co-58, Co-60, Ni-63, Ba-133, Eu-152, Eu-154, Eu-155, Pm-147, Ta-182.	1
4066	Instrumentation Repair and Calibration Building, Instrument Laboratory	Demolished	U-238, U-234, U-235, Pu-238, Pu-239, Pu-240, Pu-241, Am-241, Cs-137, Sr-90, H-3, Fe-55, Co-58, Co-60, Ni-63, Ba-133, Eu-152, Eu-154, Eu-155, Pm-147, Ta-182.	1
4100	AETR, FCEL, Radiation Safety and Computed Tomography	Standing	U-233, U-234, U-235, U-236, U-238, Th-232, Np-237, Pu-238, Pu-239, Pu-240, Pu-241, Th-228, Ra-228, Th-230, Ra-226, Pb-210, Pa-231, Ac-227.	1
4383	Instrumentation Building, LMEC Assembly and Test Building	Demolished	U-233, U-234, U-235, U-236, U-238, Th-232, Np-237, Pu-238, Pu-239, Pu-240, Pu-241, Th-228, Ra-228, Th-230, Ra-226, Pb-210, Pa-231, Ac-227.	2

Table 1.3c (continued)
Summary of Subarea HSA-5C Sites
Potential Radiological Contaminants of Concern

Site No.	Use(s)	Current Status	Potential Radiological Contaminants of Concern	Preliminary MARSSIM Class
4459	URS Building, ETEC Storage Building	Demolished	U-238, U-234, U-235, Pu-238, Pu-239, Pu-240, Pu-241, Am-241, Cs-137, Sr-90, H-3, Fe-55, Co-58, Co-60, Ni-63, Ba-133, Eu-152, Eu-154, Eu-155, Pm-147, Ta-182.	1
4461	SPTF Motor Generator Building	Demolished	U-233, U-234, U-235, U-236, U-238, Th-232, Np-237, Pu-238, Pu-239, Pu-240, Pu-241, Th-228, Ra-228, Th-230, Ra-226, Pb-210, Pa-231, Ac-227.	1
4462	SPTF Building	Awaiting Demolition	U-233, U-234, U-235, U-236, U-238, Th-232, Np-237, Pu-238, Pu-239, Pu-240, Pu-241, Th-228, Ra-228, Th-230, Ra-226, Pb-210, Pa-231, Ac-227.	1
4463	Sodium Cleaning and Handling Facility Building	Awaiting Demolition	U-233, U-234, U-235, U-236, U-238, Th-232, Np-237, Pu-238, Pu-239, Pu-240, Pu-241, Th-228, Ra-228, Th-230, Ra-226, Pb-210, Pa-231, Ac-227.	1
4482	Government Project Office	Transferred Off Site	U-233, U-234, U-235, U-236, U-238, Th-232, Np-237, Pu-238, Pu-239, Pu-240, Pu-241, Th-228, Ra-228, Th-230, Ra-226, Pb-210, Pa-231, Ac-227.	2
4483	LMEC Office Trailer	Transferred Off Site	Radiological contamination is not anticipated in this area.	3
4484	Rest Room Trailer	Transferred Off Site	Radiological contamination is not anticipated in this area.	3
4485	LMEC Office Trailer	Transferred Off Site	Radiological contamination is not anticipated in this area.	3
4486	LMEC Office Trailer	Transferred Off Site	Radiological contamination is not anticipated in this area.	3
4487	ETEC Engineering Building, SHEA Office	Demolished	U-233, U-234, U-235, U-236, U-238, Th-232, Np-237, Pu-238, Pu-239, Pu-240, Pu-241, Th-228, Ra-228, Th-230, Ra-226, Pb-210, Pa-231, Ac-227.	2
4538	Parking Lot for Buildings 4482 through 4486	Vegetated Area	Radiological contamination is not anticipated in this area.	3
4626	LMEC Equipment Storage Building, ETEC Inventory Storage Building, SNAP Storage Building	Demolished	U-238, U-234, U-235, Pu-238, Pu-239, Pu-240, Pu-241, Am-241, Cs-137, Sr-90, H-3, Fe-55, Co-58, Co-60, Ni-63, Ba-133, Eu-152, Eu-154, Eu-155, Pm-147, Ta-182.	1
4662	SPTF Small Parts Cleaning Pad	Demolished	U-233, U-234, U-235, U-236, U-238, Th-232, Np-237, Pu-238, Pu-239, Pu-240, Pu-241, Th-228, Ra-228, Th-230, Ra-226, Pb-210, Pa-231, Ac-227.	1

Table 1.3d
Summary of Subarea HSA-5D Sites
Potential Radiological Contaminants of Concern

Site No.	Use(s)	Current Status	Potential Radiological Contaminants of Concern	MARSSIM Class
4020	Hot Laboratory; Component Development Hot Cell	Demolished	U-235, U-238, Pu-238, Pu-239+240, Th-232, Th-234, Th-228, Ac-228, Ra-226, Pb-214, Bi-214, Pb-212, Bi-212, and Tl-208. Also, H-3, Sr-90, Co-60, Cs-137, Eu-152, Am-241, and Am-243. Na-24 has a 15 hour half-life and Co-57 has a 272 d half-life, hence these contaminants have decayed and will not be analyzed.	1
4055	Nuclear Material Development Laboratory	Standing	U-235, U-238, Pu-238, Pu-239+240, Th-232, Th-234, Th-228, Ac-228, Ra-226, Pb-214, Bi-214, Pb-212, Bi-212, and Tl-208. Also, H-3, Sr-90, Co-60, Cs-137, Eu-152, Am-241, and Am-243.	1
4173/ 4865	Gammagraph Building	Demolished	Co-60, U-234, U-235, and U-238	2
4353	Organics Reactor Development Building; Research and Development Laboratory Building	Demolished	Co-60, Mn-54, Ni-59, Ni-63, and Fe-55. Mn-54 and Fe-55 have short half-lives and will not be analyzed.	1
4363	Mechanical Component Development and Counting Building; Research and Development Laboratory Building	Demolished	U-235, U-238, Ra-226, Pb-214, Bi-214, Pb-212, Bi-212, Tl-208, H-3, Sr-90, Cs-137, Co-60, Eu-152	1
4373	SNAP Critical Facility	Demolished	U-235, U-238, Pu-238, Pu-239+240, Th-232, Th-234, Th-228, Ac-228, Ra-226, Pb-214, Bi-214, Pb-212, Bi-212, and Tl-208. Also, H-3, Sr-90, Co-60, Cs-137, Eu-152, Am-241, and Am-243.	1
4374	Test Loop Enclosure	Demolished	U-235, U-238, Pu-238, Pu-239+240, Th-232, Th-234, Th-228, Ac-228, Ra-226, Pb-214, Bi-214, Pb-212, Bi-212, and Tl-208. Also, H-3, Sr-90, Co-60, Cs-137, Eu-152, Am-241, and Am-243.	1
4375	Control Shelter Building	Demolished	None identified.	2
4468	Holdup Tank	Demolished	U-235, U-238, Pu-238, Pu-239+240, Th-232, Th-234, Th-228, Ac-228, Ra-226, Pb-214, Bi-214, Pb-212, Bi-212, and Tl-208. Also, H-3, Sr-90, Co-60, Cs-137, Eu-152, Am-241, and Am-243.	1
4473	Hydraulic Test Instrumentation Building	Demolished	None identified.	3
4509	Parking Lot	Demolished		2

Table 1.3d (continued)
Summary of Subarea HSA-5D Sites
Potential Radiological Contaminants of Concern

Site No.	Use(s)	Current Status	Potential Radiological Contaminants of Concern	MARSSIM Class
4520	Parking Lot	Demolished	U-235, U-238, Pu-238, Pu-239+240, Th-232, Th-234, Th-228, Ac-228, Ra-226, Pb-214, Bi-214, Pb-212, Bi-212, and Tl-208. Also, H-3, Sr-90, Co-60, Cs-137, Eu-152, Am-241, and Am-243.	1
4553	Parking Lot	Demolished	None identified.	3
4575	Parking Lot	Demolished	None identified.	3
4701	Water Tank	Demolished	None identified	3
4702	Water Tank	Demolished	None identified	3
4854	Radiation Fuel Gauge Test Structure	Demolished	None identified.	2
4863	Hydraulic Test Loop	Demolished	None identified.	3
4873	Hydraulic Test Laboratory; Fuel Rod Test Tower and Pad	Demolished	None identified.	2
4874	Control Rod Test Tower and Pad	Demolished	None identified.	2
4875	Pad and Creep Loop Tower	Demolished	None identified.	2

Table 1.3e
Summary of Subarea HSA-6 Sites
Potential Radiological Contaminants of Concern

Site No.	Use(s)	Current Status	Potential Radiological Contaminants of Concern	MARSSIM Class
4003	Sodium Reactor Experiment (SRE) Support Building, Hot Cave	Demolished	U-238, U-234, U-235, U-236, Pu-238, Pu-239+240, Th-228, Th-232, Th-234, H-3, C-14, Ni-59, Ni-63, Co-60, Sr-90, I-129, Cs-137, Eu-152, Ra-226, Ac-228, and Am-241. Radionuclides in prior reports, which will not be analyzed due to decay include Na-22, Sb-125, Cs-134, and Ce-144.	1
4014	Sodium Storage Building	Demolished	U-238, U-233, U-234, U-235, U-236, Pu-238, Pu-239+240, Th-228, Th-232, Ra-226, Cs-137, Sr-90, H-3, Co-60, Ni-59, Ni-63, Eu-152, Eu-154 and Am-241. Radionuclides in prior reports, which will not be analyzed due to decay include: Na-22, Fe-55, Sb-125, Cs-134, and Ce-144.	2
4040	Contaminated Medical/ Storage Facility	Demolished	U-238, U-233, U-234, U-235, U-236, Pu-238, Pu-239+240, Am-241, Th-228, Th-232, Ra-226, Cs-137, Sr-90, H-3, Co-60, Ni-59, Ni-63, Eu-152, and Eu-154.	2
4041	SRE Component Storage, Energy Technology Engineering Center (ETEC) Equipment Storage Building	Demolished	U-238, U-234, U-235, U-236, Pu-238, Pu-239+240, Am-241, Th-232, H-3, Co-60, Sr-90, and Cs-137.	1
4053	Fire Department Service Building	Demolished	U-238, U-233, U-234, U-235, U-236, Pu-238, Pu-239+240, Am-241, Th-232, Sr-90, H-3, Co-60, Eu-152, and Eu-154.	2
4063	Electronics Shop, Maintenance Service Building	Demolished	U-238, U-233, U-234, U-235, U-236, Pu-238, Pu-239+240, Am-241, Th-232, Np-237, Cs-137, Sr-90, H-3, Co-60, Ni-63, Ba-133, Eu-152, and Eu-154.	2
4064	Fuel Element Storage Facility	Demolished	U-238, U-233, U-234, U-235, U-236, Pu-238, Pu-239+240, Am-241, Th-232, Np-237, Cs-137, Sr-90, H-3, Co-60, Ba-133, Eu-152, and Eu-154.	1
4114	Decontamination Trailer	Demolished	U-238, U-234, U-235, U-236, Pu-239+240, Am-241, Th-232, H-3, Co-60, Sr-90, and Cs-137.	2
4143	SRE Reactor Building, ETEC Component Storage	Demolished	U-238, U-234, U-235, U-236, Pu-238, Pu-239+240, Am-241, Np-237, Th-232, H-3, Co-60, Sr-90, Tc-99, I-129, and Cs-137.	1
4153	SRE Sodium Service Building	Demolished	U-238, U-234, U-235, U-236, Pu-238, Pu-239+240, Am-241, Th-232, H-3, Co-60, Sr-90, and Cs-137.	1
4163	SRE Support, Component Equipment Repair Facility (CERF)	Demolished	U-238, U-234, U-235, U-236, Pu-238, Pu-239+240, Am-241, Th-232, H-3, Co-60, Sr-90, and Cs-137.	1
4183	Fire Pump Building	Demolished	U-238, U-234, U-235, U-236, Pu-238, Pu-239+240, Am-241, Th-232, H-3, Co-60, Sr-90, and Cs-137.	1

Table 1.3e (continued)
Summary of Subarea HSA-6 Sites
Potential Radiological Contaminants of Concern

Site No.	Use(s)	Current Status	Potential Radiological Contaminants of Concern	MARSSIM Class
4184	SRE Battery Room, Diesel Generator Canopy	Demolished	U-238, U-234, U-235, U-236, Pu-238, Pu-239+240, Am-241, Th-232, H-3, Co-60, Sr-90, and Cs-137.	1
4185	Steam Generator Control Building	Demolished	U-238, U-234, U-235, U-236, Pu-238, Pu-239+240, Am-241, Th-232, H-3, Co-60, Sr-90, and Cs-137.	1
4273	Radioactive Laundry	Demolished	U-238, U-234, U-235, U-236, Pu-238, Pu-239+240, Am-241, Th-232, H-3, Co-60, Sr-90, and Cs-137.	1
4283	Radioactive Laundry	Demolished	U-238, U-234, U-235, U-236, Pu-238, Pu-239+240, Am-241, Th-232, H-3, Co-60, Sr-90, and Cs-137.	1
4320	Fuel Oil Control/Pump Building	Demolished	U-238, U-234, U-235, U-236, Pu-238, Pu-239+240, Am-241, Th-232, H-3, Co-60, Sr-90, and Cs-137.	1
4505	Storage Area/Concrete Pad	Demolished	U-238, U-234, U-235, U-236, Pu-238, Pu-239+240, Am-241, Th-232, H-3, Co-60, Sr-90, and Cs-137.	1
4511	Parking Lot at Main Gate	Removed	U-238, U-234, U-235, U-236, Pu-238, Pu-239+240, Am-241, Th-232, H-3, Co-60, Sr-90, and Cs-137.	2
4513	Parking Lot between Buildings 4064 and 4030	Removed	U-238, U-233, U-234, U-235, U-236, Pu-238, Pu-239+240, Am-241, Th-232, Np-237, Cs-137, Sr-90, H-3, Co-60, Ba-133, Eu-152, and Eu-154.	2
4540	Parking Lot for Building 4040	Part of G Street	U-238, U-233, U-234, U-235, U-236, Pu-238, Pu-239+240, Am-241, Th-228, Th-232, Ra-226, Cs-137, Sr-90, H-3, Co-60, Ni-59, Ni-63, Eu-152, and Eu-154.	2
4583-Old	Old Energy Systems Group (ESG) Salvage Yard (1962-1975)	Removed	U-238, U-234, U-235, U-236, Pu-238, Pu-239+240, Am-241, Th-232, H-3, Co-60, Sr-90, and Cs-137.	1
4583-New	New Salvage Yard (1977-1983)	Demolished	U-238, U-233, U-234, U-235, U-236, Pu-238, Pu-239+240, Am-241, Th-228, Th-232, Ra-226, Cs-137, Sr-90, H-3, Co-60, Ni-59, Ni-63, Eu-152, and Eu-154.	1
4653	Interim Radioactive Waste Vault	Demolished	U-238, U-234, U-235, U-236, Pu-238, Pu-239+240, Am-241, Th-232, H-3, Co-60, Sr-90, and Cs-137.	1
4684	Steam Generator Pad	Demolished	U-238, U-234, U-235, U-236, Pu-238, Pu-239+240, Am-241, Th-232, H-3, Co-60, Sr-90, and Cs-137.	1
4686	Temporary Hot Waste Storage	Demolished	U-238, U-234, U-235, U-236, Pu-238, Pu-239+240, Am-241, Th-232, H-3, Co-60, Sr-90, and Cs-137.	1
4689	Interim Storage Facility for Contaminated Items from the SRE Complex	Demolished	U-238, U-234, U-235, U-236, Pu-238, Pu-239+240, Am-241, Th-232, H-3, Co-60, Sr-90, and Cs-137.	1

Table 1.3e (continued)
Summary of Subarea HSA-6 Sites
Potential Radiological Contaminants of Concern

Site No.	Use(s)	Current Status	Potential Radiological Contaminants of Concern	MARSSIM Class
4695	SRE Cold Trap Vault	Demolished	U-238, U-234, U-235, U-236, Pu-238, Pu-239+240, Am-241, Th-232, H-3, Co-60, Sr-90, and Cs-137.	1
4703	Water Tower	Demolished	U-238, U-234, U-235, U-236, Pu-238, Pu-239+240, Am-241, Th-232, H-3, Co-60, Sr-90, and Cs-137.	2
4714	Research and Development Shop Work Area associated with Building 4163	Demolished	U-238, U-234, U-235, U-236, Pu-238, Pu-239+240, Am-241, Th-232, H-3, Co-60, Sr-90, and Cs-137.	1
4723	Steam/Sodium Cleaning Pad associated with the SRE	Demolished	U-238, U-234, U-235, U-236, Pu-238, Pu-239+240, Am-241, Th-232, H-3, Co-60, Sr-90, and Cs-137.	1
4724	Hot Oil Sodium Cleaning Facility for the SRE	Demolished	U-238, U-234, U-235, U-236, Pu-238, Pu-239+240, Am-241, Th-232, H-3, Co-60, Sr-90, and Cs-137.	1
4731	Fuel Oil Storage Tank	Demolished	U-238, U-234, U-235, U-236, Pu-238, Pu-239+240, Am-241, Th-232, H-3, Co-60, Sr-90, and Cs-137.	1
4732	Fuel Oil Storage Tank	Demolished	U-238, U-234, U-235, U-236, Pu-238, Pu-239+240, Am-241, Th-232, H-3, Co-60, Sr-90, and Cs-137.	1
4733	Sodium Cleaning Pad for the SRE Complex	Demolished	U-238, U-234, U-235, U-236, Pu-238, Pu-239+240, Am-241, Th-232, H-3, Co-60, Sr-90, and Cs-137.	1
4743	Tetralin Heat Exchanger for the SRE	Demolished	U-238, U-234, U-235, U-236, Pu-238, Pu-239+240, Am-241, Th-232, H-3, Co-60, Sr-90, and Cs-137.	1
4753	SRE Primary Fill Tank Vault	Demolished	U-238, U-234, U-235, U-236, Pu-238, Pu-239+240, Am-241, Th-232, H-3, Co-60, Sr-90, and Cs-137.	1
4773	SRE Waste Water Retention Pond and Dam	Demolished	U-238, U-234, U-235, U-236, Pu-238, Pu-239+240, Am-241, Th-232, H-3, Co-60, Sr-90, and Cs-137.	1

Table 1.3f
Summary of Subarea HSA-7, HSA-3, and NBZ Sites
Potential Radiological Contaminants of Concern

Site No.	Use(s)	Current Status	Potential Radiological Contaminants of Concern	MARSSIM Class
4021	Radioactive Material Disposal Facility (RMDF) Waste Decontamination and Packaging ; Radioactive Material Handling Facility (RMHF) Waste Decontamination and Packaging	Standing	Am-241, Co-60, Cs-137, Eu-152, Eu-154, H-3, K-40, Ni-59, Ni-63, Pm-147, Pu-238, Pu-239, Pu-240, Pu-241, Pu-242, Sr-90, Th-228, Th-232, U-234, U-235, and U-238.	1
4022	RMDF Vault Storage; RMHF Radioactive Vault Storage	Standing	Am-241, Co-60, Cs-137, Eu-152, Eu-154, H-3, K-40, Ni-59, Ni-63, Pm-147, Pu-238, Pu-239, Pu-240, Pu-241, Pu-242, Sr-90, Th-228, Th-232, U-234, U-235, and U-238.	1
4028	Shield Test Irradiation Reactor (STIR) Facility; Liquid Metal Fast Breeder Reactor (LMFBR) Fuel Safety Building	Demolished	Am-241, Cs-137, Co-60, Eu-152, Eu-154, H-3, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, U-234, U-235, and U-238.	1
4034	RMDF Office Building; RMHF Office Building	Standing	Am-241, Co-60, Cs-137, Eu-152, Eu-154, H-3, K-40, Ni-59, Ni-63, Pm-147, Pu-238, Pu-239, Pu-240, Pu-241, Pu-242, Sr-90, Th-228, Th-232, U-234, U-235, and U-238.	1
4044	RMDF Clean Shop; RMDF Support Lab; RMDH Support Lab	Standing	Am-241, Bi-210, Co-60, Cs-137, Eu-152, Eu-154, H-3, K-40, Ni-59, Ni-63, Pb-210, Pm-147, Pu-238, Pu-239, Pu-240, Pu-241, Pu-242, Sr-90, Tc-99, Th-228, Th-232, U-234, U-235, and U-238.	1
4075	RMDF Contaminated Equipment Storage Building	Standing	Uranium, plutonium, thorium, mixed fission products. Isotopes of cobalt and europium.	1
4133	Hazardous Waste Treatment Facility; Hazardous Waste Management Facility	Standing	None identified.	1
4563	Building 4633 Storage Yard; Covered Storage Area Adjacent to Building 4075	Standing	Uranium, plutonium, thorium, and mixed fission products.	1
4614	RMDF Drainage Sump; RMHF Drainage Sump; RMHF Holdup Pond	Standing	Am-241, Co-60, Cs-134, Cs-137, Eu-152, Eu-154, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, Th-228, Th-232, U-234, U-235, and U-238.	1
4621	RMDF Equipment Storage Building; RMHF Equipment Storage Building	Standing	Am-241, Bi-210, Co-60, Cs-137, Ir-192, Pb-210, Ra-226, Sr-90, Th-228, and Th-232.	1

Table 1.3f (continued)
Summary of Subarea HSA-7, HSA-3, and NBZ Sites
Potential Radiological Contaminants of Concern

Site No.	Use(s)	Current Status	Potential Radiological Contaminants of Concern	MARSSIM Class
4622	RMDF Counting Building	Demolished	None identified. It is presumed that waste handled at other RMHF complex buildings had the potential to be sampled and counted at Building 4622 and thus this building area should be surveyed for the same radionuclides of concern as the rest of the RMHF complex.	1
4654	Interim Storage Facility	Demolished	Uranium and mixed fission and activation products.	1
4658	RMDF Guard Shack; RMHF Guard Shack	Standing	None identified. However, this building was at the entry point for all incoming and outgoing fuel and waste shipments.	1
4663	RMDF Storage Area; RMHF Storage Area	Concrete Pad	Uranium, plutonium, thorium isotopes, and mixed fission products.	1
4664	RMHF Low-Level Waste Processing	Demolished	Uranium, plutonium, thorium isotopes, and mixed fission products.	1
4665	RMDF Oxidation Facility; RMHF Equipment Storage	Standing	Uranium, plutonium, thorium isotopes, and mixed fission products.	1
4688	Auxiliary Skid Shack; RMDF Storage Building; RMHF Storage Building	Standing	Uranium, plutonium, thorium isotopes, and mixed fission products.	1
N/A	RMHF Leach Field	Excavated	Am-241, Co-60, Cs-137, Eu-152, Eu-154, H-3, K-40, Ni-59, Ni-63, Pm-147, Pu-238, Pu-239, Pu-240, Pu-241, Pu-242, Sr-90, Th-228, Th-232, U-234, U-235, U-238, and Y-90	1
N/A	Southern California Edison Substation	Standing	Am-241, Co-60, Cs-134, Cs-137, H-3, I-129, Pu-239, Pu-240, Pu-241, Pu-242, Sb-125, Sr-90, Th-232, U-234, U-235, and U-238.	2
N/A	Northern Buffer Zone – Northeast Area	No structures	Am-241, Co-60, Cs-134, Cs-137, H-3, I-129, Pu-239, Pu-240, Pu-241, Pu-242, Sb-125, Sr-90, Th-232, U-234, U-235, and U-238.	1
N/A	Northern Buffer Zone – Northwest Area	No structures	Am-241, Co-60, Cs-134, Cs-137, H-3, I-129, Pu-239, Pu-240, Pu-241, Pu-242, Sb-125, Sr-90, Th-232, U-234, U-235, and U-238.	1

Table 1.3g
Summary of Subarea HSA-8 Sites
Potential Radiological Contaminants of Concern

Site No.	Use(s)	Current Status	Potential Radiological Contaminants of Concern	MARSSIM Class
4009	Organic Moderated Reactor Critical Facility, Sodium Graphite Reactor Critical Facility	Standing	U-235, U-238, Th-232, Th-234, Th-228, Ra-226, Ac-228, Pb-214, Pb-212, Tl-208, Bi-214, Bi-212, Sr-90, Cs-137, Na-24, Co-57, Co-60, Eu-152.	1
4056	Landfill	Closed	U-238, U-233, U-234, U-235, U-236, Pu-238, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Th-228, Th-232, Ra-226, Cs-134, Cs-137, Sr-90, H-3, Na-22, K-40, Mn-54, Fe-55,Co-58, Co-60, Ni-59, Ni-63, Ba-133, Eu-152, Eu-154, Pm-147, Ta-182.	1
4317/4730	Pistol Range/Isotope System Impact Test Control Building	Demolished	U-238, U-234, U-235, Pa-231, Th-230, Ac-227, Ra-226, Pb-210, H-3, K-40, Mn-54, Fe-55, Co-60, Eu-152, Eu-154.	1
4318/4820	Pistol Range/Isotope System Impact Test Device	Demolished	U-238, U-234, U-235, (Pa-231, Th-230, Ac-227, Ra-226, Pb-210, H-3, K-40, Mn-54, Fe-55, Co-60, Eu-152, Eu-154.	1
4425	Solar Concentrator Test Facility/Weather Station and Astronomical Observatory/Uranium Fuel Element Drop Site	Demolished/ In Use	U-238	1 in/near Fuel Element Drop Site; 3 elsewhere.
4814	Sodium-Water Reaction Test Structure, Large leak Injector Device	Demolished	Cs-137	2
4885	Pistol Range	Demolished	U-238, U-234, U-235, U-236, Pu-239, Pu-240, Pu-241, Pu-242, Th-232, Na-22, Na-24, Cr-51, Mn-54, Fe-59, Co-60, Kr-85, Sr-89, Sr-90, Sb-125, I-131, Cs-134, Cs-137, Ce-141, Ce-144, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xe-133, Xe-135, Pm-147, Sm-151.	1
4886	Sodium Burn Pit, Sodium Disposal Facility	Demolished	U-238, U-234, U-235, U-236, Pu-239, Pu-240, Pu-241, Pu-242, Th-232, Na-22, Na-24, Cr-51, Mn-54, Fe-59, Co-60, Kr-85, Sr-89, Sr-90, Sb-125, I-131, Cs-134, Cs-137, Ce-141, Ce-144, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xe-133, Xe-135, Pm-147, Sm-151.	1

FIGURES

PARTIALLY SCANNED
OVERSIZE ITEM(S)

See document # 2266487
for partially scanned image(s).

PLATE 1 AREA IV

For complete hardcopy version of the oversize document
contact the Region IX Superfund Records Center

APPENDIX A

United States
Environmental Protection
Agency

Environmental Sciences
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P.O. Box 93478
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TS-PIC-20909963S/21009965S
March 2010

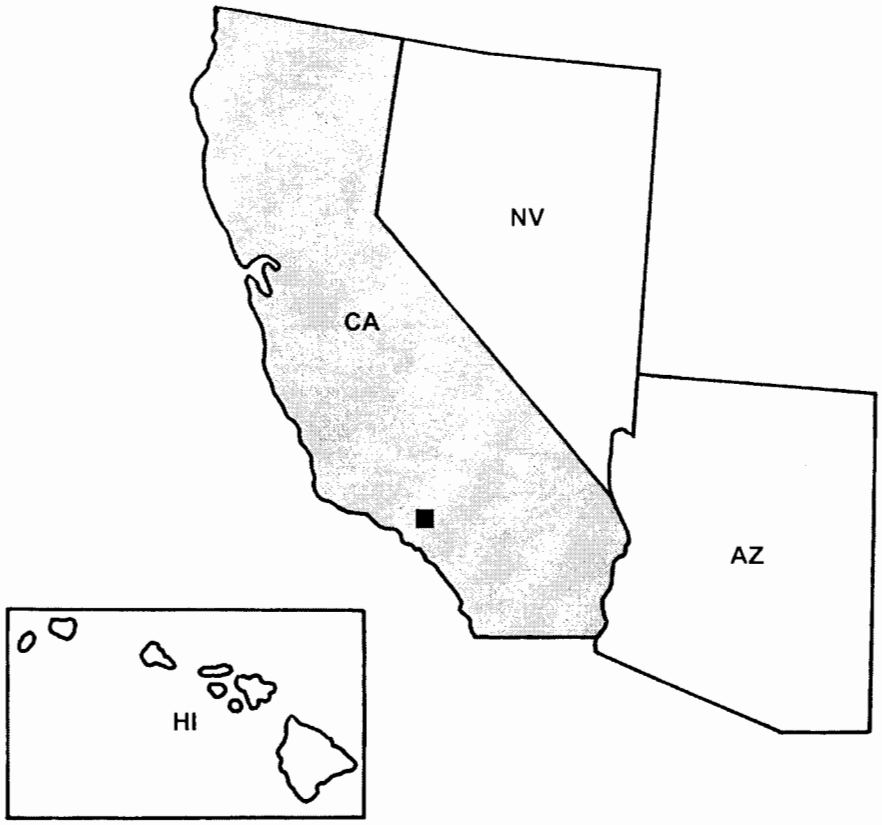
Research and Development

AERIAL PHOTOGRAPHIC ANALYSIS OF SANTA SUSANA FIELD LABORATORY - AREA IV

Ventura County, California

Volume 1 & 2

EPA Region 9



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AERIAL PHOTOGRAPHIC ANALYSIS OF SANTA SUSANA FIELD LABORATORY - AREA IV

Ventura County, California

Volume 1 & 2

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NOTICE

This document has undergone a technical and quality control/assurance review and has been approved for publication by personnel of the U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, Landscape Ecology Branch at Las Vegas, Nevada. It is for internal Agency use and distribution only.

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ABSTRACT

This report presents the results of a historical aerial photographic analysis of the Santa Susana Field Laboratory-Area IV, located in Ventura County, California. The U.S. Environmental Protection Agency (EPA) Region 9 Office requested operational remote sensing support to document observable past patterns of waste disposal activity and other conditions of environmental significance on the Santa Susana Field Laboratory-Area IV. Collateral information supplied by EPA Region 9 states that Santa Susana Field Laboratory-Area IV was the location of nuclear power development activities from the 1950s until the late 1980s.

The purpose of this report is to document historical conditions at Solid Waste Management Units (SWMU), Areas of Concern (AOC), and other environmentally significant features related to waste management at the Santa Susana Field Laboratory-Area IV. Findings from the analysis revealed details related to waste disposal areas, impoundments, processing areas, fill areas, and open storage areas on seventeen SWMUs/AOCs and other locations on Santa Susana Field Laboratory-Area IV.

Thirty-eight dates of historical photographs covering the period from 1939 through 2005 were analyzed to produce this report and thirteen years of photography were reproduced for inclusion in the report. The report is presented in two volumes. Volume 1 presents the text description of the findings from the analysis of the thirty-eight dates of photography. Volume 2 contains photos with interpretive overlays from the analysis.

The EPA Environmental Sciences Division, Landscape Ecology Branch in Las Vegas, Nevada, prepared this report for the EPA Region 9 Superfund Division in San Francisco, California, and the EPA Office of Superfund Remediation Technology Innovation in Washington, D.C.

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INTRODUCTION

This report presents the results of a historical aerial photographic analysis of the Santa Susana Field Laboratory-Area IV (CERCLIS ID# CAN000908498), located in Ventura County, California (Figures 1 and 2). The Santa Susana Field Laboratory covers approximately 1,153 hectares (2,850 acres), and is administratively divided into four areas and a Buffer Zone. This report covers Area IV which is located in the western section of the Santa Susana Field Laboratory and comprises approximately 117 hectares (290 acres). The U.S. Environmental Protection Agency (EPA) Region 9 Office requested operational remote sensing support to document observable past patterns of waste disposal activity and other conditions of environmental significance on the Santa Susana Field Laboratory-Area IV.

Collateral information supplied by EPA Region 9 states that Santa Susana Field Laboratory-Area IV was the location of nuclear power development activities from the 1950s until the late 1980s when most nuclear related activities ceased operations. However, activity related to radioactive materials handling, fuel storage, and instrument calibration continued for several more years. By the early 1990s, decommissioning and decontamination activities commenced.

The primary task of this analysis was to identify and document environmentally significant features within the Santa Susana Field Laboratory-Area IV. The analysis findings presented in the text portion of the report are organized by Solid Waste Management Units (SWMUs) and Areas of Concern (AOCs) that are delineated on the Resource Conservation and Recovery Act Facility Investigation (RFI) Location Map, Santa Susana Field Laboratory (California Environmental Protection Agency website). The SWMUs and AOCs reviewed in this current report are:

SWMU 7.1 - Building 56 Landfill
SWMU 7.3 - Former Sodium Disposal Facility
SWMU 7.4 - Old Conservation Yard
SWMU 7.5 - Building 100 Trench

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SWMU 7.6 - Radioactive Materials Handling Facility
SWMU 7.7 - Rockwell International Hot Laboratory
SWMU 7.8 - New Conservation Yard
SWMU 7.9 - ESADA Chemical Storage Area
SWMU 7.10 - Former Coal Gasification PDU
AOC - Former Hazardous Materials Storage Area
AOC - Chemistry Laboratory Metals Clarifier
AOC - Pond Dredge Area
AOC - Sodium Reactor Experiment Area
AOC - SE Drum Storage Yard
AOC - SNAP Facility
AOC - Boeing Area IV Leach Fields
AOC - DOE Area IV Leach Fields

NOTE: No significant environmental activity was identified at the AOC-Boeing Area IV Leach Fields or the AOC-DOE Area IV Leach Fields. These two AOCs are no longer discussed nor are they annotated on the photographic overlays.

Five types of environmentally significant features were identified in the analysis: waste disposal areas (WDA), processing areas (PA), open storage areas (OS), fill areas (FA), and impoundments (IM). If one of these features is located on a SWMU/AOC it is discussed in the text with that SWMU/AOC. If a feature is not located on any of the Santa Susana Field Laboratory-Area IV SWMUs or AOCs it will be discussed after the SWMU/AOC section of the report. Additional features and conditions of environmental significance, such as stains, storage tanks, pipelines, disturbed ground, mounded material, smokestacks, ground scars, building foundations, and cleared areas are annotated on the overlays when observed on the photographs, but may not be discussed in the text. Buildings (B) when first observed are annotated on the overlays and may not discussed in the text.

This report is presented in two volumes. Volume 1 contains the text of the report, including the introduction, methodology, historical photographic analysis, glossary, and reference sections. Volume 2 contains the various maps and the photographs; a transparent overlay with interpretative data is affixed to each of the digital prints.

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A text description of the findings from the analysis of all thirty-eight dates of historical photographs is provided in Volume 1. Thirteen years of photography (1952, 1957, 1959, 1962/63, 1965, 1967, 1972, 1978, 1980, 1983, 1988, 1995, and 2005) were reproduced for Volume 2. Volume 2 contains these photographs along with interpretive overlays depicting the findings from the analysis. Findings from the analysis of photographs not reproduced in Volume 2 are, however, present in the report. An asterisk (*) is used in both the text and on the photographic overlays to denote dates of photography not reproduced in the report. For example, if the text reads: "A fill area was seen in 1993*.", the fill area was visible on the 1993 photographs which were not reproduced in the report.

All proper names utilized in this report are derived from the Resource Conservation and Recovery Act Facility Investigation (RFI) Location Map, Santa Susana Field Laboratory (California Environmental Protection Agency website, see References section). Boundaries of the Santa Susana Field Laboratory-Area IV used in this report were determined from observations made on aerial photographs in conjunction with collateral data supplied by Region 9, and do not necessarily denote legal property lines or ownership. A list of all aerial photographs that were identified and evaluated for potential application to this study can be obtained by contacting the EPA Work Assignment Manager.

The EPA Environmental Sciences Division, Landscape Ecology Branch in Las Vegas, Nevada, prepared this report for the EPA Region 9 Superfund Division in San Francisco, California, and the EPA Office of Superfund Remediation Technology Innovation in Washington, D.C.

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METHODOLOGY

This report was prepared using a standard methodology that includes the following steps:

- data identification and acquisition,
- photographic analysis and interpretation, and
- graphics and text preparation.

These steps are described below. Subsections also address details related to specific kinds of analyses that may be required to identify environmental features such as surface drainage and wetlands. All operational steps and processes used to perform this work (including data identification and acquisition, photographic analysis and interpretation, and graphics and text preparation) adhere to strict QA/QC guidelines and standard operating procedures (SOPs). These guidelines and procedures are documented in the Master Quality Assurance Project Plan (QAPP) prepared for Remote Sensing Support Services Contract No. EP-D-05-088 (LMS, 2006).

Data identification and acquisition included a search of government and commercial sources of historical aerial film for the study area. Photographs with optimal spatial and temporal resolution and image quality were identified for acquisition. In addition, U.S. Geological Survey (USGS) topographic maps were obtained to show the study area location and to provide geographic and topographic context.

To conduct this analysis, the analyst examined diapositives (transparencies) of historical aerial photographs showing the study area. Diapositives are most often used for analysis instead of prints because the diapositives have superior photographic resolution. They show minute details of significant environmental features that may not be discernible on a paper print.

A photographic analyst uses a stereoscope to view adjacent, overlapping pairs of diapositives on a backlit light table. In most cases, the stereoscope is capable of various magnifications up to 60 power.

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Stereoscopic viewing involves using the principle of parallax (observing a feature from slightly different positions) to observe a three-dimensional representation of the area of interest. The stereoscope enhances the photo interpretation process by allowing the analyst to observe vertical as well as horizontal spatial relationships of natural and cultural features.

The process of photographic analysis involves the visual examination and comparison of many components of the photographic image. These components include shadow, tone, color, texture, shape, size, pattern, and landscape context of individual elements of a photograph. The photo analyst identifies objects, features, and "signatures" associated with specific environmental conditions or events. The term "signature" refers to a combination of components or characteristics that indicate a specific object, condition, or pattern of environmental significance. The academic and professional training, photo interpretation experience gained through repetitive observations of similar features or activities, and deductive logic of the analyst as well as background information from collateral sources (e.g., site maps, geologic reports, soil surveys) are critical factors employed in the photographic analysis.

The analyst records the results of the analysis by using a standard set of annotations and terminology to identify objects and features observed on the diapositives. Significant findings are annotated on overlays attached to the photographic or computer-reproduced prints in the report and discussed in the accompanying text. Annotations that are self-explanatory may not be discussed in the text. The annotations are defined in the legend that accompanies each print and in the text when first used.

Objects and features are identified in the graphics and text according to the analyst's degree of confidence in the evidence. A distinction is made between certain, probable, and possible identifications. When the analyst believes the identification is unmistakable (certain), no qualifier is used. Probable is used when a limited number of discernible characteristics allow the analyst to be reasonably sure of a particular identification. Possible is used when only a few characteristics are discernible, and the analyst can only infer an identification.

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The prints in this report have been reproduced, either by photographic or computer methods, from the original film. Reproductions are made from the original film and may be either contact (the same size) prints or enlargements, depending on the scale of the original film. Any computer-produced prints used in this report are generated from scans of the film at approximately 1,300 dots per inch (dpi) and printed at 720 dpi. Although the reproductions allow effective display of the interpretive annotations, they may have less photographic resolution than the original film. Therefore, some of the objects and features identified in the original image and described in the text may not be as clearly discernible on the prints in this report.

Study area boundaries shown in this report were determined from aerial photographs and from information supplied by EPA Region. Boundaries used in this report do not necessarily denote legal property lines or ownership.

Digital Diapositives

Some film vendors no longer supply analog film products (e.g., diapositive transparencies) to their customers. Digital files, created by scanning the original analog film products, are provided. The digital file, a representation of an original analog film product, can be analyzed either by computer viewing techniques or by creating a secondary diapositive from the digital file and viewing the secondary diapositve on a light table. The result of this process of converting an analog diapositive image to a digital file may be a reduction in the photographic resolution. A potential consequence of this in the realm of aerial photographic analysis is a lower confidence in the identification of features or conditions of environmental significance. For example, what may have been identified with certainty as "a drum" on the analog version of the diapositive may, on the digital diapositive, only be determined to be "a probable drum."

Color Infrared Photographs

Some photographs used for this analysis were made from color infrared film. Normal color film records reflected energy in the blue, green, and red portions of the electromagnetic spectrum. Color infrared film differ

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in that it is sensitive not only to reflected blue, green, and red energy, but also to reflected energy in the infrared portions of the electromagnetic spectrum; however, the blue energy is filtered out and only the green, red, and infrared energy is recorded. When color infrared film is processed, it displays "false" colors that do not correspond with the true colors of the features photographed. For example, features that are highly reflective in the infrared portion of the spectrum, such as healthy vegetation, appear red to magenta on color infrared film. The false color displayed by a feature is produced in accordance with the proportions of green, red, and infrared energy it reflects. These portions are referred to as the "spectral reflectance characteristics" of the feature. To interpret the true color of a particular feature accurately from color infrared film, a knowledge of the spectral reflectance characteristics of that feature is required. This information is not readily available for the majority of features identified in this report. Therefore, unless otherwise indicated, no attempt has been made to interpret the true colors of the features identified on the color infrared film analyzed for this report.

Surface Drainage

The surface drainage analysis produced for this report identifies the direction and potential path that a liquid spill or surface runoff would follow based on the topography of the terrain and the presence of discernible obstacles to surface flow. The analyst determines the direction of surface drainage by stereoscopic analysis of the aerial photographs and by examining USGS topographic maps. Site-specific surface drainage patterns are annotated on the map or photo overlay. Where the direction of subtle drainage cannot be determined, an indeterminate drainage line symbol is used. Regional surface flow is ascertained from the USGS topographic maps.

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HISTORICAL PHOTOGRAPHIC ANALYSIS

The Santa Susana Field Laboratory-Area IV, located south of Simi Valley in Ventura County, California, covers approximately 117 hectares (290 acres). Surface elevations range from approximately 658 meters (2,160 feet) above sea level in the southwestern part of Area IV to about 525 meters (1,725 feet) above sea level near the northwestern part of Area IV (USGS, 1967). The Santa Susana Field Laboratory-Area IV is bounded by undeveloped land to the north, west, and south; and to the east by Area III of the Santa Susana Field Laboratory-Area III.

The location of the future Santa Susana Field Laboratory-Area IV (i.e., before the laboratory had been built) is depicted on Figure 3 (December 22, 1952). At that time no buildings or other features associated with the Santa Susana Field Laboratory-Area IV had been constructed. A small agricultural area (AG), several roads (not annotated), trees and shrubs, grasses (VEG), and numerous rock outcrops or bedrock (not annotated) were visible. South of the Santa Susana Field Laboratory-Area IV were several residential homes (RES) and impoundments which contained liquid (LQ).

Drainage patterns are shown on the photographic overlay for 1952 (Figure 3). Most of the runoff from the northern part of Area IV trends north into Meire Canyon. Runoff in the southern part of Area IV is directed to the south and southeast into the future location of Santa Susana Field Laboratory-Area III. Offsite impoundments are shown on the photographic overlays.

For the remainder of this report the Santa Susana Field Laboratory-Area IV will be divided into the west section (Figures 4 through 15) and the east section (Figures 16 through 27).

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An asterisk (*) is used in the text to denote dates of photography not reproduced in the report. For example, if the text reads: "A fill area was seen in 1993*.", the fill area was visible on the 1993 photographs which were not reproduced in the report.

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WEST SECTION OF THE SANTA SUSANA FIELD LABORATORY-AREA IV

Figures 4 through 15 (1957 through 2005)

Solid Waste Management Units (SWMU) and Areas of Concern (AOC)

SWMU 7.1 - Building 56 Landfill

SWMU 7.1 - Building 56 Landfill is located at the terminus of access roads extending from unnamed roads and F Street in the northern part of the Santa Susana Field Laboratory-Area IV. This area was active in 1957 (Figure 4). Fill areas FA-3, FA-4 and FA-9, and waste disposal area WDA-3 were located on the Building 56 Landfill. In addition, in 1965 an excavation area (EX) was noted, and by 1967 the excavation pit was filled with liquid. Liquid was in this excavation through the remainder of the analysis.

FA-3: FA-3 is located at the head of a drainage ravine. An access road extends north from Arness Fire Road and terminates at this fill area. The deposition of light-toned material (LTM) occurred at this location before 1957 (Figure 4) and ended by 1967. In 1959 partial vegetation was observed on the surface of the fill area. No evidence of fill activity was observed in 1962/63, but by 1965 light-toned material had again been deposited near the head of the drainage ravine. This deposited material may have come from a nearby excavation area. Deposition slowed or ceased by 1967, and ground scars (GS) and scattered vegetation were observed. By 1972 this fill area was partially vegetated (PV) and approximately ten light-toned objects were observed. From 1978 through 2005, this fill area remained vegetated and there were no signs of disturbance.

FA-4: FA-4 is located on the eastern slope of a drainage ravine. An access road extending north from Arness Fire Road leads to this fill area. Deposition of light-toned material was initiated prior to 1957 (Figure 4) and the fill area remained active through at least 1980. In 1962/63 a collection of individual dump-truck-sized mounds of medium-toned material (MTM) were visible atop this fill area. The deposition of material that occurred between 1963/63 and 1965 increased the areal extent of this fill area. The collection of individual dump-truck-sized mounds of medium-ton

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material noted in 1962/63 could not be seen atop this fill area. These mounds had been removed or spread across the surface of the fill area. In 1967 no activity was observed and vegetation was noted and in 1972 light-toned material and partial vegetation were observed. In 1978 solid waste disposal activity was identified (see waste disposal area WDA-3 below) and the areal extent of this fill area had increased when compared to 1972. By 1980 the areal extent of this fill area appeared to have been expanded slightly compared to 1978, and uniform light-toned material and a mound of similar material were seen atop this fill area. In 1983 ground scars were observed. From 1986* through 2005 the fill area remained vegetated; however, in 2002* ground scars were identified.

FA-9: FA-9 is located immediately west of a liquid-filled excavation. Deposition of material occurred at FA-9 between 1980 and 1983 (Figure 12). By 1983 medium-toned material had been deposited in the drainage channel adjacent to the excavation. No further deposition activity was noted, and by 1988 this fill area was partially vegetated. In 1994* and 1995, ground scars were present. From 1998* through 2005 this area remained vegetated.

WDA-3: In 1978 solid waste disposal activity was visible at two locations atop FA-9 (Figure 10). Alongside the access road leading onto FA-4 was a small pile of possible solid waste (SW). By February 1980*, dump-truck-sized mounds of uniform light-toned material were identified atop the landfill and may have been used to cover the possible solid waste. No additional solid waste deposition activity was observed at this location through the remainder of this analysis.

SWMU 7.3 - Former Sodium Disposal Facility (FSDF)

SWMU 7.3 - Former Sodium Disposal Facility is located in the far western part of the Santa Susana Field Laboratory-Area IV, north of Arness Fire Road. This area was active by 1957 (Figure 4) and fill area FA-1 was in place. Waste disposal area WDA-1; impoundments IM-2, IM-3, and IM-7; and fill area FA-1 are located on the Former Sodium Disposal Facility. In addition, trenches (TR), stains (ST), and dark-toned material (DTM) were also visible on the Former Sodium Disposal Facility.

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By 1993* an excavation that encompassed impoundments IM-2, IM-3, and IM-7 had been initiated. The area of excavation was slightly larger in areal extent than the three impoundments. The ground surface on the excavation was mostly covered with dark-toned material, and heavy equipment (HE) was noted nearby. Excavation activity continued through at least 1998*. During this time, the ground surface was mostly composed of uniform light- and dark-toned material and pools of standing liquid (SL) were also noted. By 2002* this area had been filled. In 2005 dark-toned material was observed at this location.

WDA-1: By 1959 (Figure 4) light-toned solid waste material had been deposited on WDA-1. In 1962/63 only a ground scar and probable disposal activity were visible within a trench at this location. By 1965 the trench had been filled. A possible trench extending to the north, which terminated near a rock outcrop, was seen nearby. By 1967 the possible trench was no longer observed and may have been filled. In 1978 two possible derelict (DER) storage tanks were seen near a rock outcrop. Also in 1978, a possible burn area and disturbed ground (DG) were visible on and along the western containment berm (not annotated) of impoundment IM-3. This area was stained in 1980 and possible stains were noted in 1983.

IM-2: In 1965 (Figure 7) and 1967 this earthen-bermed (not annotated) impoundment contained liquid. In 1967 portions of this impoundment were used as a possible burn pit. In 1972 the level of liquid in the impoundment was less when compared to 1967. Also visible in 1972 was a drainage pathway, which extended northward from a ground scar near this impoundment to a vegetated area, situated between rock outcrops (not annotated). Liquid continued to be observed in the impoundment through 1978. By February 1980* the impoundment was empty. Ground scars could be seen in 1983. In 1988 stains (possibly burned) and ground scars were visible. By 1993* an excavation that encompassed impoundment IM-2 had begun.

IM-3: This earthen-bermed impoundment was first noted in 1972 (Figure 9) and contained liquid. In 1978 no liquid was identified, but a possible burn area and disturbed ground were visible on and along the western containment berm (not annotated). Stained ground was identified in September 1978* and February 1980*. Possible stains and ground scars cou

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be seen from 1983 to 1988. Immediately to the west were ground scars located along a drainage channel. By 1993* an excavation that encompassed impoundment IM-3 had begun.

IM-7: First seen in 1965 (Figure 7) this possible impoundment was located on a raised rectangular-shaped pad in the southern part of the denuded area. From 1965 to 1988 possible liquid was noted. In 1988 a man-made drainage ditch was visible west of IM-7, alongside Arness Fire Road, near a building (not annotated). The ditch ran along the north side of Arness Fire Road, then north through a vegetated area, before terminating between rock outcrops. By 1993* an excavation that encompassed impoundment IM-7 had begun.

FA-1: By 1957 (Figure 4) light-toned material had been deposited at this fill area, which is located between rock outcrops at the terminus of an access road. By 1959 deposition activity appeared to have ceased. Parts of the surface were graded (GR) and supported possible vegetation (not annotated). In 1962/62 approximately six light-toned objects (LT OBJ), approximately one-fourth the size of an automobile, and a rectangular-shaped graded area were noted. In 1965 light-toned material and vegetation were noted, and by 1972 the fill area was partially vegetated. In 1978 stains were present and immediately northwest of the fill area was a possible pit. The surface of this fill area remained disturbed through at least 1983. Ground scars and vegetation were noted through 1988. By 1995 the fill area was mostly vegetated. In 2002* through 2005 this fill area was covered with a dark-toned material.

SWMU 7.5 - Building 100 Trench

The SWMU 7.5 - Building 100 Trench is located between G Street and the SWMU 7.1 - Building 56 Landfill. Several trenches and rectangular-shaped ground scars were observed near this location from 1959 (Figure 5) through 1967. Probable waste disposal area WDA-2 was located within one of the trenches.

WDA-2: In 1959 (Figure 5) a possible excavation area was noted. By 1962/63 a probable waste disposal was visible within a rectangular-shaped trench just north of G Street. Near this trench was a mound of medium-

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toned material (MTMM) likely excavated from the trench. In 1965 evidence of waste disposal activity and the rectangular-shaped trench was no longer visible. The trench appeared to be covered with light-toned material. T. additional open trenches could be seen nearby. One trench was located atop a mound of medium-toned mounded material. The second trench was alongside this mound. Also noted near this light-toned mound was an area of stained ground. By 1967 the trenches appeared to have been filled; the mound of medium-toned material remained. This mound could be seen until 1980.

Just to the west of the Building 100 Trench was a rectangular-shaped ground scar first observed in 1957. This ground scar could be the result of a former excavation and was visible through 1962/63.

SWMU 7.7 - Rockwell International Hot Laboratory (RIHL)

SWMU 7.7 - Rockwell International Hot Laboratory is a building located in the western part of the Santa Susana Field Laboratory-Area IV, alongside 24th Street. This building appeared to be in use when first observed in 1959 (Figure 5). The building was removed before 1998*. During this analysis, a smokestack (SS), four possible horizontal storage tanks (HT), probable stains, and open storage area OS-16 were observed attached to or adjacent to this building.

OS-16: OS-16 contained material from 1962/63 (Figure 6) to 1998*. In 1962/62 possible stains were noted. Through 1972 no environmentally significant conditions or features were identified at this open storage area. In 1978 possible drums (DR) were noted and in 1980 possible stains were observed. From 1983 through 1998*, no environmentally significant features or conditions could be identified at this open storage area.

SWMU 7.9 - ESADA Chemical Storage Area (ESADA)

SWMU 7.9 - ESADA Chemical Storage Area is located in the far western part of the Santa Susana Field Laboratory-Area IV, south of Arness Fire Road. In 1959 (Figure 5), a possible trench alongside Arness Fire Road and two linear (LIN) ground scars were observed. By 1962/63 the trench alongside the road had been widened. A second trench, thinner and located perpendicular to Arness Fire Road, was visible at the same location of th

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ground scar seen on the 1959 photographs. In 1965 two buildings had been constructed that were connected by an aboveground pipeline. A trench extending almost parallel to Arness Fire Road ended at a probable ground scar. By 1967 two trenches extending north-south were identified between Arness Fire Road and the buildings. In 1972 dark-toned material was observed and the two trenches seen in 1967 appeared to be closed. On the 1978 photographs, a horizontal storage tank was noted. By 1980 two new buildings had been constructed and numerous containers (CONT) were present. Containers continued to be identified through 1983. By 1986* these containers had been removed. In 1995 a mound of uniform light-toned material was visible, but most structures at the ESADA had been removed.

AOC - Chemistry Laboratory Metals Clarifier (CLMC)

The AOC - Chemistry Laboratory Metals Clarifier is located immediately north of G Street. The Chemistry Laboratory Metals Clarifier is an impoundment (IM-6) and appears to be part of processing area PA-4 (see Processing Areas section of this report).

IM-6: Impoundment IM-6 was first observed on the 1978 photographs (Figure 10) but no liquid was visible within the impoundment. By September 1978* probable liquid was noted. From February 1980* through 1986* the impoundment appeared to be dry. In 1987* liquid was observed, and in 1988 possible liquid was noted. In 1990* through 1995, liquid could be identified within this impoundment. Possible liquid was noted in 1998*. Through the remainder of the analysis period medium-toned material was observed.

AOC - Pond Dredge Area (PDA)

The AOC - Pond Dredge Area is located near the western terminus of J Street. This area contains fill areas FA-13 and FA-14.

The eastern part of the Pond Dredge Area was active in 1990*; light-toned mounded material (LTMM) was noted within an excavation area. The volume of light-toned material increased through 1993*. Dark-toned mounded material (DTMM) was also seen in 1993*. In 1994* and 1995 (Figure 14), light-toned mounded material and mounded material covered with scattered

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vegetation were observed. By 1998* the excavation had been filled with material, forming fill area FA-13. This area remained undisturbed through 2005.

The western part of the Pond Dredge Area also was active in 1990*; piles of light-toned material were noted. By 1992* the surface was covered with light-toned material and appeared disturbed; no mounded material could be discerned. By 1993* mounds of both light- and dark-toned material covered the western part of the Pond Dredge Area forming fill area FA-14. This area remained undisturbed through 2005.

AOC - Systems for Nuclear Auxiliary Power (SNAP) Facility

The AOC - Systems for Nuclear Auxiliary Power Facility is a building located at the northern terminus of 20th Street. This building was first observed in 1965 (Figure 7). The building remained active through 1998*. Open storage areas (OS-9 and OS-10) are located on the AOC - Systems for Nuclear Auxiliary Power (SNAP) Facility. By 2002* the building appeared abandoned and the open storage areas near the building no longer contained material. By 2003* the building had been removed. During this analysis, a smokestack, vertical storage tanks (VT), and stains were observed attached to or adjacent to this building.

OS-9: OS-9 is located near the terminus of 20th Street. This open storage area was first observed as being in use in 1978 (Figure 10). The open storage area contained material until 1992*. In 1978 stained ground, probable stained ground, and a probable horizontal storage tank could be seen at this open storage area. No features or conditions of environmental significance were observed at this location in 1980. From 1983 through 1988, stains and probable stains were noted.

OS-10: OS-10 is located near the terminus of 20th Street. It was used to house material from 1978 (Figure 10) to 1998*. In 1978 probable stains and two vertical storage tanks were seen. Probable stains remained present at this open storage area through 1980. In 1983 this open storage area was no longer in use but was in use again in 1988. Possible and probable stains could be seen in 1995.

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Waste Disposal Areas

WDA-1: This waste disposal area is part of the SWMU 7.3 - Former Sodium Disposal Facility (see SWMU and AOC section of this report).

WDA-2: This waste disposal area may be part of the SWMU 7.5 -Building 100 Trench (see SWMU and AOC section of this report).

WDA-3: This waste disposal area is located atop the SWMU 7.1 - Building 56 Landfill (see SWMU and AOC section of this report).

Processing Areas

Figures 10 through 15

PA-4: This processing area is located on the northern side of G Street and includes the AOC - Chemistry Laboratory Metals Clarifier (see AOC - Chemistry Laboratory Metals Clarifier in this report). By 1972 (Figure 9) one building had been constructed at PA-4. From 1978 through 2005, additional buildings were constructed, impoundment IM-6 was added, and this processing area appeared to be active. During the analysis period, storage tanks, a crane, a smokestack, possible stains, and possible overhead pipelines (OP) were observed.

PA-5: This processing area is located between J and L streets. Buildings were visible at this location as early as 1957 (Figure 4), but environmentally significant activity was not observed until 1978. During the years of operation, probable storage tanks, stains, and probable overhead pipelines were observed. This processing area remained active through the early 1990s, after which, it appeared to be abandoned. By 2003* all structures related to this processing area had been removed from this location.

Open Storage Areas

Figures 6 through 15

Open storage areas house crates or containers of different sizes. All

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open storage areas identified in the analysis will be labeled on the photographic overlays. However, only open storage areas where environmentally significant activity was present will be discussed in the text.

OS-9: OS-9 is located near the AOC - Systems for Nuclear Auxiliary Power Facility (see SWMU and AOC section of this report).

OS-10: OS-10 is located near the AOC - Systems for Nuclear Auxiliary Power Facility (see SWMU and AOC section of this report).

OS-11: OS-11 is located near a building at the terminus of G Street. OS-11 was first noted as active in 1978 (Figure 10) and contained material until 1988. In 1978 possible stains and two possible tank pads were seen. In 1980 probable stains, possible debris (DB) and probable leakage from an unknown source near a building could be seen. Also visible in 1980 was a drainage pathway which directed liquid north through a vegetated area. This drainage pathway then appeared to be blocked by rock outcrops, resulting in a liquid collection area. Stains were also seen at this open storage area in 1983. No features or conditions of environmental significance could be identified after 1983.

OS-16: OS-16 is located alongside the SWMU 7.7 - Rockwell International Hot Laboratory (see SWMU and AOC section of this report).

OS-18: OS-18 is located just west of processing area PA-4. It was used to store material from 1986* (Figure 13) to 1995. Probable stains, horizontal storage tanks, possible debris and ground scars could be seen until 1995.

OS-22: OS-22 is located just north of processing area PA-4. Material was first noted in 1993* (Figure 14) but by 1998* all contained material was removed. In 1995 probable stains could be seen.

OS-23: OS-23 is located just south of processing area PA-4. It was used to house material from 1990* (Figure 14) to 1995. Stains and possible stains were identified through 1993*.

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Fill Areas

Figures 4 through 15

FA-1: FA-1 is part of the SWMU 7.3 - Former Sodium Disposal Facility (see SWMU and AOC section of this report).

FA-2: FA-2 is located at the head of a drainage ravine. An access road extends north from Arness Fire Road and terminates at this probable fill area. The deposition of light-toned material was initiated on FA-2 by 1957 (Figure 4) and terminated prior to 1962/63, when medium-toned material and ground scars were visible. By 1965 the fill area and the mound of material had become partially vegetated. Ground scars and scattered vegetation were noted in 1967 and the mound had been removed. From 1972 through 1987*, the fill area was vegetated and there were no signs of disturbance, but in 1988, possible disturbed ground was noted. From 1990* through 2005, this fill area remained covered with vegetation and no activity of environmental significance was observed.

FA-3: Fill area FA-3 is part of the SWMU 7.1 - Building 56 Landfill (see SWMU and AOC section of this report).

FA-4: Fill area FA-4 is part of the SWMU 7.1 - Building 56 Landfill (see SWMU and AOC section of this report).

FA-9: Fill area FA-4 is part of the SWMU 7.1 - Building 56 Landfill (see SWMU and AOC section of this report).

FA-10: FA-10 is located between G and J streets. Deposition activity was initiated after 1983 and ended prior to 1986*. Mounded material covered with vegetation was observed through 2005 and remained undisturbed.

FA-12: FA-12 is located within the boundary of the SWMU 7.3 - Former Sodium Disposal Facility (see SWMU and AOC section of this report).

FA-13: FA-13 is located within the boundary of the AOC - Pond Dredge Area (see SWMU and AOC section of this report).

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FA-14: FA-14 is located within the boundary of the AOC - Pond Dredge Area (see SWMU and AOC section of this report).

Impoundments

Figures 7 through 15

IM-2: This impoundment is part of the SWMU 7.3 - Former Sodium Disposal Facility (see SWMU and AOC section of this report).

IM-3: This impoundment is part of the SWMU 7.3 - Former Sodium Disposal Facility (see SWMU and AOC section of this report).

IM-6: This impoundment is identified in the collateral data as the AOC - Chemistry Laboratory Metals Clarifier located within processing area PA-4 (see SWMU and AOC section of this report).

IM-7: This impoundment is part of the SWMU 7.3 - Former Sodium Disposal Facility (see SWMU and AOC section of this report).

Miscellaneous Activity

1965 (Figure 7): Stained ground is observed to the north of G Street.

1978 (Figure 10): North of the terminus of G Street is a probable outfall (OF). Any liquid (none was observed) emitted from the probable outfall would flow north into a drainage ravine.

1980 (Figure 11): Dump-truck sized mounds of light-toned material are located within a borrow pit south of Arness Fire Road. The amount of mounded materials increased through 1983, but by 1988 this material had been removed.

1988 (Figure 13): Near J and L streets are two mounds comprised of tightly packed, dump-truck-sized piles of medium-toned material. Over time these mounds appeared to become weathered, compressed, and vegetated. By 2005 the mounds could not be discerned from the surrounding landscape.

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EAST SECTION OF SANTA SUSANA FIELD LABORATORY-AREA IV

Figures 16 through 27 (1957 through 2005)

Solid Waste Management Units (SWMU) and Areas of Concern (AOC)

SWMU 7.4 - Old Conservation Yard (OCY)

SWMU 7.4 - Old Conservation Yard is located in the far eastern part of the Santa Susana Field Laboratory-Area IV, north of E Street. The Old Conservation Yard was first seen as active on the 1957 photographs (Figure 16). It remained active through 1995, but by 1998* all contained material had been removed. Waste disposal area WDA-4, and open storage areas OS-3 and OS-4 are located within the boundary of the Old Conservation Yard.

WDA-4: WDA-4, noted in 1965 (Figure 19), contained possible waste and was located at the terminus of an access road. In 1967 probable debris was noted at this location.

OS-3: An open storage area was active at this location in 1959 (Figure 17), but no conditions of environmental significance were observed. In 1962/63 ground scars and debris were noted at this open storage area, and it contained material until 1978. Possible debris could be seen in 1965 and stains were discerned on the 1967 photographs. By 1967 the areal extent of this open storage area had been increased. By 1972 possible stains and possible debris were noted. By 1978 all material had been removed from this open storage area.

OS-4: An open storage area was active at this location in 1957 (Figure 16), but no features of environmental significance were observed. In 1959 possible stains were noted at this open storage area. Materials were contained at this location until 1998*. In 1959 through 1980, stains, probable stains, and possible stains were noted. Probable debris piles could be seen in 1983 but were removed prior to 1986*. In 1988 a tanker, several transportation trailers (TT), and possible stains were observed. Only transportation trailers were noted by 1995. Refuse containers and stains were identified in 1998* and were removed by 2002*. After 2002* ground scars and vegetation could be seen at this location.

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SWMU 7.6 - Radioactive Materials Handling Facility (RMHF)

SWMU 7.6 - Radioactive Materials Handling Facility is located at the north terminus of 12th Street atop a portion of fill area FA-8. The Radioactive Materials Handling Facility is comprised of several buildings and open storage facilities. This area was active from 1959 (Figure 17) through 2005. During this time period, overhead pipelines, a smokestack, stains, dark-toned material, and a crane were observed. In 1965 open storage area OS-1 and a possible aboveground pipeline were visible. This possible aboveground pipeline extended west to impoundment IM-4 (see Impoundments section of this report). This pipeline/drainage channel was observed throughout this analysis. From 1967 through 1980, an aboveground pipeline was seen extending from a building and terminating near the north end of this facility. In 1980 this aboveground pipeline appeared to enter a subsurface feature. In 1995 an area of stained ground was observed. By 2005 earth-moving activity was visible at the base of the Radioactive Materials Handling Facility.

OS-1: The open storage area was in use in 1962/63 (Figure 18), but features of environmental significance were observed. In 1965 possible stains were noted at this open storage area. Material was contained at this location through the remainder of the analysis period. Possible stains, probable stains, and stains were identified through 1978. Also noted in 1978 were probable debris and a possible crane. From 1980 through 1987*, no environmentally significant features or conditions were observed. In 1988 and 1990*, stains and probable stains were again identified. After 1990* no environmentally significant features or conditions were observed at this open storage area.

SWMU 7.8 - New Conservation Yard (NCY)

SWMU 7.8 - New Conservation Yard is located in the far eastern part of the Santa Susana Field Laboratory-Area IV, south of E Street. No activity was observed at this location until 1965 (Figure 19), when a possible construction area was observed along G Street. A building was added at this location by 1967. No environmentally significant features or conditions were noted with this building through the analysis period. In

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1978 an open storage area (OS-6) was observed. This New Conservation Yard remained active through at least 1998*.

OS-6: In 1978 (Figure 22) open storage area OS-6 was in use within the New Conservation Yard. This open storage area remained active through at least 1998*. Stains were first identified within this open storage area in 1978. From 1980 to at least 1983 possible debris and probable debris were identified. Also, a probable drainage ditch connected this open storage area to a natural drainageway to the south. This drainageway directs runoff toward an offsite impoundment. Stains continued to be seen until 1988 and possible stains were noted on the 1990* photographs. In 1995 refuse containers were seen and remained at this open storage through at least 1998*.

SWMU 7.10 - Former Coal Gasification PDU (FCG PDU)

SWMU 7.10 - Former Coal Gasification PDU, located on the eastern side of 17th Street, appears to be a processing area (PA-3). This area was active by 1959 (Figure 17). Additional buildings were added by 1965. By 2005 all structures had been removed from this location.

PA-3: Two buildings were observed at processing area PA-3 in 1959 (Figure 17). Additional buildings were constructed through 1965, when all main structures were in place. This processing area appeared to remain active through at least 1995. By 1998* several buildings and the storage tanks had been removed. By 2002* grounds scars and only one building were observed at this location, but by 2005 all the buildings had been removed. During the years of operation, storage tanks, overhead pipelines, a smokestack, open storage areas, stains and ground scars were identified. From 1978 to 1990* a probable conveyor connected processing area PA-3 to a coal storage area to the south. A drainage channel carried runoff from this processing area into impoundment IM-5 (see Impoundments section of this report) in 1965 and 1967.

AOC - Former Hazardous Materials Storage Area (HMSA)

The AOC - Former Hazardous Materials Storage Area is located near a

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group of buildings on the western side of 17th Street. The Former Hazardous Materials Storage Area is located on processing area PA-1 (see Processing Areas section of this report).

The Former Hazardous Materials Storage Area was first noted on the 1959 photographs (Figure 17). In 1959 a new building, a possible below ground/recessed area, and a possible stain were observed. The possible recessed area remained visible in 1962/63 and a possible underground storage tank (UST) was noted. These features could not be confirmed on the 1965 or 1967 photographs and no environmentally significant features could be seen in 1972. By 1978 a probable open storage area was observed housing approximately six to eight objects, each about one-fourth the size of an automobile (features not annotated). In 1980 probable staining was observed, and in 1983 and 1987* an area of dark-toned material was visible. By 1988 no environmentally significant features or conditions were noted. In 1990* and 1992*, areas of possible staining were noted. By 1993* this area no longer appeared active. In 1998* approximately twelve containers, each about the size of an automobile, were observed at this location. By 2002* the containers and the building had been removed from the Former Hazardous Materials Storage Area.

AOC - Sodium Reactor Experiment Area (SRE)

The AOC - Sodium Reactor Experiment Area is located at the terminus of E Street. It was active from 1957 (Figure 16) through 1998*. By 2002* all of the structures were removed from this area. Processing area PA-2, impoundment IM-1, and possible impoundment IM-8 are located on the Sodium Reactor Experiment Area.

PA-2: In 1957 (Figure 16) a collection of buildings was visible at this location. By 1967 a building with two cooling fans was removed. This processing area remained active through at least 1998*. By 2002* all structures had been removed. In 2002* ground scars and vegetation were seen at this location. During the years this processing area was operating, storage tanks, aboveground pipelines, overhead pipelines, open storage areas, stains, light- and dark-toned material, and trailers were identified. Connected to this processing area were several aboveground pipelines. On the 1978 and February 1980* photographs, an excavation are

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was noted alongside a building at this processing area. This excavation was filled by 1983.

An aboveground pipeline appeared to connect this processing area to a vertical storage tank located on a rock outcrop immediately to the north. This vertical storage tank was removed by 1978.

IM-1: A drainage channel leads from processing area PA-1 to this impoundment located at the head of a drainage ravine. In 1957 (Figure 16) saturated material was seen in this impoundment. From 1959 through 1983 liquid or possible liquid was observed within this impoundment. By 1986* the impoundment was dry. This impoundment supported vegetation through the remainder of the analysis period and was not utilized.

IM-8: In 1959 (Figure 17) no liquid could be seen in this possible impoundment. An aboveground pipeline appeared to extend from near this possible impoundment to processing area PA-2. By 1962/63 a light-toned object (LT OBJ) was visible at this location and this possible impoundment was likely inoperative.

AOC - SE Drum Storage Yard (SDSY)

The AOC - SE Drum Storage Yard is located near the southern boundary of the Santa Susana Field Laboratory-Area IV. This open storage area was visible only on the 1962/63 photographs (Figure 18) and contained containers at that time. No features or conditions of environmental significance were observed at this location through the analysis period.

Waste Disposal Areas

Figure 19 through 25

WDA-4: This waste disposal area is associated with the SWMU 7.4 - Old Conservation Yard (see SWMU and AOC section of this report).

WDA-5: In 1967 (Figure 20) a possible waste disposal area was noted atop an area of disturbed ground to the northwest of processing area PA-1. In 1972 only a ground scar and partial vegetation were observed.

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WDA-6: In 1978 (Figure 22), this possible waste disposal area was located alongside open storage area OS-7 and north of processing area PA-1 Possible solid waste and debris were identified at this location.

WDA-7: This probable waste disposal area is located west of processing area PA-2 on an area of disturbed ground. On the September 1978* photographs, a probable pit containing dark-toned material was observed at this location. By February 1980* the probable pit could not be identified; however, a mound of light-toned material was observed nearby. In October 1980 (Figure 23), the mound of light-toned material was no longer observed, and may have been spread on the ground surface at this location. In addition, a possible ground stain was noted.

WDA-8: In 1988 (Figure 25) this waste disposal area could be seen adjacent to the southern side of G Street. In 1988 solid waste, debris, stains, and disturbed ground were observed. Probable debris was noted at this location in 1987* and in June 1990*. No further activity was observed, and by 1995 this area was partially vegetated.

Processing Areas

Figures 17 through 27

PA-1: This processing area is located on 17th Street and is comprised of several buildings constructed between 1957 and 1959 (Figure 17). A building with two cooling fans was added to this area by 1965. This processing area appeared to be operational until 1998*. From 1959 through 1998* storage tanks, overhead pipelines, stains, open storage areas, a smokestack, and a possible crane were observed. Runoff from this processing area appeared to be directed south and into impoundment IM-5 (see Impoundments section of this report). In 1988 a new grouping of overhead pipelines was observed. These pipelines extended north from this processing area, to a building near a new structure with four cooling fans. By 2003* most structures comprising this processing area had been removed, and only two buildings were observed. The AOC - Former Hazardous Materials Storage Area is associated with this processing area (see SWMU and AOC section of this report).

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PA-2: Processing area PA-2 is part of the AOC - Sodium Reactor Experiment Area (see SWMU and AOC section of this report).

PA-3: Processing area PA-3 coincides with the SWMU 7.10 - Former Coal Gasification PDU facility (see SWMU and AOC section of this report).

PA-6: This processing area is located atop fill area FA-5 just west of the AOC - Sodium Reactor Experiment Area. A building was first observed at the PA-6 location in 1978 (Figure 22). By 1980 the building appeared surrounded by an open storage area (OS-14) and in 1983, stains were noted at this location. From 1988 to 1998*, storage tanks, stains, an overhead pipeline, a revetment, open storage, dark-toned material, and medium-toned mounded material were identified on the area. By 2002* only the building and a vertical storage were observed.

Open Storage Areas

Figures 17 through 27

OS-1: OS-1 coincides with the SWMU 7.6 - Radioactive Materials Handling Facility (see SWMU and AOC section of this report).

OS-2: OS-2 is located immediately south of the SWMU 7.6 - Radioactive Materials Handling Facility. This area was first noted in use in 1967 (Figure 20). Stains were identified on the 1967 photographs. From 1972 through 1990*, this open storage area was infrequently used and no environmentally significant conditions or features were noted during this time period.

OS-3: OS-3 is encompassed within the SWMU 7.4 - Old Conservation Yard (see SWMU and AOC section of this report).

OS-4: OS-4 is encompassed within the SWMU 7.4 - Old Conservation Yard (see SWMU and AOC section of this report).

OS-6: OS-6 is encompassed within the SWMU 7.8 - New Conservation Yard (see SWMU and AOC section of this report).

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OS-7: OS-7 is located just north of processing area PA-1. It was first noted in use in 1978 (Figure 22) but by 1980 all material had been removed. Probable stains were noted at this open storage area.

OS-13: OS-13 is located near impoundment IM-4. Possible stains were noted in 1980 (Figure 23) through 1983. Heavy equipment (HE) was also seen in 1983. By 1988 contained material and heavy equipment were removed from this open storage area.

OS-14: This open storage was in use west of the AOC - Sodium Reactor Experiment Area in 1980 (Figure 23). No environmentally significant activity was observed that year. In 1983 possible stains were noted within open storage area OS-14. In 1988 this open storage became a component of processing area PA-6 (see Processing Areas section of this report). By 1993* this open storage area was no longer in use.

OS-15: OS-15 is located near the intersection of G and 20th streets. It contained material from 1962/63 (Figure 18), when stains were observed, to 1967. Probable and possible stains could be seen in 1967.

OS-17: OS-17 is located near the intersection of 12th and G streets. It contained material from 1978 (Figure 22) until 2003*. No environmentally significant features were noted until 1988 when stains were observed. These stains could also be seen in 1995. A pool of possible standing liquid was also observed in 1995. Possible stains were observed through 2002*. In 2003* no environmentally significant activity was noted at this open storage area.

OS-19: OS-19 is located north of processing area PA-3 (Figure 26). It contained material from 1990* to 2003*. In 1994* stains were observed. Probable stains continued to be observed in 2002*.

OS-20: OS-20 is located near the intersection of G and 17th streets (Figure 26). It contained material from 1993* through 2005. In 1995 dump-trucks (not annotated), probable refuse containers and stains could be seen. After 1998* no environmentally significant features or conditions could be identified.

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OS-24: OS-24 is located near a building adjacent to 10th Street (Figure 26). It contained material from 1992* to 2002*. From 1995 through 2002*, probable and possible stains could be seen. In 2003* dark-toned material was identified and in 2005, ground scars were evident.

Fill Areas

Figures 16 through 27

FA-5: FA-5 is located at the head of a ravine immediately west of the AOC - Sodium Reactor Experiment Area. Deposition activity was initiated after 1954*, and by 1957 (Figure 16) uniform light-toned material was seen at this fill area. From 1959 through 1962/63 deposition activity continued. In 1962/63 the fill area had been configured into an upper section and a lower section. By 1965 deposition activity appeared to have ceased. From 1967 through 1972 no activity was observed. In 1978 a building had been constructed on this fill area, and by 1988 processing area PA-6 was visible (see Processing Areas section of this report).

FA-6: FA-6 is located near the intersection of G and E streets. Deposition activity commenced after 1954*, and by 1957 (Figure 16) uniform light-toned material (not annotated) had been placed and graded at this location. By 1959 a parking area has been constructed on this fill area.

FA-7: FA-7 is located in the far northeast part of Santa Susana Field Laboratory-Area IV. Part of the SWMU 7.4 - Old Conservation Yard (see SWMU and AOC section of this report) is located atop this fill area. By 1965 (Figure 19) uniform light-toned material had been deposited on FA-7. Deposition activity continued through at least 1967, increasing the areal extent of this fill area. By 1972 deposition activity appeared to have ceased.

FA-8: FA-8 is located north of processing area PA-1 along the north boundary of the Santa Susana Field Laboratory-Area IV. Deposition activity commenced after 1957, and by 1959 (Figure 17) uniform light-toned material had been deposited. The areal extent of this fill area increased marginally by 1962/63. Deposition activity ceased thereafter, and in 1965 no changes to areal extent could be identified. The SWMU 7.6 - Radioactive

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Materials Handling Facility (see SWMU and AOC section of this report) was constructed atop this fill area.

FA-11: FA-11 is located south of the intersection of G and 20th streets (Figure 23). In February 1980* two mounds of material composed of smaller, dump-truck-sized mounds were on the fill area. Deposition activity continued through the mid-80s, and by 1988 material had been added to the mounds forming one large mound. Through the remainder of this analysis, no environmentally significant activity was noted at this fill area and it became vegetated.

Impoundments

Figures 16 through 27

IM-1: This impoundment is located on the AOC - Sodium Reactor Experiment Area (see SWMU and AOC section of this report).

IM-4: This impoundment, first seen in 1965 (Figure 19), is located to the west of the SWMU 7.6 - Radioactive Materials Handling Facility, atop fill area FA-8. In 1965 liquid was observed within this impoundment. A possible aboveground pipeline/drainage channel was seen near the impoundment from 1965 through 2005, and appeared to direct runoff from the SWMU 7.6 - Radioactive Materials Handling Facility into this impoundment. Liquid was observed in the impoundment at least through 1978, and in 1980 the impoundment was empty. In 1983 possible liquid was noted. Through the remainder of the analysis period, liquid or possible liquid was identified within this impoundment.

IM-5: This impoundment is located south of the intersection of G and 17th streets. From 1965 (Figure 19) through at least 1967, liquid was observed within this impoundment. Runoff from processing area PA-1, including the AOC - Former Hazardous Materials Storage Area, and the SWMU 7.10 - Former Coal Gasification PDU, may have been directed into this impoundment. In 1972, the impoundment appeared empty and dense vegetation was identified within it. This impoundment was not utilized through the remainder of this analysis; however, a drainage pathway was visible at the location.

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IM-8: This possible impoundment is located within the AOC - Sodium Reactor Experiment Area (see SWMU and AOC section of this report).

Miscellaneous Activity

1957 (Figure 16): A possible underground structure with an adjoining possible smokestack is observed near 12th Street. It was last observed in 1967.

1959 (Figure 17): Medium-toned mounded material, light-toned mounded material (LTMM) including a mound with a cover tarp, and light-toned material are located immediately north of the Former Coal Gasification PDU. This material was observed from 1959 through 1962/63.

1978 (Figure 22): A large swath of stained ground is located at the eastern boundary of the Santa Susana Field Laboratory-Area IV.

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GLOSSARY

Access Road (AR) - A paved or unpaved route of vehicular access.

Berm/Dike - An embankment of either natural or man-made materials that impounds liquids, solids or other materials, or controls flood waters.

Building (B) - A relatively permanent, essentially boxlike construction having a roof.

Cleared Area (CA) - An area from which man has removed trees, shrubs, or other natural vegetative cover.

Container (CONT) - Any portable device in which material is stored, transported, handled, or disposed.

Dark- (DT), Medium- (MT), or Light-Toned (LT) - Tones of features in question are compared with the darkest and lightest tones of gray (if using B&W photography) on the print.

Debris (DB) - The remains of anything that can be identified as being broken down, destroyed, demolished, or dismantled.

Disturbed Ground (DG) - A rough area where the ground surface has been dug up or overturned.

Excavation Area (EX) - An area where earth or other material is being removed in order to alter the ground level (e.g., building construction).

Face - The wall or slope of a mine, extraction, excavation, landfill, or fill area at which work is progressing (e.g., working face, fill face).

Fill (FL) - Earth, stones, or other material that is used to build up the level of an area of ground.

Fill Area (FA) - An area where material is being deposited to fill a depression; or area where materials have been added, altering the elevation of the ground surface.

Graded Area (GR) - An area where the surface of the ground has been leveled or altered by a vehicle pulling or pushing a wide blade.

Ground Scar (GS) - An area of bare soil, apparently the result of human activity.

Impoundment (IM) - A topographic depression, excavation, or diked area, primarily formed from earthen materials and designed to hold accumulated liquid.

Linear (LIN) - An adjective that describes the straight-line nature of features on the terrain or on maps and images.

Liquid (LQ) - Used when discussing impoundments, lagoons, catchment basins, or features that contain a liquid or when discussing discharge from outfalls, at storm drains, or tank trucks.

Material (M) - Raw or waste materials on or in the vicinity of the site.

Mounded Material (MM) - Piles of raw or waste materials on or in the vicinity of the site.

Outfall (OF) - The place where an effluent is discharged into the environment.

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Open Storage Area (OS) - An area of open-air (outdoor) storage of containerized, raw or waste materials, within industrial or manufacturing sites.

Processing Area (PA) - A grouping of buildings and associated structures (storage tanks, pipelines, impoundments, open storage areas) focused on research, design, assembly, production, and testing of products and equipment.

Solid Waste (SW) - Any discarded material other than fluids, including solid or semi-solid material resulting from industrial, commercial, mining, and agricultural operations, and from community activities.

Stain (ST) - A residue or discoloration resulting from a spill, discharge, or removed/dispersed materials.

Standing Liquid (SL) - A small, shallow, temporary collection of liquid, not necessarily waste.

Tanks - Vertical tanks (VT), horizontal tanks (HT), pressure tanks (PT), tank farms, and solid waste management units. A large receptacle, container, or structure for holding liquid or gas.

Trench (TR) - A long, narrow excavation unrelated to drainage.

Waste Disposal Area (WDA) - An area where waste materials are discarded.

Redacted

REFERENCES

MAPS

Source[a]	Figure	Name	Scale	Date
USGS	1	United States	1:2,500,000	1972
USGS	2	Calabasas, CA	1:24,000	1967
USGS	2	Santa Susana, CA	1:24,000	1969

COLLATERAL INFORMATION

EPA. 2009. Collateral data and site map supplied by EPA Region 9 as attachment to Remote Sensing Services Request Form.

LMS (Lockheed Martin Services). 2006. Master Quality Assurance Project Plan. Prepared for EPA Environmental Sciences Division. Contract EP-D-05-088. Las Vegas, Nevada.

California Environmental Protection Agency, Department of Toxic Substance Control website: RFI Site Location Map, Santa Susana Field Laboratory. http://www.dtsc-ssfl.com/files/maps/Fig_1-3_G6_Loc_Map.pdf: last visited 03/10/10.

AERIAL PHOTOGRAPHS

Photo source[a]	Figure[b]	Date of acquisition	Original scale	Film type[c]	Mission I.D.	Source frame #	EPIC ID #
NAS/VIP	-	04-07-39	1:20,000	B&W	AXI	23-25	150670-150672
USGS[d]	-	08-15-47	1:24,000	B&W	GS-EM	46-50	DI0000218
USGS[d]	-	08-24-47	1:24,000	B&W	GS-EM	14-18	DI0000218
USDA	3	12-22-52	1:20,000	B&W	AXI	29-31	86628-86630
USDA	-	01-03-53	1:20,000	B&W	AXI	5-8	86632-86635
WHIT	-	09-07-54	1:32,000	B&W	C20897	L:6A,7,7A,8, R:6A,7,7A,8	150932-150935, 150936-150939
USGS[d]	-	06-26-56	1:21,660	B&W	MPTF	914a,914b	DI0000224
EPA	4,16	08-17-57	1:24,000	B&W	C22962	64,65, 76,77	86637,86638, 86639,86640
USDA/FSA	5,17	08-21-59	1:20,000	B&W	AXI	141-143, 110-112	150785-150787, 150696-150698
WHIT	6,18	1962/1963	1:12,000	B&W	UNK	147,148, 131-133	150962,150963, 150955-150957
UCSB	7,19	03-01-65	1:36,000	B&W	251	60,61	86642,86643
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USGS[d]	8,20	08-13-67	1:30,000	B&W	GS-VBUK	100-104, 182-187	DI0000218, DI0000219
CASINC	9,21	04-20-72	1:48,000	B&W	107	10-4, 11-13,11-14	150720, 150721,150722
USGS[d]	-	07-02-73	1:32,500	CIR	UNK	165a,165b	DI0000224
PAS	10,22	05-16-78	1:24,000	CC	PW	152,153	86645,86646
USDA	-	09-21-78	1:40,000	B&W	06111	26-28	150716-150718
CASINC	-	05-12-79	1:24,000	B&W	FC-LA	2-242, 3-241	150725, 150727
EPA	-	02-00-80	1:40,000	B&W	VEN	5-28,5-30	86647,86648
USGS[d]	11,23	10-21-80	1:24,000	B&W	GS-VEZS	247-249	DI0000220
AIRPHO	12,24	08-21-83	1:36,000	B&W	UNK	V-66	150753
USDA/FSA[d]	-	08-29-86	1:60,000	CIR	HAP84	222-224	DI0000237
AIRPHO	-	01-10-87	1:18,000	B&W	UNK	V-67,V-66-2, V-75,V-76	150755,150756, 150757,150758
AIRPHO	-	01-12-87	1:18,000	B&W	UNK	LR-4	150759
PAS	13,25	10-10-88	1:24,000	CC	PWVEN	102-104	86649-86651
USGS[d]	-	07-18-89	1:40,000	CIR	NAPP	10,139-142	DI0000236

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AERIAL PHOTOGRAPHS

Photo source[a]	Figure[b]	Date of acquisition	Original scale	Film type[c]	Mission I.D.	Source frame #	EPIC ID #
CASINC	-	06-07-90	1:40,000	B&W	C82	18-20	150728-150730
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CASINC	-	05-10-93	1:24,000	B&W	C88	107-110, 137-139	150731-150734, 150735-150737
USDA/FSA	-	06-01-94	1:40,000	B&W	NAPP	195-198, 211-214	150707-150710, 150711-150714
CASINC	14,26	06-19-95	1:24,000	B&W	C113	113-115, 63-65	86652-86654, 150740-150742
CASINC	-	12-07-98	1:24,000	B&W	C-130	143-146 85-88	150743-150746, 150747-150750
USDA/FSA[d]	-	06-05-02	1:40,000	CIR	NAPP	230	DI0000236
USDA/FSA[d]	-	06-11-02	1:40,000	CIR	NAPP	273-275 285-288	DI0000236, DI0000236
USDA/FSA[d]	-	11-10-03	1:40,000	CC	NAIP03	DOQQ	DI0000238
USDA/FSA[d]	-	07-14-04	1:40,000	CC	NAIP04	DOQQ	DI0000238
USDA/FSA[d]	15,27	06-08-05	1:40,000	CC	NAIP05	DOQQ	DI0000238

[a]AIRPHO Air Photographics, Inc., Martinsburg, Virginia
CASINC Continental Aerial Surveys, Inc., Bartow, Florida
EPA United States Environmental Protection Agency, Environmental Sciences Division, Las Vegas, Nevada
NAS/VIP National Aerial Survey Center Corp./Visual Image Presentations, Silver Spring, Maryland
PAS Pacific Aerial Surveys, Oakland, California
UCSB University of California at Santa Barbara, Santa Barbara, California
USDA U.S. Department of Agriculture, Salt Lake City, Utah
USDA/FSA U.S. Department of Agriculture, Farm Service Agency, Salt Lake City, Utah
USGS U.S. Department of Interior, U.S. Geological Survey, Washington, D.C.
WHIT Fairchild Aerial Photography, Whittier College, Whittier, California
[b]Photographs listed with no figure number were analyzed but not placed in this report.
[c]B&W Black-and-white
CIR Color infrared
CC Conventional Color
[d]Digital diapositive (see Methodology section)

Redacted

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**FIGURE 1. SITE LOCATION MAP, CALIFORNIA (USGS, 1972).
APPROXIMATE SCALE 1:3,600,000**

Redacted

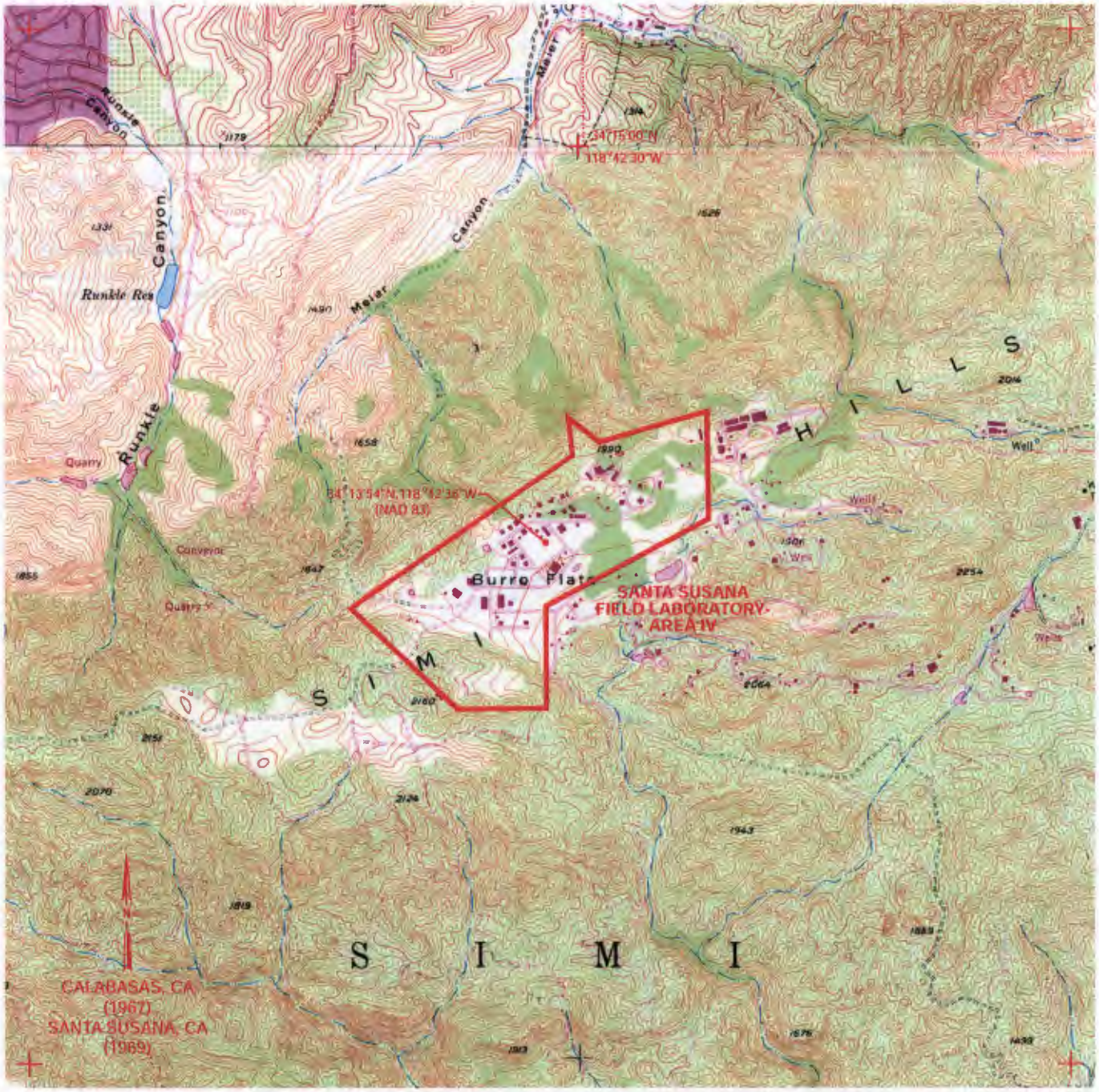

FIGURE 2. LOCAL SITE LOCATION MAP, CALABASAS, CA (USGS, 1967) AND SANTA SUSANA, CA (USGS, 1969). APPROXIMATE SCALE 1:14,370.

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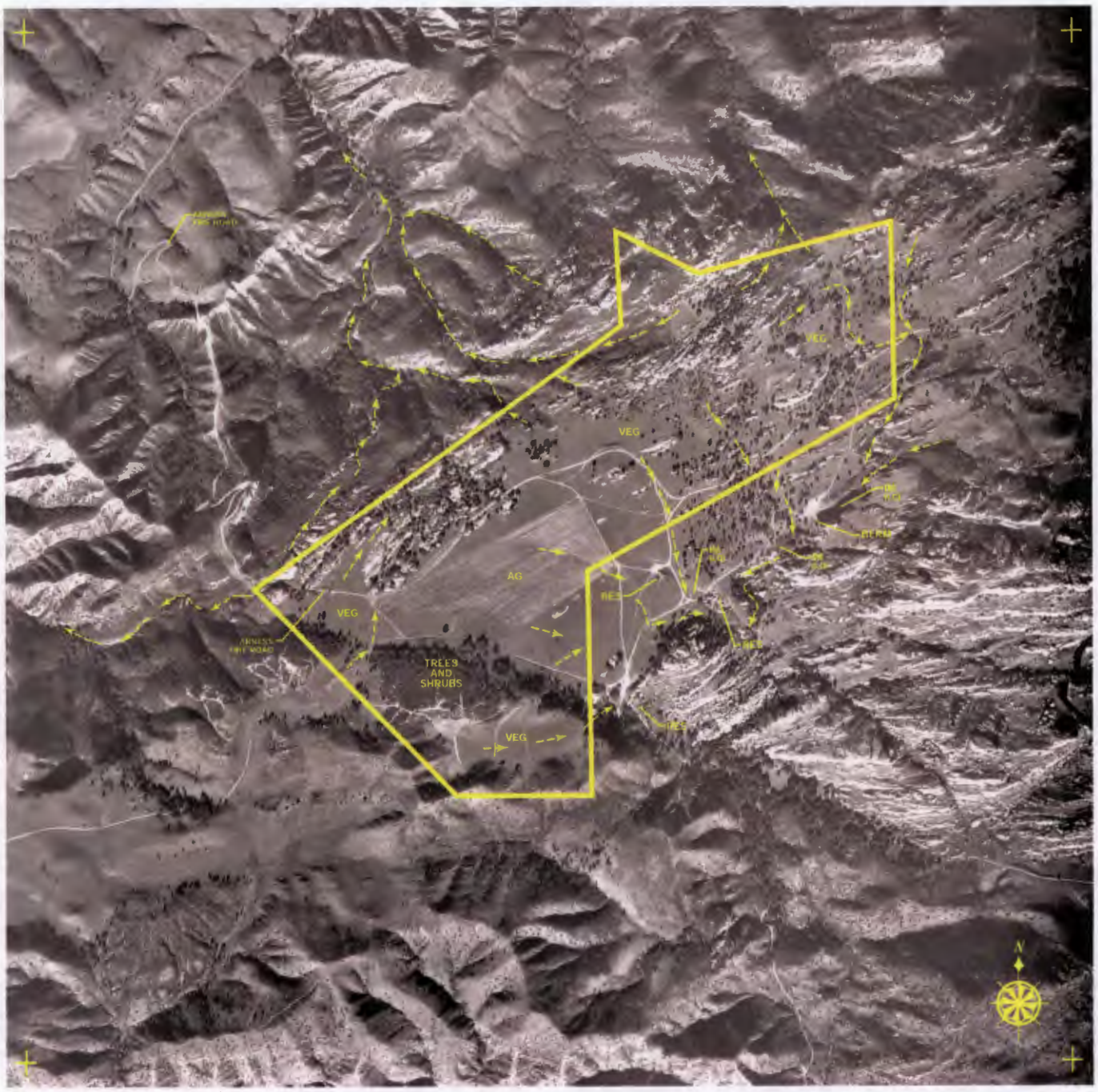

FIGURE 3. SANTA SUSANA FIELD LABORATORY - AREA IV, DECEMBER 22, 1952. APPROXIMATE SCALE 1:7,400.

Redacted

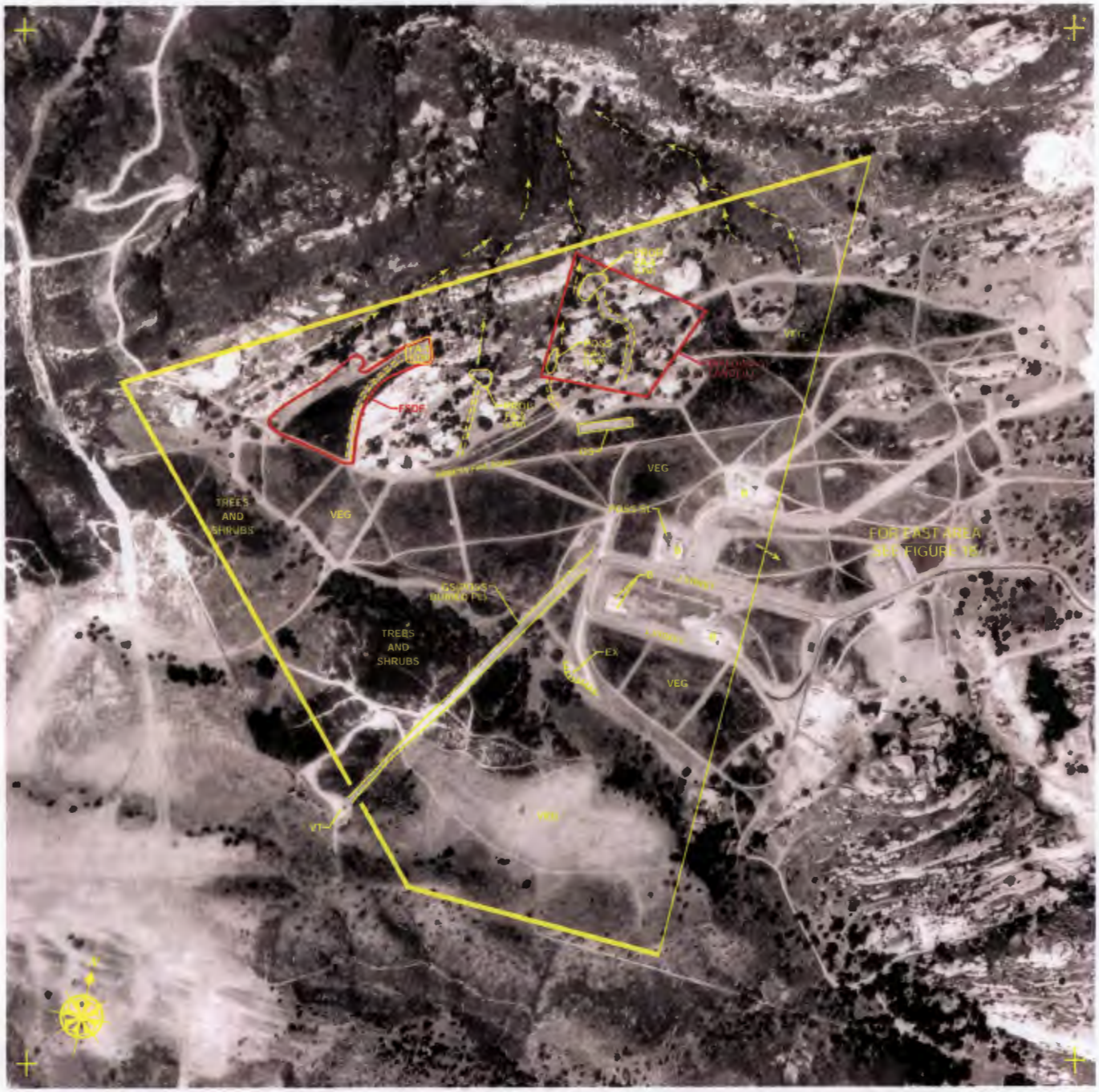

FIGURE 4. SANTA SUSANA FIELD LABORATORY - AREA IV, WEST SECTION, AUGUST 19, 1957. APPROXIMATE SCALE 1:3,750.

Redacted

FIGURE 5. SANTA SUSANA FIELD LABORATORY - AREA IV, WEST SECTION, AUGUST 21, 1959. APPROXIMATE SCALE 1:3,500.

Redacted

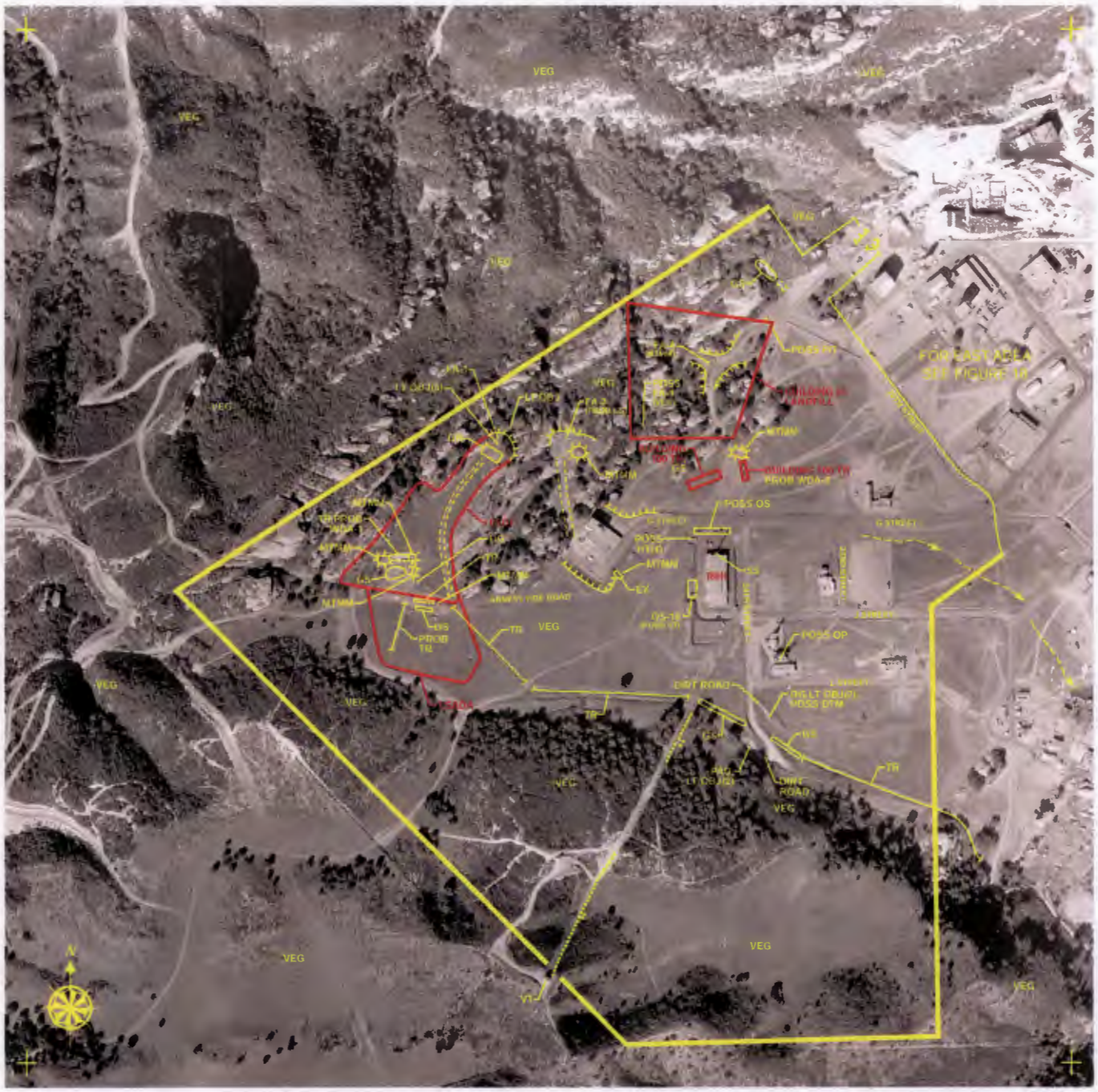

FIGURE 6. SANTA SUSANA FIELD LABORATORY - AREA IV, WEST SECTION, 1962/1963. APPROXIMATE SCALE 1:3,490.

Redacted

FIGURE 7. SANTA SUSANA FIELD LABORATORY - AREA IV, WEST SECTION, MARCH 1, 1965. APPROXIMATE SCALE 1:3,455.

Redacted

FIGURE 8. SANTA SUSANA FIELD LABORATORY - AREA IV, WEST SECTION, AUGUST 13, 1967. APPROXIMATE SCALE 1:3,430.

FIGURE 9. SANTA SUSANA FIELD LABORATORY - AREA IV, WEST SECTION, APRIL 20, 1972. APPROXIMATE SCALE 1:3,475.

FIGURE 10. SANTA SUSANA FIELD LABORATORY - AREA IV, WEST SECTION, MAY 16, 1978. APPROXIMATE SCALE 1:3,445.

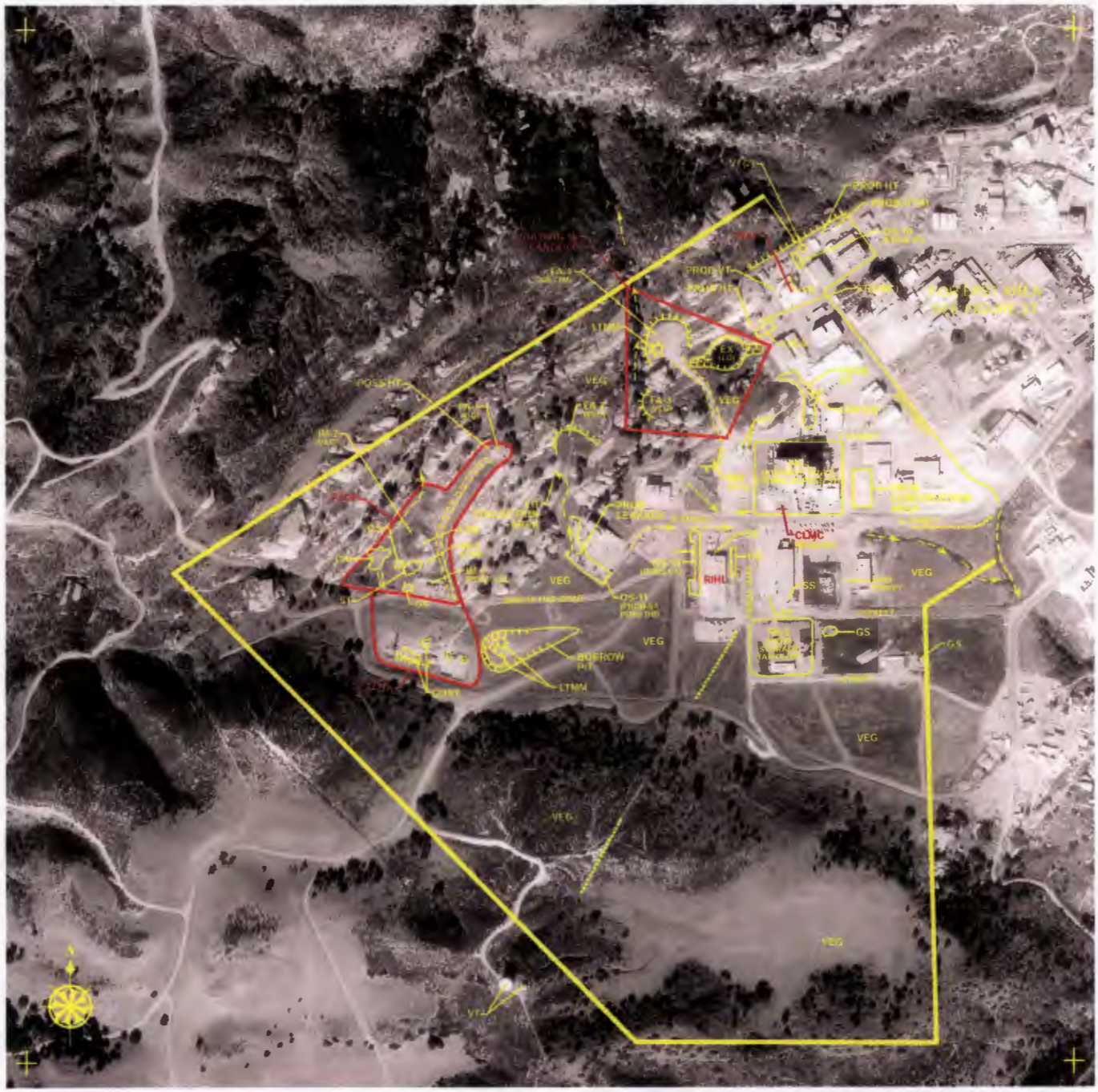

FIGURE 11. SANTA SUSANA FIELD LABORATORY - AREA IV, WEST SECTION, OCTOBER 21, 1980. APPROXIMATE SCALE 1:3,475.

FIGURE 12. SANTA SUSANA FIELD LABORATORY - AREA IV, WEST SECTION, AUGUST 21, 1983. APPROXIMATE SCALE 1:3,520.

Redacted

FIGURE 13. SANTA SUSANA FIELD LABORATORY - AREA IV, WEST SECTION, OCTOBER 10, 1988. APPROXIMATE SCALE 1:3,360.

FIGURE 14. SANTA SUSANA FIELD LABORATORY - AREA IV, WEST SECTION, JUNE 19, 1995. APPROXIMATE SCALE 1:3,445.

FIGURE 15. SANTA SUSANA FIELD LABORATORY - AREA IV, WEST SECTION, JUNE 8, 2005. APPROXIMATE SCALE 1:3,455.

Redacted

FIGURE 16. SANTA SUSANA FIELD LABORATORY - AREA IV, EAST SECTION, AUGUST 19, 1957. APPROXIMATE SCALE 1:4,020.

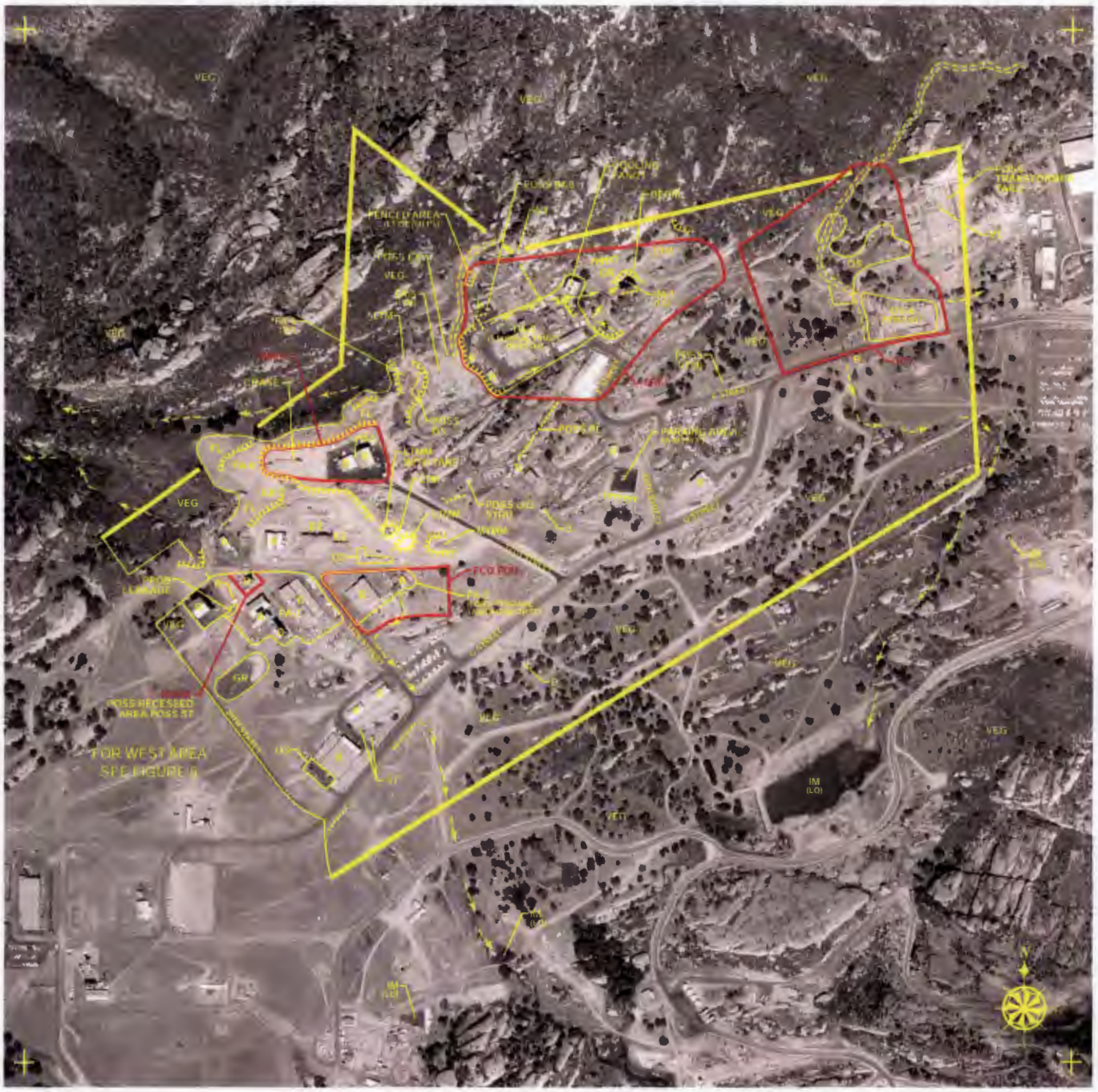

FIGURE 17. SANTA SUSANA FIELD LABORATORY - AREA IV, EAST SECTION, AUGUST 21, 1959. APPROXIMATE SCALE 1:3,430.

Redacted

FIGURE 18. SANTA SUSANA FIELD LABORATORY - AREA IV, EAST SECTION, 1962/1963. APPROXIMATE SCALE 1:3,380.

Redacted

FIGURE 19. SANTA SUSANA FIELD LABORATORY - AREA IV, EAST SECTION, MARCH 1, 1965. APPROXIMATE SCALE 1:3,440.

Redacted

FIGURE 20. SANTA SUSANA FIELD LABORATORY - AREA IV, EAST SECTION, AUGUST 13, 1967. APPROXIMATE SCALE 1:3,350.

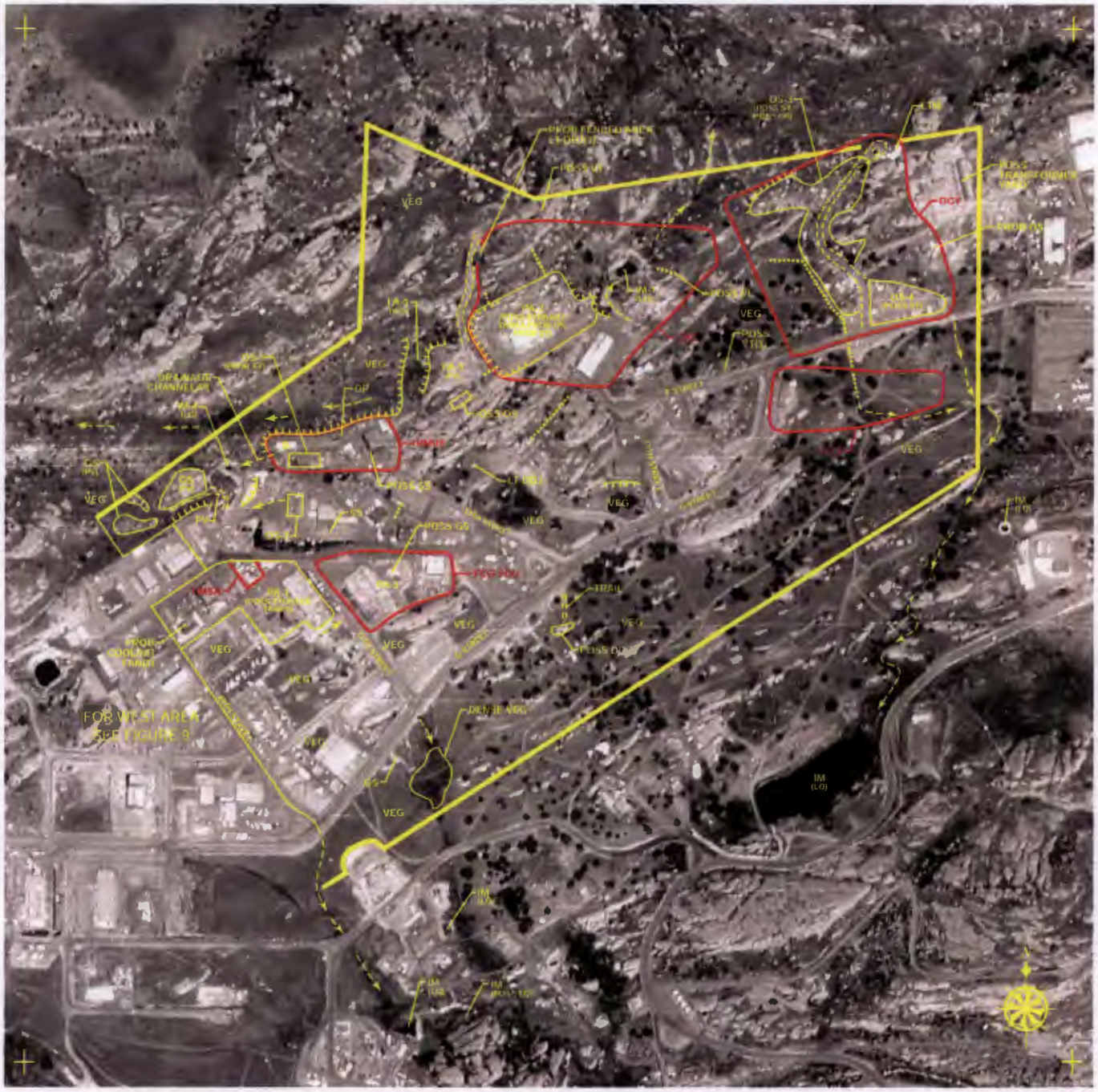

FIGURE 21. SANTA SUSANA FIELD LABORATORY - AREA IV, EAST SECTION, APRIL 20, 1972. APPROXIMATE SCALE 1:3,350.

Redacted

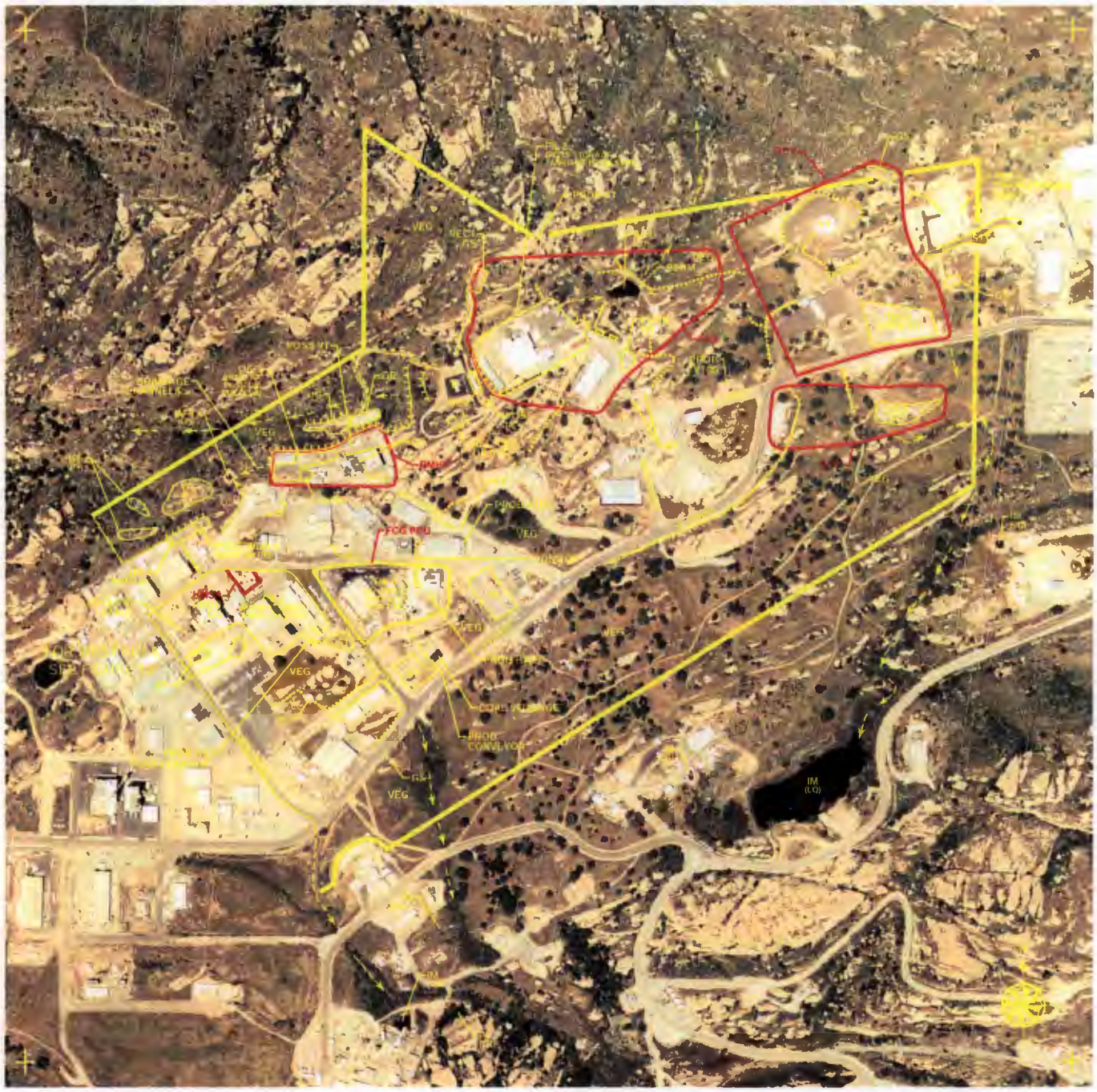

FIGURE 22. SANTA SUSANA FIELD LABORATORY - AREA IV, EAST SECTION, MAY 16, 1978. APPROXIMATE SCALE 1:3,415.

FIGURE 23. SANTA SUSANA FIELD LABORATORY - AREA IV, EAST SECTION, OCTOBER 21, 1980. APPROXIMATE SCALE 1:3,405.

Redacted

FIGURE 24. SANTA SUSANA FIELD LABORATORY - AREA IV, EAST SECTION, AUGUST 21, 1983. APPROXIMATE SCALE 1:3,455.

FIGURE 25. SANTA SUSANA FIELD LABORATORY - AREA IV, EAST SECTION, OCTOBER 10, 1988. APPROXIMATE SCALE 1:3,420.

FIGURE 26. SANTA SUSANA FIELD LABORATORY - AREA IV, EAST SECTION, JUNE 19, 1995. APPROXIMATE SCALE 1:3,390.

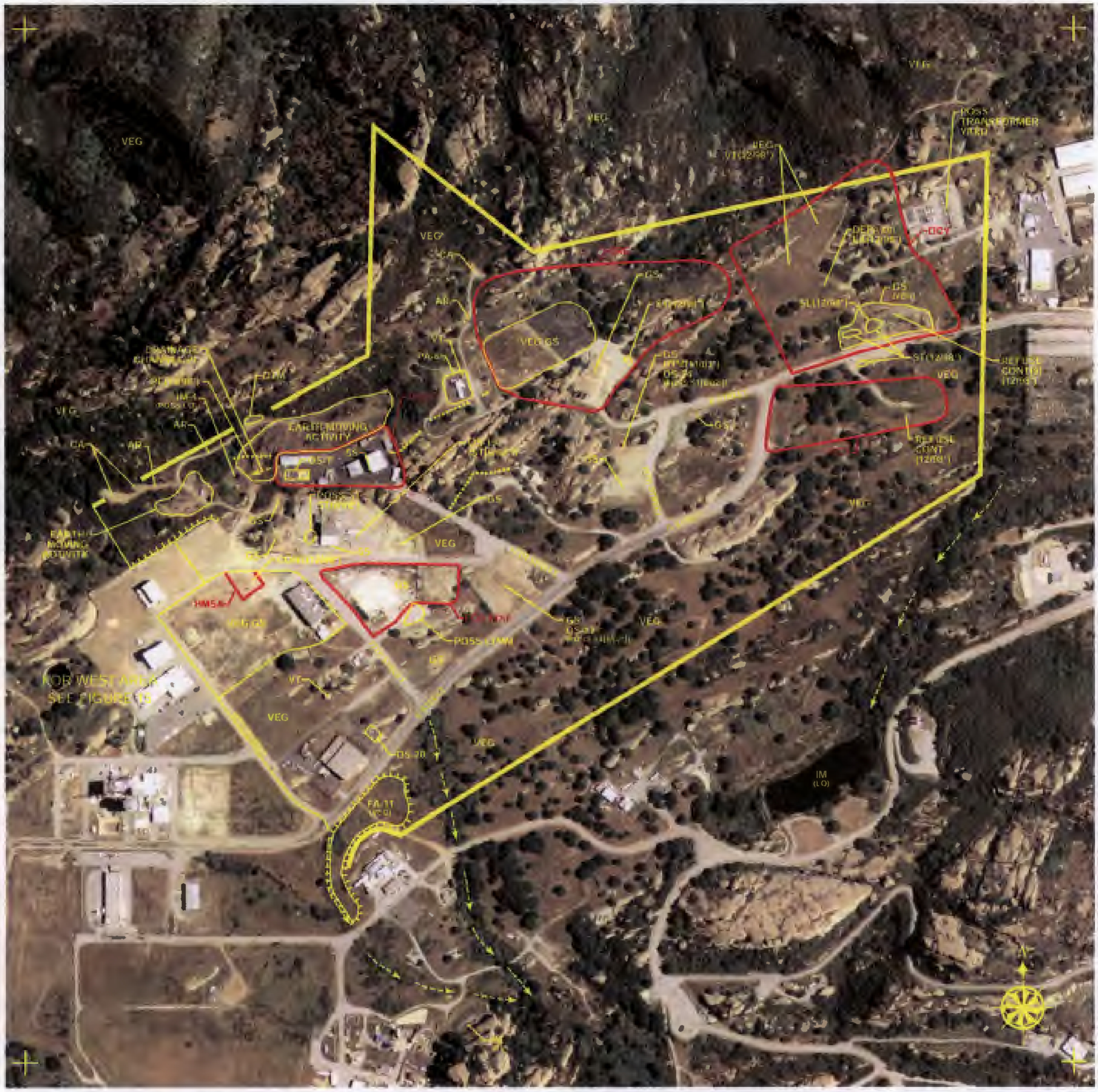

FIGURE 27. SANTA SUSANA FIELD LABORATORY - AREA IV, EAST SECTION, JUNE 8, 2005. APPROXIMATE SCALE 1:3,480.

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LEGEND

SITE BOUNDARY

DRAINAGE DIRECTION

ACCESS ROAD

ABOVEGROUND PIPELINE (PL)

MOUNDED MATERIAL

EXCAVATION/PIT

FILL FACE

BERM/DIKE

AG	AGRICULTURAL
AR	ACCESS ROAD
B	BUILDING
BF	BUILDING FOUNDATION
CA	CLEARED AREA
CONT	CONTAINER
CR	CRATES
CYL	CYLINDRICAL
DB	DEBRIS
DER	DERELICT
DG	DISTURBED GROUND
DEP	DEPRESSION
DT	DARK-TONED
EX	EXCAVATION
FA	FILL AREA
FL	FILL
GR	GRADED
GS	GROUND SCAR
HE	HEAVY EQUIPMENT
HT	HORIZONTAL TANK
IM	IMPOUNDMENT
LIN	LINEAR
LQ	LIQUID
LT	LIGHT-TONED
M	MATERIAL
MM	MOUNDED MATERIAL
MT	MEDIUM-TONED
OBJ	OBJECT
OP	OVERHEAD PIPELINE(S)
OS	OPEN STORAGE AREA
PA	PROCESSING AREA
PV	PARTIAL VEGETATION
RECT	RECTANGULAR
RES	RESIDENTIAL
REVEG	REVEGETATED
SL	STANDING LIQUID
SS	SMOKESTACK
ST	STAIN
STRU	STRUCTURE
SW	SOLID WASTE
TR	TRENCH
TT	TRUCK TRAILER
U/G	UNDERGROUND
UO	UNIDENTIFIED OBJECT
UST	UNDERGROUND STORAGE TANK
VEG	VEGETATED
VT	VERTICAL TANK
WDA	WASTE DISPOSAL AREA
~	APPROXIMATE
(M/YY*)	FINDING FROM PHOTO NOT REPRODUCED

Redacted

APPENDIX B

FINAL
FORMER EMPLOYEE INTERVIEW REPORT
SANTA SUSANA FIELD LABORATORY SITE
AREA IV RADIOLOGICAL STUDY
VENTURA COUNTY, CALIFORNIA

Prepared for:

EPA Contract Number: EP-S7-05-05
Task Order Number: 0038

U.S. Environmental Protection Agency, Region 7
901 North 5th Street
Kansas City, KS 66101
and
U.S. Environmental Protection Agency, Region 9
75 Hawthorne Street
San Francisco, CA 94105

Prepared by:

HydroGeoLogic, Inc.
5800 Woolsey Canyon Road, Building 204
Canoga Park, California 91304

October 2012

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HGL
HydroGeoLogic, Inc

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1.2	Purpose	2
2.0	METHODOLOGY	2
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Appendix A EPA Interview Script/Questions

Appendix B Sample Aerial Photograph Annotation

Appendix C DOE/EPA Joint Interview Script/Questions

Appendix D EPA Interview Summaries

Appendix E DOE/EPA Joint Interview Summaries

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LIST OF ACRONYMS AND ABBREVIATIONS

AEC	U.S. Atomic Energy Commission
AI	Atomics International
Boeing	The Boeing Company
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
ETEC	Energy Technology Engineering Center
HSA	historical site assessment
KEWB	Kinetics Experiments Water Boiler
NAA	North American Aviation, Inc.
RMHF	Radioactive Materials Handling Facility
SRE	Sodium Reactor Experiment
SSFL	Santa Susana Field Laboratory
STIR	Shield Test and Irradiation Reactor

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FINAL
FORMER EMPLOYEE INTERVIEW REPORT
SANTA SUSANA FIELD LABORATORY SITE
AREA IV RADIOLOGICAL STUDY
VENTURA COUNTY, CALIFORNIA

1.0 INTRODUCTION

This report presents the U.S. Environmental Protection Agency's (EPA's) efforts to interview former employees working in Area IV of the Santa Susana Field Laboratory (SSFL). The interview project was a critical component in developing an accurate historical site assessment (HSA) for the SSFL, as well as informing EPA's Area IV radiological characterization study.

1.1 Background

SSFL is located approximately 30 miles northwest of downtown Los Angeles, California, in the southeast corner of Ventura County. It consists of approximately 2,850 acres of hilly terrain. SSFL is separated into four administrative areas that reflect historical operations and ownership. Areas I, II, and III were used for rocket engine testing, while Area IV was used for nuclear research and development. EPA is currently conducting a radiological characterization study of Area IV.

In 1947, North American Aviation (NAA) established SSFL for testing of liquid-fueled rocket engines and associated components. Later uses of SSFL included nuclear energy research and development activities. NAA's rocket development division became known as Rocketdyne and the nuclear research division became known as Atomics International (AI). Rocketdyne later became part of Rockwell International Corporation and in 1996 was bought by The Boeing Company (Boeing).

Beginning in 1953, AI conducted two types of research sponsored by the U.S. Department of Energy (DOE), and its predecessor agency the U.S. Atomic Energy Commission (AEC): civilian nuclear energy research; and testing of liquid metals in non-nuclear components. These operations were conducted within 90 acres of SSFL Area IV. The facilities within these 90 acres would later be referred as the Energy Technology Engineering Center (ETEC).

The nuclear energy research activities became increasingly active from 1953 through the late 1960s. After that time, activities declined until 1988, when most nuclear operations ceased. A few facilities remained active beyond 1988. As a result of operations conducted at SSFL, many buildings and land areas became radiologically and chemically contaminated. Starting in the early 1990s and continuing to the present, DOE has been performing decontamination and decommissioning activities of the nuclear facilities in Area IV.

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1.2 Purpose

A key purpose of EPA's interview effort was to verify and add to the overall understanding of past operations at SSFL Area IV. First-hand knowledge from former employees was included as a component of EPA's HSA. The HSA, in turn, served to support decisions made for the Area IV radiological characterization study, specifically by directing soil sampling teams to potential source areas of radiological contamination. Interviewee information strengthened the accuracy and completeness of the HSA and helped to focus sampling efforts. Interviewees were able to provide operational information of interest including specific radionuclides of concern at SSFL; locations where radioactive material was used and handled; waste management and disposal practices; and descriptions of incidents, releases, or unusual occurrences. This information aided in the understanding of where potential contamination may exist. Accounts of SSFL operations by the employees who worked there provided confirmation of documented evidence, information lacking from the historical record, and a depiction of how standard operating procedures were put into practice. EPA's HSA summarized interviewee information as it pertained to specific building areas. The HSA was one of many lines of evidence EPA used to select soil sample locations in SSFL Area IV to further characterize the region.

2.0 METHODOLOGY

EPA's interview effort occurred in two phases: an effort by EPA alone, and a joint effort between EPA and DOE. DOE simultaneously conducted its own interview effort, which is described further in DOE's document titled *Santa Susana Field Laboratory Former Worker Interviews*. This section will describe the general interview process, including the identification, screening, and interviewing of former SSFL employees through both the EPA only and joint DOE/EPA efforts. It will also discuss the pursuit of follow-up interviews and protection of confidentiality.

The former employee interviews conducted by EPA and EPA/DOE were completed by multiple personnel in multiple teams. These personnel were all familiar with the SSFL site and the EPA/DOE missions at Area IV. Individual interviewers were as follows:

- Mr. Gregg Dempsey, EPA
- Mr. Andrew Taylor, EPA
- Ms. Kimberly Clower, HGL
- Ms. Wendy Green Lowe, P2 Solutions

2.1 General Process

Interviewees were identified directly by EPA and DOE in one of two manners: public advertising or direct mailing. To maintain privacy, DOE reached out to former SSFL employees originally through letters mailed by Boeing, while EPA initially solicited interviews through a public news release and newspaper advertisements. Additionally, former employees were identified indirectly through conversations with community stakeholders, document reviews, screening phone calls, and full interviews. These individuals also were sought out for interviews.

Upon receiving the name of a former employee through any one of the methods described above, EPA and/or DOE conducted research to determine or verify contact information and then reached out to the former employee via telephone. If the former employee was willing, a brief screening call was conducted to collect basic information, ensure the former employee worked in SSFL Area IV, and confirm whether the employee would be agreeable to an in-depth interview.

Interviews were generally conducted in person at the former employee's home. Audio recordings and/or notes were taken during the interviews and transcribed into interview summaries. Aerial photographs were used to help orient former employees to the site during the time of their employment and pinpoint locations of known or potential contamination. Information collected in interviews was incorporated in EPA's HSA and Area IV radiological study, as appropriate.

2.2 Solicitation of Interviews

On July 21, 2009, DOE issued a letter to former and current employees of SSFL through Boeing. This letter informed employees of DOE's own historical interview project and provided options for learning additional information. A postcard was included in the letter that allowed employees to indicate interest in DOE's interview project and provide their contact information for follow up. Approximately 307 postcards were returned to DOE signifying further interest in the interview project.

On November 10, 2009, EPA issued a news release soliciting assistance from former employees of SSFL Area IV in identifying potential radiological contamination at the site. EPA requested interviews with former employees, as well as written information and photographs associated with radiological activities at SSFL. The news release noted that interviews could be conducted by EPA representatives only, DOE representative only, or jointly by EPA and DOE representatives. EPA also placed advertisements in the *Los Angeles Daily News*, the *Simi Valley Acorn*, and the *Ventura County Star* seeking former SSFL employees for interviews. These requests to interview former employees were also picked up by the local radio and numerous websites actively reporting on SSFL. Additionally, a less formal request for information from former SSFL employees appeared in a May 2009 EPA fact sheet. EPA received approximately 35 calls and/or emails from these solicitations. Because EPA's request to interview former employees was published to the general public, responses came in from former employees as well as from community stakeholders, residents in areas surrounding SSFL, and survivors of former employees that thought they had information pertinent to EPA's investigation.

Along with the initial EPA and DOE outreach efforts, document review, community stakeholder meetings, screening interviews, and full interviews produced additional former employee names and contact information. This information was collected and pursued. In many cases, the name of a former employee was the only piece of information available. Occasionally, a last known city or last known address was also provided. Regardless of details, EPA, DOE and their representatives examined multiple research databases to determine if the former employee was still alive, where he or she may be living, and what telephone contact information was available. Over 150 individual names were researched as part of EPA's interview effort.

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2.3 EPA Interviews

EPA began conducting telephone screening and interviews in late 2009. A telephone screening script was developed to help gauge the type of information a former employee could provide, ensure it was relevant to EPA's investigation, and determine if the former employee could participate in a formal interview. Screening call questions included:

- When did you work at Santa Susana?
- What type of work did you do?
- What areas of the complex did you work in?
- Did you work with or around any radioactive materials or wastes?

The complete EPA Former Employee Screening Call Script is attached as Appendix A. In some instances, it was discovered that an employee did not work in SSFL Area IV. Additionally, in the case of community members, local residents, and survivors, calls were often related to providing a specific piece of information thought to be helpful, but not necessarily useful for EPA's goal of characterizing Area IV. EPA conducted 75 screening calls in its initial interview effort.

Upon establishing knowledge of SSFL Area IV operational activities and consent for a future interview through the screening call, EPA developed a list of interviewees, primarily former employees, to be scheduled for interviews. This list included 48 individuals. It should be noted that some interviewees also were ultimately interviewed by DOE.

EPA developed an interview script specific to assisting with its radiological characterization study of Area IV. This script served as a guide and was not meant to be inclusive of all questions asked in an interview. Some interviews followed the line of questioning closely, while others were modified, as appropriate, based on an interviewee's responses. The interview script began with questions from the screening call script as a way to review information already provided and serve as a basis for asking more detailed questions. A set of 13 new questions focused on operational details, radiological material use, waste storage and disposal, potential releases or spills, and pathways of release. Interview questions included:

- Describe your typical work activities at SSFL and where they occurred. How were you trained in these activities? Who was your supervisor? Were radioactive materials used in these activities?
- Do you recall the specific type of radiological source material you worked with or around? How was it handled/stored? Where was it stored?
- Was there any on-site disposal of wastes? If so, where? Was there any temporary storage (either aboveground or underground) prior to disposal off-site? Where?
- Do you have any knowledge of spills, leaks, dumping, or other types of releases of radiological material to the land, air, and water?

The complete EPA Interview Questions list is attached in Appendix A. Closing questions always included asking for information not previously provided that might be relevant, the

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names of other individuals that could assist EPA, and permission for future contact if follow-up questions arise.

In addition to the interview script, another tool used in the interview process was a set of aerial photographs. Aerial photographs of SSFL Area IV from 1952 to 2005 were brought to the interviews with the intention of pinpointing areas of potential contamination based on interviewee knowledge. These photographs can be found in EPA's March 2010 report titled *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV*. Mylar sheets were placed over the aerial photographs and permanent markers were used to outline areas of contamination, release, disposal, or other areas of interest, if known by the interviewees. Generally, interviewers presented former employees with aerial photographs from around the time the employees left SSFL. Because SSFL changed during its operational period, more recent photographs may not reflect the site as former employees recognized it. Use of aerial photographs provided the easiest and most direct way for interviewee knowledge to be transferred to maps used by EPA's soil sampling teams. However, use of the aerial photographs was not as successful as initially thought and it often took time to familiarize interviewees with this view of SSFL, as it was not one they had seen before or immediately recognized from working there. Many former employees traced roadways on the aerial photographs to help orient themselves with SSFL. When areas of interest were marked on the mylar sheets, the sheets were digitized over electronic copies of the aerial photographs to provide a completely digital copy of interviewees annotations. Appendix B presents an example aerial photograph with interviewee annotation. It should be noted that this example also shows EPA's aerial photographic analysis (red markups on aerial photograph). The use of historical aerial photographs during interviews was another technique to help inform EPA's radiological characterization study.

Ultimately, EPA talked to 48 individuals in its interview effort and six interviewees were able to identify radiological areas of concern on aerial photographs.[1] Summaries of these interviews are included in Appendix D.

2.4 Joint DOE/EPA Interviews

Because DOE and EPA had overlapping goals with regard to interviewing former employees of SSFL Area IV, EPA was permitted to participate in DOE's outreach efforts. In the fall of 2009, a team of DOE and EPA representatives was convened to establish a joint interview protocol. Discussions were held as necessary via conference call and email over a period of 9 months to refine the joint interview protocol. DOE representatives developed initial telephone and interview scripts and EPA representatives provided feedback to ensure the goals of both agencies were met. The Former Employee Screening Call Script and Interview Script for this joint DOE/EPA interview effort are included as Appendix C. It should be noted that the telephone screening call script was used in conjunction with a spreadsheet to track responses. This is why the screening script provides parenthetical information on how to enter information into the spreadsheet.

[1] Please note that EPA's draft technical memoranda cite a total of 49 interviews. Upon further review it was discovered that one interviewee was counted twice.

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As a result of its July 2009 letter request, DOE indentified approximately 307 potential interviewees. Using the joint agency-approved script, DOE conducted telephone screening calls of these former employees. A resulting 125 people confirmed interest in being interviewed. Two former employees from DOE's solicitation opted to be interviewed by EPA representatives only and 18 former employees indicated they would prefer to be interviewed by representatives of both DOE and EPA. The remaining 105 former employees were interviewed by DOE representatives only.

From June 1 through 3, 2010, the DOE/EPA joint interview team convened in Chatsworth, California, for interview training. The interview training was followed by a day of conducting interviews, and then a debriefing session to review and refine the joint interview script. Following the training session, the remaining former employees were scheduled for interviews, which occurred over the next 3 months. DOE/EPA conducted 15 joint interviews in person and three were conducted over the phone at the interviewees' request.

The joint interview process followed the established protocol. As part of the interview process DOE and Boeing developed documentation to address potential interviewee concerns relating to health issues and pension plans (see Appendix C). It was decided that these documents would be brought to the interviews and provided only if direct concerns were expressed. One set of these documents was ultimately given out in the joint interview process. As with the EPA-only interviews, aerial photographs from 1952 through 2005 were brought to each interview so that potential areas of contamination could be identified. Two joint interviewees were able to annotate aerial photographs with areas of concern. Notes were taken during the interview and typed up in a draft interview summary. The summary was provided to the interviewee for approval. Once the interview was approved, names and any other personally identifiable information were removed from the summary. Any names cited in the interview were replaced with a three letter code, in capital letters. Interviewees were informed that their statements would not be used without their approval. Additionally, interviewees were informed that a final interview report would be prepared and they were asked if they would like to receive a copy of that final report. To date, 15 of the 18 former employees interviewed by DOE and EPA have approved their interview summaries. These summaries are included as Appendix E. For additional information on DOE's own historical interview project, see DOE's *Santa Susana Field Laboratory Former Worker Interviews*.

Notable in the joint interviews was the collection of historical records from two former employees. EPA found these records particularly useful in drafting its SSFL Area IV HSA. Section 3.2, Interview Highlights, notes the interviewees that provided records and where this information can be found.

2.5 Follow-Up Interviews

As noted above, one of the closing questions asked in all of the interviews regarded any other individuals known to an interviewee that could provide additional information to assist EPA and DOE in their characterization and cleanup efforts. This question generated additional names to research and screen. Eighty-five names were provided to EPA after its first round of interviews. EPA sought assistance from DOE and its private investigation firm contractor to research these

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additional names. Out of the 85 names provided to the private investigation firm, 41 did not have sufficient information to locate contact information. Another 14 were found to be deceased. The DOE investigators conducted screening calls using the DOE/EPA approved Former Employee Screening Call Script. Through the screening calls another 12 individuals declined to participate any further in the interview process. Of the 18 remaining individuals, EPA determined that three should be interviewed further and asked DOE to conduct the interviews using the agreed upon interview script. These interviews were processed as DOE interviews, but were made available to EPA for its research teams.

2.6 Confidentiality

Protection of confidentiality was important to the interview process as it provides former employees the ability to speak freely without fear of repercussions. This was particularly important with respect to discussing potential areas of contamination at SSFL. EPA explained to any concerned interviewees that the interviews could be conducted anonymously, if desired, and that EPA would protect anonymity by removing personally identifiable information from its notes and interview summaries. Not only was the interviewee's own personal information removed, but references to other individuals were also removed. Five EPA interviewees provided information as anonymous sources.

Interviewees in the joint DOE/EPA interview process were assured that their personal information would be protected as well. Once an interview summary was approved during the joint DOE/EPA interview process, DOE and EPA removed all personally identifiable information. All references to other individuals in an interview were replaced with a three letter code, in capital letters.

As noted above, DOE and Boeing prepared documents ensuring an interviewee's medical and/or pension benefits would be protected. Additionally, DOE agreed that results of its interviews would not be used to support criminal investigations against interviewees.

Additionally, release of records obtained or generated as a result of EPA or DOE interview efforts falls under the Privacy Act of 1974, as amended at 5 U.S.C. § 552a. The Privacy Act protects records that can be retrieved by personal identifiers such as a name, social security number, or other identifying number or symbol. An individual is entitled access to his or her records and to request correction of these records, if applicable. The Privacy Act prohibits disclosure of these records without the written consent of the individual(s) to whom the records pertain unless the records are legally exempt.

3.0 RESULTS

A key goal of EPA's interview effort was to verify and add to the overall understanding of past operations at SSFL Area IV and thereby support decisions made for the Area IV radiological characterization study. This goal was achieved by talking to former employees who worked at the site and had first-hand knowledge of historical operations. EPA and its representatives talked to former employees who began work at AI in 1953, when Area IV was first developed, as well as employees and contractors who worked in Area IV as late as 2010, when operations focused

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on decontamination and decomissioning. Interviews were conducted with former employees who worked as technicians, mechanics, reactor operators, engineers, and physicists to name some of the job titles. The scope of the interview effort was representative of the long and diverse history of the site. Ultimately, interviewee information presented in the HSA was used to support decisions made for the Area IV radiological characterization study, including recommended soil sampling locations.

3.1 Summary of Results

EPA conducted 48 interviews and teamed with DOE for 18 joint interviews. DOE conducted 114 interviews, 96 of which were approved by the interviewees. DOE made those approved interviews available to EPA for review of information useful to EPA's HSA and radiological characterization study.

Of the 181 interviews conducted by both EPA and DOE combined, only nine interviewees noted areas of radiological concern on aerial photographs for EPA's characterization study. However, 48 interviewees provided information used in EPA's draft technical memoranda for the SSFL Area IV HSA. Interviewee information generally served to corroborate or annotate historical documentation, but also filled in data gaps when historical records could not be located. In some cases, EPA's research team was able to place potential source areas on maps used by the soil sampling teams based on interviewee information, even if the interviewees could not identify these areas on the aerial photographs. It should also be noted that some of EPA's draft technical memoranda were issued prior to having completed the interview effort, and thus additional interviews may be included in the final version of the SSFL Area IV HSA. However, any immediate areas of concern were passed on to EPA's soil sampling team.

Although not all interviews provided specific information for EPA's radiological characterization study, EPA acknowledges that all information provided by interviewees is an important part of the historical record at SSFL. The inclusion of interview summaries in Appendix D of this report helps to preserve a piece of that historical record.

Figure 3.1 presents summaries of key facts noted in the EPA-only interview process, such as years of employment, job title, handling of radiological material, and the HSA subarea(s) where interviewee information informed the radiological characterization study. This figure also demonstrates the wide range of tenure and duties of the interviewees. The job titles reflected in the table and figure are self-reported titles from the time of employment. Historical job titles may not be equivalent to titles used today. This is particularly true of the title Engineer. A number of interviewees also had multiple job titles over their careers at SSFL. The job titles reflected in this figure refer to those positions held the longest or during the period where information was used for EPA's HSA.

Figure 3.2 presents summaries of key facts from the DOE/EPA interview process and follows the same format as Figure 3.1. Interviewee numbers associated with the joint interviews reflect the pool of 307 former employees who responded to DOE's original request for interviews. Three of the joint interviewees did not approve their interview summaries in time for publication of this

report, so although general information is included in Figure 3.2 for these three interviewees, the full interview summaries are not included in Appendix E.

3.2 Interview Highlights

While all interviews contributed to the SSFL body of knowledge, some key interviews provided great value to the EPA HSA and radiological characterization study. Of specific interest to EPA was information pertaining to radiological material, including use, storage, disposal, and spills or incidents; site information such as building or area operations and their specific appurtenances; and document management, including record keeping, storage and retention. This information was used to develop EPA's HSA and identify locations for soil sampling to further characterize the SSFL Area IV site. The extent of information provided by key interviews can be found in EPA's 2010 and 2011 HSA technical memoranda documents. The key interviews are highlighted below.

- A responsible engineer who worked for AI at SSFL from 1958 to 1962 provided extensive information on the Kinetics Experiments Water Boiler (KEWB) reactor.[2] As the responsible engineer for the reactor, this interviewee provided details on the operational history of the KEWB reactor, radiological material use and disposal, tanks and plumbing, and areas of possible residual contamination. This information can be found in EPA's January 2011 *Draft Technical Memorandum, Subarea HSA-5A, Historical Site Assessment, Santa Susana Field Laboratory Site, Area IV Radiological Study, Ventura County, California.*

- A technician who worked for AI from 1962 to 1965 provided useful information on the Hot Lab. This interviewee provided details on radiological waste processing and disposal, building features, protection of worker health, and examples of procedures for unplanned events. Information from this interview can be found in EPA's April 2011 *Draft Technical Memorandum, Subarea HSA-5D, Historical Site Assessment, Santa Susana Field Laboratory Site, Area IV Radiological Study, Ventura County, California.*

- A mechanic who worked for AI from 1959 to 1960 provided extensive information on the Sodium Reactor Experiment (SRE) fuel element failure. This interviewee provided nearly step-by-step details on the cleanup and fuel element recovery efforts resulting from the 1959 SRE incident. In addition, the interviewee noted cleaning practices, waste storage and disposal practices, weather monitoring, safety practices, and challenges faced during this event. Information from this interview can be found in EPA's June 2011 *Draft Technical Memorandum, Subarea HSA-6, Historical Site Assessment, Santa Susana Field Laboratory Site, Area IV Radiological Study, Ventura County, California.*

- A mechanic/engineer who worked for AI and Rocketdyne at the SSFL from 1957 to 1989 provided substantial information on the Hot Lab and Radioactive Materials Handling Facility (RMHF), as well as useful information on the SRE, Sodium Burn Pit, and Uranium Carbide Fuel Pilot Plant. This interviewee provided extensive information on

[2] It should be noted that the interviewee referred to his job title as "responsible engineer."

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operations at the Hot Lab and RMHF, and additional information on building features, waste management, spills and cleanup, and worker safety. The interviewee also provided information on SRE dismantling operations, use of the Sodium Burn Pit, and safety information related to the Uranium Carbide Fuel Pilot Plant. Additionally, the interviewee provided the DOE and EPA interview team documents that informed the EPA HSA for the Hot Lab. Information from this interview can be found in EPA's April 2011 *Draft Technical Memorandum, Subarea HSA-5D, Historical Site Assessment, Santa Susana Field Laboratory Site, Area IV Radiological Study, Ventura County, California*; EPA's August 2011 *Draft Technical Memorandum, Subarea HSA-7, Subarea HSA-3, Subarea Northern Buffer Zone, Historical Site Assessment, Santa Susana Field Laboratory Site, Area IV Radiological Study, Ventura County, California;* EPA's June 2011 *Draft Technical Memorandum, Subarea HSA-6, Historical Site Assessment, Santa Susana Field Laboratory Site, Area IV Radiological Study, Ventura County, California;* and EPA's January 2011 *Draft Technical Memorandum, Subarea HSA-5A, Historical Site Assessment, Santa Susana Field Laboratory Site, Area IV Radiological Study, Ventura County, California.*

- An engineer/physicist who worked for AI at SSFL from 1961 to 1973 provided extensive information on the Shield Test and Irradiation Reactor (STIR). This interviewee provided details on the operational history of the reactor; radiological use, handling and storage; water retention and drainage features around the reactor building; and document management. Additionally, this interviewee provided the DOE and EPA interview team numerous documents and reports that informed the EPA historical site assessment for the STIR. Information from this interview can be found in EPA's August 2011 *Draft Technical Memorandum, Subarea HSA-7, Subarea HSA-3, Subarea Northern Buffer Zone, Historical Site Assessment, Santa Susana Field Laboratory Site, Area IV Radiological Study, Ventura County, California.*

None of these key interviewees provided annotations to aerial photographs, but the information provided during the course of the interview allowed EPA's research team to highlight locations on SSFL area maps where soil sampling should occur. As noted above, in addition to these key interviews, nine interviewees provided information on aerial photographs that EPA's soil sampling teams used to inform their work.

4.0 CONCLUSIONS

Interviews conducted by EPA and DOE helped to provide a well-rounded and informative operational history of SSFL Area IV, as seen in the HSA. Key interviews presented in the HSA also corroborated and/or refuted historical documents, filled in data gaps, provided anecdotal evidence for non-standard practices, and helped identify recommendations for further investigation. The interview process was one of many important components of EPA's HSA, which itself was one of many lines of evidence used to identify potential contamination source areas at SSFL Area IV. By identifying potential source areas, soil sampling teams could evaluate these areas against established cleanup levels and determine whether further remedial action was necessary.

Generally, both interviewees and interviewers appreciated the interview process. Interviewees often mentioned the exciting nature of the work that was going on at SSFL historically and the sense of pride they had in their work. Interviewers were able to glean relevant information for characterization and cleanup efforts by their respective agencies and better understand operations at the SSFL from the men and women that worked there. EPA would like to thank all those who participated in and contributed to the interview process. It is through this collective action that remedial goals for SSFL will be met and a piece of history will be preserved.

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Figures

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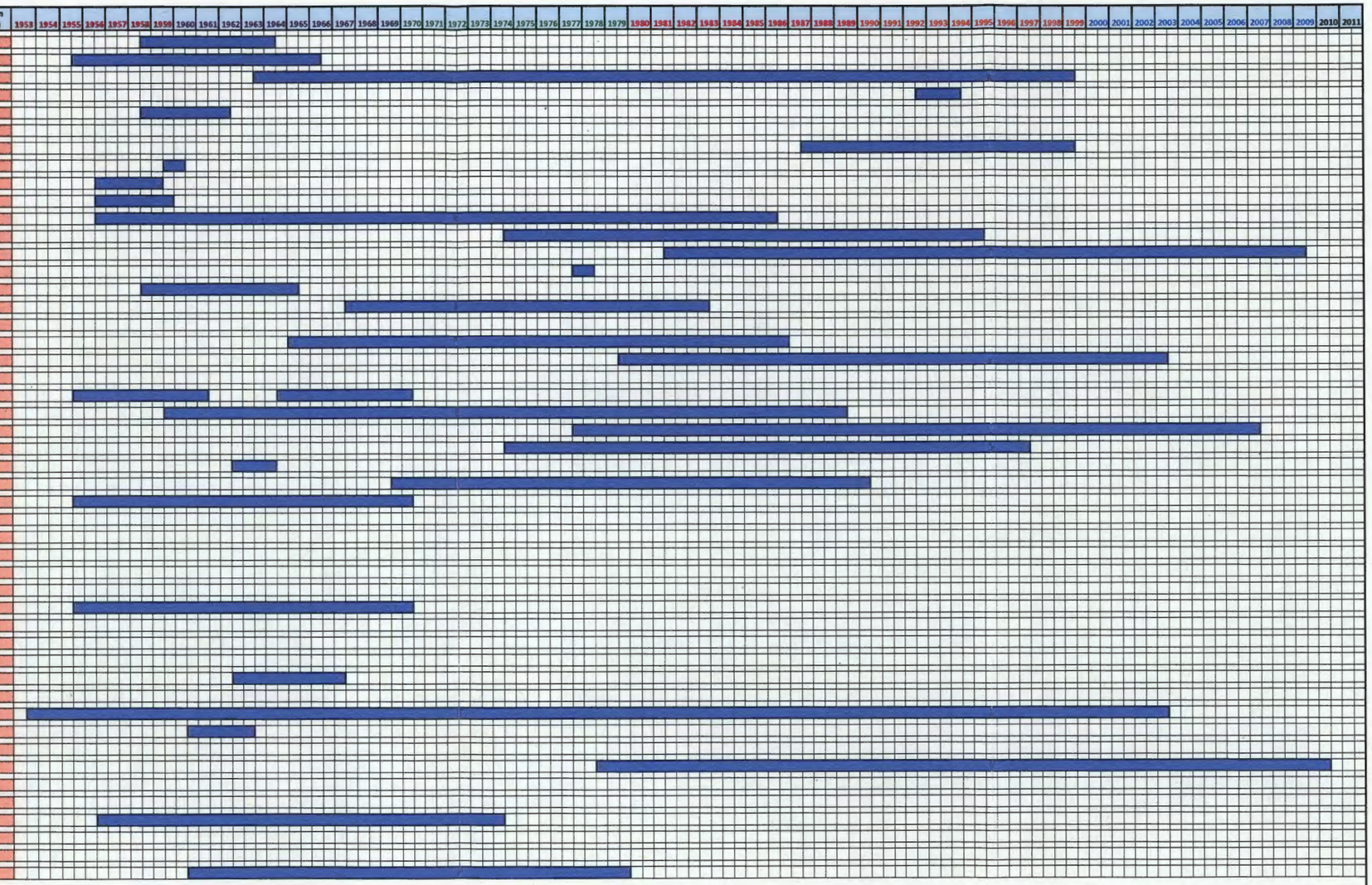
Interviewee Number	Job Title	R/A Material Handled	Subarea	Start Year	End Year	Duration (years)
1	Reactor Operator	Y	N/A	1958	1964	8*
2	Instrumentation Engineer	N	6	1955	1966	11*
3	Operations Engineer	Y	5D, 6, 7, 8	1963	1999	36
4	Supervisor	Y	N/A	1990	1994	2*
5	Responsible Engineer	Y	5D	1958	1962	4
6	Health Physicist	Y	5A, 5B, 5C, 5D, 6, 7	1962	N/A	N/A
7	Quality Engineer	N	7	1987	1999	12*
8	Mechanic	Y	6	1959	1960	1
9	Health Physicist	Y	5A, 6	1956	1959	3*
10	Electrical Technician	N	6	1956	1959	2.5
11	Inspector	N/A	5B, 5C	1956	1986	30
12	Construction Inspector	N	5B	1974	1995	21
13	Environmental Technician	Y	5A, 5B, 5C, 5D, 6, 7, 8	1981	2009	28
14	Health Physics Technician	Y	5D, 6, 7	1977	1978	1
15	Laboratory Technician	Y	7	1958	1965	7
16	Reactor Inspector	Y	5A, 5B, 5C, 6, 7, 8	1967	1983	16
17	Concrete Worker	N/A	6	1980	1980	N/A
18	Unknown	N/A	N/A	1965	1986	22*
19	Mechanic	Y	5A, 8	1979	2009	29
20	Hiker	N/A	N/A	N/A	N/A	N/A
21	Senior Engineer	Y	5B, 6	1955	1970	17*
22	Engineer	Y	5B, 6	1959	1989	30*
23	Research Mechanic	Y	5D	1977	2007	30
24	Supervisor	N	5B, 5C, 8	1974	1987	23
25	Chief Engineer	N	N/A	1962	1964	2*
26	Quality Assurance Engineer	N	5B, 5C	1969	1990	21
27	Electrical Technician	N	N/A	1955	1970	15
28	Purchase Agent	Y	N/A	N/A	N/A	20*
29	Unknown	N	N/A	N/A	N/A	N/A
30	Unknown	N	N/A	N/A	N/A	N/A
31	Bulldozer Operator	N	N/A	N/A	N/A	N/A
32	Unknown	N/A	N/A	N/A	N/A	N/A
33	Fire & Security	N/A	N/A	1955	1970	15
34	Cement Mason	N/A	N/A	1980s	1980s	N/A
35	Unknown	N/A	N/A	N/A	N/A	N/A
36	Unknown	N/A	N/A	N/A	N/A	N/A
37	Unknown	N/A	N/A	1962	1967	5*
38	Rocket Engine Testing	N	N/A	1960s	1960s	N/A
39	Photographer	N	8	1953	2002	50*
40	Lab Technician	N	N/A	1960	1963	3*
41	Mechanic	Y	N/A	1980s	2010	30*
42	Machinist	N	N/A	1978	2010	32*
43	Unknown	N	N/A	N/A	N/A	N/A
44	Unknown	N	N/A	N/A	N/A	N/A
45	Accountant	N	N/A	1956	1974	18*
46	Unknown	N	N/A	N/A	N/A	N/A
47	Unknown	N	N/A	N/A	N/A	N/A
48	Engineer	N	N/A	1960s	1970s	20*



Notes:

* These interviewees spent little to no time at the Santa Susana Field Laboratory and were based out of other Atomics International facilities.

The job titles reflected in this figure are self-reported titles from the time of employment. Historical job titles may not be equivalent to titles used today. This is particularly true of the title Engineer. A number of interviewees also had multiple job titles over their careers at the Santa Susana Field Laboratory. The job titles reflected in this figrue refer to those positions held the longest or during the period where information was used for the U.S. Environmental Protection Agency's historical site assessment.

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Interviewee Number	Job Title	R/A Metarial Handled	Subarea	Start Year	End Year	Duration (years)
8	Project Administrator	Y	5B, 6	1956	2007	51*
31	Electronics Technician	Y	N/A	1959	1960	1
34	Engineer	N	N/A	1955	1987	34
57	Technician	N	8	1955	1958	3
58	Mechanic	N	N/A	1978	1979	2
78	Mechanic	Y	5A, 8	1976	1982	6
80	Development Engineer	N	N/A	1955	1960	5
107	Engineer/Physicist	Y	7	1961	1973	12
125	Technician	Y	5D	1961	1964	3
154	Instrumentation Engineer	N	8	1977	1985	8
234	Mechanic/Engineer	Y	5D, 6, 7, 8	1957	1969	12
255	Reactor Inspector/Photog	Y	5A, 5D, 7	1967	1985	18
287	Engineer	Y	8	1962	1965	3
296	Design Engineer	Y	6	1956	1981	18**
306	Engineer/Physicist/Super*	Y	6, 8	1953	1963	10
245	Physicist***	Y	N/A	1960	1965	5
250	Mechanic/Engineer***	Y	N/A	1972	2007	35
264	Physician***	Y	N/A	1981	1993	12

Notes:

* This interviewee did not work at the Santa Susana Field Laboratory and was based out of another Atomics International facility.

** This interviewee worked for Atomics International from 1956 to 1963 and then again from 1972 to 1981.

*** These interviews have not yet been approved.

The job titles reflected in this figure are self-reported titles from the time of employment. Historical job titles may not be equivalent to titles used today. This is particularly true of the title Engineer. A number of interviewees also had multiple job titles over their careers at the Santa Susana Field Laboratory. The job titles reflected in this figure refer to those positions held the longest or during the period where information was used for the U.S. Environmental Protection Agency's historical site assessment.

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Appendix A

EPA Interview Script/Questions

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Former Employee Screening Call Script

Telephone Screening Script

Hello, my name is _____ may I please speak to _____? My name is _____ and I work for _____. The U.S. Environmental Protection Agnecy (EPA) is developing a history of site operations at Area IV of the Santa Susana Field Laboratory in Simi Valley, California and has been conducting interviews to gather information. I am calling to find out a little more about your experience at Santa Susana. Do you have time to answer some preliminary questions?

1) When did you work at Santa Susana? *[Record start and end year]*

2) Who did you work for? *[Record name of company, North American, AI, Rocketdyne, NASA, etc.]*

3) What was your job title or titles? If multiple job titles are mentioned, ask for the approximate timeframe each position was held. *[Record full titles]*

4) What type[s] of work did you do? *[Record short answers]*

5) What areas of the complex did you work in? *[Record Areas]*
   a) Where did you spend the most time?
   b) At what other areas did you perform or observe work?
   c) If Area IV is mentioned, ask about any specific buildings and/or programs.

6) a) Did you work with or around any radioactive materials or radioactive wastes? *[Yes/No; Where?]*

   b) Did you observe the handling or disposal or radioactive material or waste? [Yes/No, Where?]

   c) Did you ever wear a dosimetry badge?

7) The EPA is specifically interested in operational information related to radioactive materials and waste. Since you indicated that you have knowledge in this area, would you be willing to be interviewed by EPA?

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8) We will get back to you to schedule a date, time and place for your interview. We may do some interviews by telephone and some in person, do you have a preference? *[In-person or Telephone]*

9) Can you please confirm for me your mailing address and/or e-mail address and any other telephone numbers so that we can reach you easily? *[Verify and update contact info]*

Thank you for your time in answering these questions. You have been very helpful and we appreciate your assistance.

-- **End of Script** --

At the conclusion of the call the Screener will make subjective notes in the spreadsheet about:

a) Health status (frail, said they were sick, spouse reported recent stroke, etc.)
b) Mental status (seemed clear, seemed confused)
c) Hearing issues (difficult to communicate with on the telephone)
d) Attitude (cooperative, fearful, angry, hesitant)

EPA Former Employee Interview Questions

Review of information provided in screening call (Questions 1-6 below). Use aerial photos/maps to review Area IV locations.

1. When did you work at Santa Susana?
2. Who did you work for?
3. What was your job title(s) and timeframe of each position?
4. What type(s) of work did you do?
5. Where in Area IV did you work? What buildings or programs did you work in/on? Where did you spend most of your time in Area IV?
6. Did you work with or around any radioactive materials or wastes? Where? Did you observe the handling or disposal of radioactive material or waste? Did you wear a dosimetry/film badge?

Additional questions to gather more detailed information.

1. Describe your typical work activities at SSFL and where they occurred. How were you trained in these activities? Who was your supervisor? Were radioactive materials used in these activities?

2. Are you aware of any other activities that occurred in the building you worked in outside from the work you were conducting?

3. Do you recall the specific type of radiological source material you worked with or around? How was it handled/stored? Where was it stored?

4. Do you recall the specific type of radiological waste material you worked with or around? How was it disposed?

5. Was there any on-site disposal of wastes? If so, where? Was there any temporary storage (either aboveground or underground) prior to disposal off-site? Where?

6. Were you aware of any unusual occurrences or accidents during your time at SSFL? Either pertaining to the building you worked in or to another area of the site.

7. Do you have any knowledge of spills, leaks, dumping, or other types of releases of radiological material to the land, air, and water?

8. Are you aware of any leach fields, septic tanks, or drainage discharge locations? If so, where?

9. Are you aware of any storage tanks, gas holdup tanks, etc.? If so, where are they located?

10. Are you aware of any problems with underground pumps, sumps, storage tanks, piping, sewer, or drainage systems?

11. Do you have any concerns about contamination at the site? Any areas that EPA should evaluate more closely?

12. Were you aware of any other activities being conducted at the site not done by your employer? Other contractors?

13. Did you keep any memorabilia, scrapbooks, or photographs of your experience? [Ask this when scheduling interviews so any information can be made available]

Closing questions

1. Is there any other information on activities at SSFL you think might help EPA's investigation into contamination at the site?

2. Can you think of any other individuals that could help EPA's search for information about SSFL activities? Do you have last known contact information?

3. May we contact you in the future if we have any follow-up questions?

Appendix B
Sample Aerial Photograph Annotation

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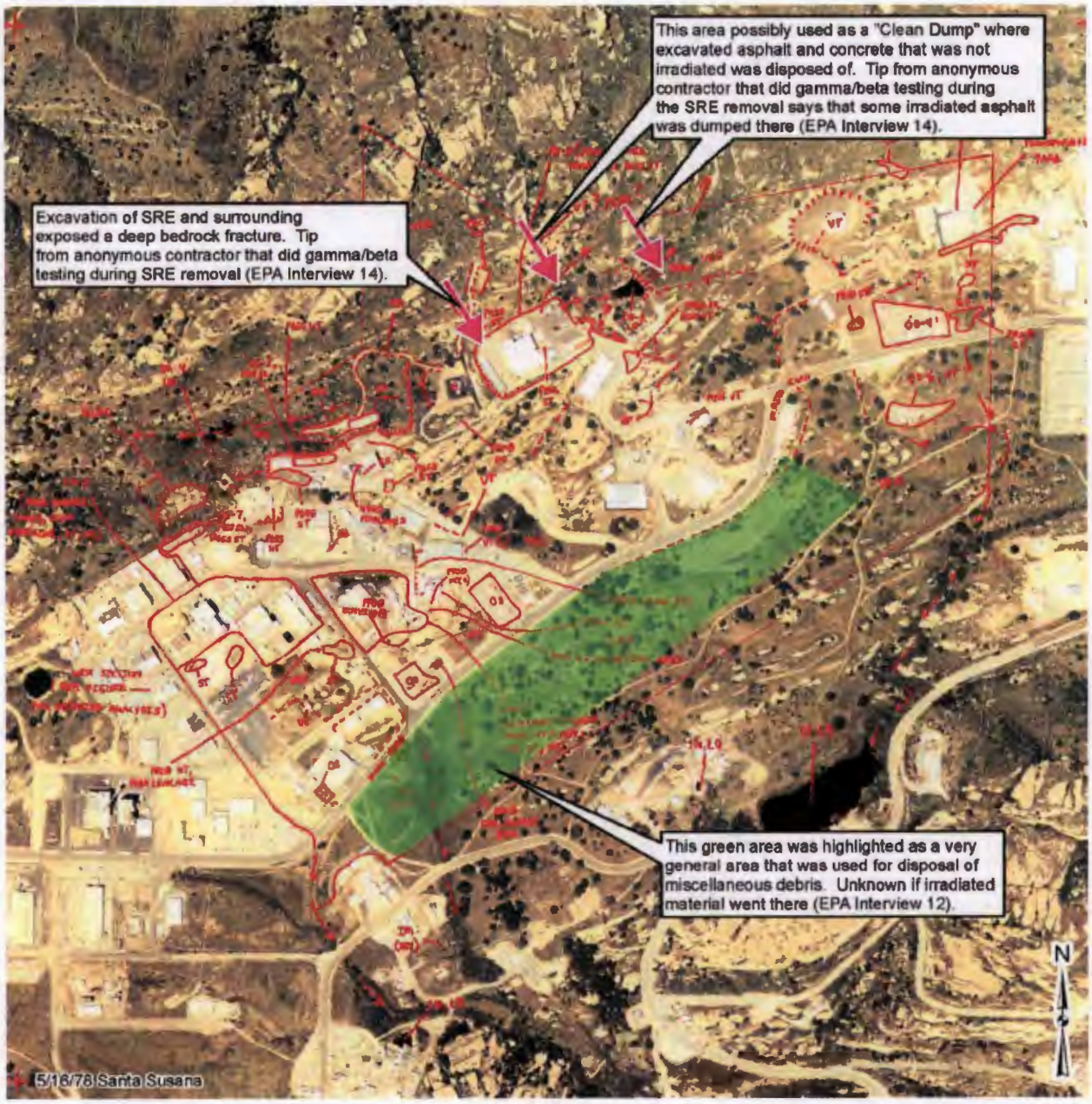
Sample U.S. Environmental Protection Agency Historical Aerial Photograph with Annotations and Interviewee Callouts



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Appendix C

DOE/EPA Joint Interview Script/Questions

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Former Employee Screening Call Script

The Department of Energy is in the early stages of preparing an Environmental Impact Statement to support decisions about how best to remove remaining facilities and contamination that resulted from their activities in Area IV at the Santa Susana Field Laboratory. In addition, the US Environmental Protection Agency is conducting a radiological survey to determine where radioactive contamination is on the site. In order to help DOE and EPA do a thorough job, they are interested in interviewing former employees that worked at the site.

The Boeing Company sent out letters to approximately 10,000 former employees to notify them of an opportunity to participate in tours of SSFL, public meetings, and asking if they were interested in being interviewed concerning their work at the site. Approximately 300 former employees have responded indicating a willingness to be interviewed. We will conduct screening telephone calls with these former employees to confirm the accuracy of their contact information, determine the time frame of their association with SSFL and the type(s) of work they performed at the site. The information gathered during the telephone screening calls will be used to plan and conduct face to face or extended telephone interviews.

The following list of questions has been developed to elicit brief, factual answers that can be used to evaluate the types of information that we might learn from each former employee and match them with appropriate interviewers or interview teams.

Telephone Screening Script

Hello, my name is _____. May I please speak to _____? Recently you were contacted because you used to work at the Santa Susana Field Lab and you indicated that you might be willing to be interviewed concerning your recollections of your time there. I'm calling on behalf of the US Department of Energy to follow up with you and find out a little more about your work at Santa Susana. Are you still interested in being interviewed? This is not the interview, but rather we are seeking to learn a little bit more about your employment so that we can schedule the appropriate type of interview later. Do you have a few minutes now to answer a few preliminary questions?

The purpose for our interviews will be to develop a fully-informed history of site operations and facilities for use in preparing environmental documentation that is being prepared to support final cleanup and closure of DOE's facilities at the SSFL.

1) When did you work at Santa Susana Field Laboratory?

[Record start year and end year, confirm total number of years calculated by spreadsheet.]

2) What company or organization(s) did you work for?

[Record "1" in column corresponding with the name of company. Record all responses.]

3) What was your job title or titles?

[Record titles. If multiple titles are given, record all. If only one mentioned, do not press.]

4) What areas of the complex did you work in? (If Area IV, ask where)

[Record "1" in column corresponding with the administrative area of site. Record all responses. If Area IV is mentioned, ask where and record specific buildings and/or programs mentioned.]

5) The following questions will help us pair you with the most appropriate interview team.

a) Did you work with or around, or manage any chemicals, or cleaning materials?
b) Did you work with or around, or manager any radioactive materials or radioactive wastes?
c) Did you ever wear a dosimetry or film badge?

[Record "1" for Yes, leave blank for No.]

Ask Question No. 6 only if former employee indicated that he/she worked in Area 4 (Question 4) or worked with radioactive materials/waste (Question 5).

6) The US Environmental Protection Agency is also interviewing former employees about Area 4 at SSFL. There are three options that you can choose from your interview.

- You can be interviewed by EPA alone
- By DOE alone
- Or jointly by both EPA and DOE

Which would you prefer?

[Indicate one choice only, using "1" in the proper column to indicate their preference.]

7) Based on your work or observations at the site do you have any specific concerns that you think we should learn about right away to help us focus our investigations over the next few months? We will use this information to determine who should be involved in your interview and how soon we will need to get your interview scheduled.

[Use "1" to indicate an affirmative response. Please avoid allowing caller to share their concerns/observations during the screening call by explaining that you would like them to share that information with the interviewer instead.]

8) Many of the interviews will be conducted by telephone. Would that work for you?

[If not, record concern briefly.]

9) Once we look at the results of all of these screening calls, we will be in touch again to schedule your interview. When is the best time to reach you?

[Record response capturing preferences about day of week, time of day, etc. as well as upcoming plans they mention.]

10) Finally, we want to confirm the contact information we have for you. Is this the best telephone number to reach you at?

[Read number aloud, record different number upon request.]

Is this address correct?

[Read aloud, correct as appropriate.]

Is this email address correct? / Do you have an email address?

[Read aloud if we have one, confirm, record if we don't already have one.]

Thank you for your time in answering these questions. You have been very helpful and we appreciate your assistance. Once we have completed these screening calls, we will be back in touch to schedule the interview.

-- End of Script --

At the conclusion of the call, please record your notes in the spreadsheet about the following which should be considered during scheduling of interviews:

a) Health status (frail, said they were sick, spouse reported recent stroke, etc.)
b) Mental status (seemed clear, seemed confused)
c) Hearing issues (difficult to communicate with on the telephone)
d) Attitude (cooperative, fearful, angry, hesitant)
e) Expressed desire to have family member (spouse or child) participate/present for interview

Preparation for each Interview

Take the following to each interview

- A copy of the health concerns fact sheet (to be left with the individual if they express concerns about health issues they attribute to their employment at SSFL)
- A copy of the letter from Boeing (to be left with the individual as needed)
- A set of aerial photographs to help them remember what things looked like when they worked there
- Sheets of mylar and appropriate marking pens to record locations of facilities, buildings, release sites, disposal sites, storage sites, etc. that come up during the interview
- A set of fact sheets about the Area IV facilities (for use by the interviewer)
- Envelopes and/or boxes to transport materials provided by the former employee.

Questions and Answers

In response to questions/expressions of concern about the confidentiality of their responses to questions and/or the interview process:

"Once DOE finalizes the environmental documentation that they prepare to support decisions about how to clean-up the site, the information learned during the interviews will be made public, but that information will not include the names of the people that have been interviewed. DOE also expects to share that information provided by former employees with the Environmental Protection Agency and the California Department of Toxic Substances Control. However, if DOE is required to respond to an appropriate legal inquiry, such as a Freedom of Information Act request, for example, DOE may be required to disclose the names of people who have been interviewed. In other words, we will only disclose your name if we are required to under a properly filed legal inquiry."

In response to expressions of concerns about whether providing the information requested in the interview could jeopardize a worker's pension:

"DOE has talked with Boeing and we would like to give you their assurance regarding the information you might share with us during this interview. We have a copy of a letter provided by Boeing that explains that nothing that is said will jeopardize any former employee's pension or retirement plan. This letter also encourages retirees to participate in this interview with honesty and candor."

In response to any mention of concerns about health effects associated with working at SSFL:

"Individuals, or their eligible survivors, who worked as an employee, contractor, or subcontractor at a Department of Energy (DOE) facility and have been diagnosed with an illness that may have been caused by that work may be eligible for benefits under the Energy Employees' Occupational Illness Compensation Program (EEOICPA). We have prepared a fact sheet with information about this program if you are interested. Employees, or their survivors, whose claims are approved may receive a lump-sum payment up to $150,000 and medical benefits for the covered illness. Other benefits may be possible. This fact sheet has addresses, telephone numbers, and email addresses for obtaining further information."

Interview Script

Hello. My name is (name) and this is (name). Thank you for being willing to sit down with us today. As you know, we are interviewing former employees who worked at the Santa Susana Field Laboratory. DOE has decided that it no longer needs to conduct research activities at the SSFL and that it is time to remove all of the facilities and clean up the portion of the site where their operations occurred.

To support decisions about how to clean up the site, DOE needs to know the nature and extent of all environmental contamination that is attributable to Area IV activities. Before they can begin that process, site investigations will be done to identify the location of contamination at the site, including a radiological survey that will be completed by the US Environmental Protection Agency. What you tell us during this interview will help us know where to look during the site investigations.

In addition, this interview will help us:

- Develop a fully-informed history of site operations and facilities
- Learn about operational procedures that were used over the years for handling radioactive and chemical materials, as well as any unplanned or unusual events that occurred, so that DOE can develop a full understanding of radiological and hazardous chemical handling and any releases that may have occurred
- Identify what records exist and where those records might be located
- Identify additional people who might have relevant knowledge.

Before we get too far along, I would like to review a few points about these interviews and how we will use your answers to our questions.

During the interview, I will be asking the questions and (name) will be taking notes. We both may ask clarifying questions to make sure we understand what you are telling us. Once the interview is complete, we will type up our notes of this conversation and provide the draft to you for your approval. Once you have approved the notes from your interview, we will remove your personal information and submit the notes for inclusion in the report on all of the interviews.

When the interview process is completed, we will prepare a final report. As one of the individuals interviewed, we will provide you with a copy of that final document if you are interested. Would you like a copy of the final report on all of the interviews?

Yes No (circle one)

(Show them the aerial maps and explain how they will be used. Ask if they have any materials to share with us. If any appear to be particularly valuable, ask if we could have or make copies at the end of the interview. Put in an appropriate and labeled envelope/box. Make every effort to return materials that they want back.)

With that, we are ready to begin the interview. We have a number of topic areas that we would like to ask you about. We will try to complete the interview within (the estimated timeframe).

Before we get started, do you have any questions about this interview or what we will be doing with your responses?

Start of Interview

Interviewee Name and Affiliation: _____

Interview Date, Time, and Location: _____

1. Based on the screening call, we understand that you (review what we already know). What else can you tell us about what it was like to work at Santa Susana Field Laboratory?

   (Prompting questions: Where did you work at the SSFL? What did you do? What were some of the projects you worked on? When did you work at the SSFL and what were your responsibilities over that timeframe? Describe your typical work activities at SSFL and where they occurred. How were you trained in these activities? Who supervised your work?)

2. What do you know about radiological materials that were generated and/or stored at the SSFL? What can you tell us about normal operations related to the handling of radiological materials? How where they handled? How and where were they stored? How were they dispositioned?

3. We recognize that much of the work at SSFL was primarily experimental and with experiments, sometimes things did not go as planned. What happened when something occurred that was out of the ordinary or unplanned?

   (Prompting questions: How often did off-normal events involving radiological materials occur? How were those occasions documented? What happened in the event that a worker was exposed to radiation? What was the decontamination procedure? What happened to contaminated clothing and equipment?)

4. How was worker exposure to radiological materials monitored? Did you wear a radiation badge or dosimeter? Did you regularly use or work with someone who regularly used radiation monitoring equipment?

5. Was there any on-site disposal of radiological wastes? If so, where? Was there any temporary storage (either aboveground or underground) prior to disposal off-site? Where? Do you have any knowledge of spills, leaks, dumping, or other types of releases of radiological material to the land, air, or water?

6. What hazardous chemicals were generated and/or stored at the SSFL? A partial list of chemicals that we would be interested in would include: chlorinated solvents, metals, PCBs, asbestos, and fire retardants. What can you tell us about normal operations related to the handling of those hazardous chemicals? How were they handled? How and where were they stored? How were they dispositioned?

7. How often did off-normal events occur involving hazardous chemicals? What happened when something occurred that was out of the ordinary or unplanned? How were those occasions documented?

8. Was there any on-site disposal of hazardous chemicals? If so, where? Was there any temporary storage (either aboveground or underground) prior to disposal off-site? Where?

9. Do you have any knowledge of spills, leaks, dumping, or other types of releases of hazardous chemicals to the land, air, and water?

10. Were there company policies and procedures in place that dictated how to do your work? How closely were those policies and procedures followed? How often did they change? Was there a workplace culture that supported compliance with standard operating procedures, or was it common for workers to disregard those procedures? What happened if there was no specific procedure in place?

11. How were workers trained? How was performance monitored? We know it was standard practice at facilities like SSFL to bury waste materials. Do you know of any waste materials that were buried on site? Where?

12. We have records that show most of the radioactive and hazardous materials were hauled away and disposed of elsewhere. We do know that some of the rocket fuel materials used in Areas I and II was left behind in drainages. Are you familiar with anything similar happening in Area IV?

13. How did you document what you did?

    (Prompting questions: Do you write in log-books, ledgers, or other records? Where were those kept and where did they go when you were done with them? What sorts of activities were documented? Do you know of anything that occurred that was not documented? Do you know of any documents, log books, records, or other documentation that may not be in the official records? Where are those located and how might we go about getting copies? Did you keep any records at home? Do you still have any of those records?)

14. Did anything ever happen that was not documented? We don't care who was responsible – we just want to understand how complete the existing documents are. Who managed the reports on incidents?

15. Were any liquid materials ever disposed of using toilets or floor drains to dispose of anything?

16. What can you tell me about the following facilities in Area IV:

    a. The sodium burn pit

    b. A surface disposal area at the western edge of Area IV

    c. Any of the leach fields, septic tanks, or drainage discharge locations

    d. The old conservation yard (junk yard)

    e. Any storage tanks, gas holdup tanks, etc.?

    Tell us more about that.

17. Are you aware of any problems with underground pumps, sumps, storage tanks, piping, sewer, or drainage systems?

18. Is there anything else you would like to tell me today?

19. Can you think of any other individuals that could help us develop a full understanding about site contamination within Area IV at SSFL? Do you know how to get in touch with them?

20. May we contact you again in the future if we have any follow-up questions?

We want you to know how much we appreciate your time today. Can you make sure we have the correct contact information for you? Thank you so very much for talking with us today.

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October 22, 2009
In reply refer to: SHEA-109240

Mr. Richard Schassburger, Director
U S Department of Energy
Oakland Projects Office
1301 Clay Street, Suite N1660
Oakland, CA 94612

Re: Environmental Impact Study at Santa Susana Field Laboratory

Dear Mr. Schassburger:

We are writing in response to the Department of Energy's request that The Boeing Company ("Boeing") provide a letter to address possible concerns or fears that Boeing retirees may have or express in conjunction with their participation in the interview process of the DOE's Environmental Impact Study relating to Boeing's Santa Susana facility. The DOE has advised Boeing that some retirees are fearful their good faith, voluntary participation as interviewees in the study may adversely affect their retirement and/or medical benefits.

Please be advised that Boeing encourages its retirees to participate in the study fully and to respond to interview questions from the DOE with honesty and candor. Boeing does not intend to and will not take any actions regarding retirees' medical or pension benefits as a result of their good faith participation as interviewees in the study.

Sincerely,

Thomas D. Gallacher, Director
Santa Susana Field Laboratory
Environmental Health and Safety
The Boeing Company

Peter Rosenbloom, Counsel
Labor & Employment
The Boeing Company

cc: Stephanie Jennings, DOE, SSFL

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If you have health concerns related to your prior work at Santa Susana Field Laboratory, the US Department of Energy has compiled this information for you.

The **US Department of Energy** (DOE) **Former Worker Medical Screening Program** (FWP) was established following the issuance of the FY 1993 National Defense Authorization Act (PL 102-484, Section 3162), which called for DOE to provide medical screening services to former employees who may be at risk for health conditions as a result of exposure to hazardous or radioactive substances during their employment at DOE facilities.

External teams of health experts are funded to independently evaluate DOE site hazards and exposures, and to offer medical screening, at no cost, to former workers who may be at risk for occupational diseases. The medical screening exam is customized according to each individual's work history and likely exposures. The program serves ***all*** former Federal, contractor, and subcontractor workers from ***all*** DOE sites in locations close to their residences.

Medical screening tests include a physical exam, general blood and urine tests, hearing test, chest x-ray, lung function test, and other tests based on exposures (e.g., a beryllium lymphocyte proliferation test for individuals exposed to beryllium).

Participants with abnormal findings are referred to their personal physicians or specialists for any follow up medical exams and diagnoses. Individuals with findings consistent with a potential occupationally related disease are referred to the **Department of Labor** for possible compensation and medical benefits under the **Energy Employees Occupational Illness Compensation Program**.

Medical screening exams for former workers from Area IV of the Santa Susana Field Laboratory are currently available through the National Supplemental Screening Program (NSSP), a component of the FWP. Learn more about the NSSP by calling toll free at 866-812-6703 or visiting their website: http://www.orau.org/nssp/

For more information about FWP, please visit their website at: http://www.hss.energy.gov/HealthSafety/FWSP/formerworkermed/

The **Energy Employees Occupational Illness Compensation Program Act of 2000**, as amended, established a compensation program for the civilian men and women who performed duties related to the nuclear weapons production and testing programs of the US Department of Energy and its predecessor agencies over the past 50 years. The Act recognizes that these workers may have developed certain work-related illnesses as a result of exposure to radioaction and toxic substances unique to nuclear weapons production and testing. Compensation and medical benefits are provided to eligible workers under The Act and, in some case, their survivors.

The **US Department of Labor** administers the Energy Employees Occupational Illness Compensation Program Act of 2000, which provides benefits to eligible employees and former employees of the Department of Energy and its contractors and subcontractors as well as certain survivors of such individuals as provided in The Act. Benefits are available for people made sick as a result of exposure to radiation (Part B) and exposure to hazardous contamination (Part E).

Part B is available to current and former employees of Department of Energy and Department of Energy contractors and subcontractors as well as certain family members of deceased workers. The program was recently expanded to include a new class of former employees who worked at Area IV of Santa Susana Field Laboratory at least 250 workdays within a specific period of time in the 1950s. More information on this class and the eligibility requirements can be found on the NIOSH website:

http://www.cdc.gov/niosh/ocas/ocassec.html; Or on the DOL website:

http://www.dol.gov/owcp/energy/regs/compliance/law/SEC-Employees.htm

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Under Part B, individuals made sick as a result of exposure to radiation are eligible for:

- $150,000 maximum compensation (radiogenic cancer, chronic beryllium disease, chronic silicosis) and
- Medical benefits are available in addition to compensation.

To be eligible for coverage under Part B, individuals must provide proof of

- employment at a qualifying facility
- exposure to radiation, beryllium or silica
- medical diagnosis, e.g. radiogenic cancer, chronic beryllium disease or sensitivity, or chronic silicosis.

Part E is available to contractor and subcontractor employees of covered Department of Energy facilities as well as certain family members of deceased workers. Workers made sick as a result of exposure to hazardous contamination are eligible for:

- $250,000 maximum compensation and
- Medical bills for accepted illnesses.

To be eligible for coverage under Part E, individuals must provide proof of:

- employment at a qualifying Department of Energy facility
- exposure to toxic substance
- medical diagnosis, e.g. asbestosis, cancer, chronic beryllium disease, dermatitis, asthma, etc.

For both Part B and Part E, the Department of Labor will assist in collection of evidence, including employment & exposure records and medical documentation, but the ultimate responsibility for claim rests with claimants

For further information, contact the Energy Employees Occupational Illness Compensation Program Act Program by calling 1-866-888-3322 (TTY: 1-877-889-5627) or visiting their website at http://www.dol.gov/owcp/energy/index.htm

The **National Institute for Occupational Safety and Health** (under the auspices of the U.S. Department of Health and Human Services Centers for Disease Control and Prevention) operates the Division of Compensation Analysis and Support to support implementation of the Energy Employees Occupational Illness Compensation Program Act Program of 2000. They are responsible for assisting claimants under the Energy Employees Occupational Illness Compensation Program Act of 2000 and:

- Developing scientific guidelines for determining whether a worker's cancer is related to the worker's occupational exposure to radiation (probability of causation).
- Developing methods to estimate worker exposure to radiation (dose reconstruction).
- Using the dose reconstruction regulation to develop estimates of radiation dose for workers who have applied for compensation.
- Establishing a process by which classes of workers can be considered for inclusion in a Special Exposure Cohort.
- Providing staff support for an independent Advisory Board that will (1) advises on the methods, guidelines, and the program mentioned above, and (2) make recommendations to the Secretary of the Department of Health and Human Services on petitions by classes of workers to be designated as members of the Special Exposure Cohort.

Contact the Division of Compensation Analysis and Support via email to ocas@cdc.gov or telephone 1-877-222-7570 (toll-free). Learn more about the program by visiting their website at http://www.cdc.gov/niosh/ocas.

Appendix D

EPA Interview Summaries

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 3/16/2010

Interviewee(s): 1

I worked at Atomics International (AI) beginning in 1958, but I was never "assigned to the hill" while working for AI. I was on the hill while working for Rocketdyne in 1965 at a research facility located just past the entrance gate. I was not in any of the test facility areas.

I did work a few times at Building 4093, the AE-6 reactor. There was a nuclear reactor there and because I was a licensed reactor operator I went up there just a couple of times to run the reactor. It was sub-critical at the time. As I recall, they were running experiments on the core and they needed a licensed reactor operator at the console. This was probably prior to 1965, probably 1963 or 1964. I was licensed on the L-77 reactor, which was a little reactor operator down at headquarters. We were running some experiments for the Systems for Nuclear Auxiliary Power (SNAP) program and we were also teaching for the SNAP reactor. It was a prerequisite for people to run the SNAP reactor. People had to become licensed through the Atomic Energy Commission (AEC) and they would go through a testing program with us. This was all down at DeSoto.

I was up to the hill a few times for an experiment when I first went to work probably in 1959 or 1960, I was working on a project called radiation fuel gage. The purpose of that was to place nuclear sources around fuel tanks for airliners. Various tanks were up on the hill that we would work on, but I can't remember where this area was located. I worked on this program at the Rocketdyne facility off of Van Owen, at the DeSoto facility, and then at the Santa Susana Field Laboratory (SSFL). The facility at SSFL was outdoors. There was a building area and there was a blacktop area outside where we worked. After that I went and became a licensed reactor operator for the L77 reactor at DeSoto. We did training with the SNAP reactor people and also at that time I was doing experiments pertaining to radiation effects on electronic circuits. We had a flash x-ray machine and we would simulate gamma explosions from nuclear weapons and the effects it would have on electronic circuits like guidance missiles. That was all done at DeSoto.

Going back to the AE-6 reactor, I would be at the console because they needed a licensed reactor operator. The console was separated from the reactor core by a wall or building or something. I would essentially just run the reactor. As I recall, it was all subcritical. I would just run it up a little bit and they would do their experiments or move things around. I don't really know what they were doing. I think it was an open core with graphite. I ran the controls one or two times

for about a half-day. It wasn't a part of my everyday routine. My time on the hill was very limited.

The radiation fuel gauge project used cobalt-60 (Co-60). The Co-60 sources were small, but we used a lot of them. We placed them all around tanks of various shapes and sizes. We would fill the tanks with water and try to get readouts with Geiger counters. Then we would rotate the tanks and see how the results changed. I remember starting off with a squared-off tank that was perhaps 3 to 4 feet high. I think I tested this tank for 6 months with various configurations of the Co-60 sources. The only thing I ever used was water in those tanks. We didn't test a lot of tanks, but we tested a lot of source configurations. It was really boring. You would set up the sources on a tank and run a test and maybe that would take an hour or two and then you would move the source around. I'm sure I was doing other things too. I can remember building some circuitry. You did a lot at AI, there were various programs and you did a little of this and a little of that. I didn't set up a test and then leave though, especially when you had radioactive sources, you wouldn't leave those out. You had a lead-line container, a "pig," where you would store the radioactive sources. After you ran your test, you put all your sources away. This testing was a one man job, I was the one placing the sources on the tank and putting them away. I was told were to place the sources and guided by people who knew what was going on. I was a tech at this time and not that familiar with the nuclear field. I had an engineer that told me were to put the source and which tests to run. I would also collect the data and so some analysis. I can't recall how I stuck the sources on. I don't know if there was some kind of magnet or tape. That was my first project at AI and it was not a very exciting project. Eventually the project lost its funding. I can't remember if it was outside funding or internal. We had outside contracts and internal projects that were funded by AI.

I am not aware of the disposal practices at SSFL.

We had always been trained in the proper handling of radioactive materials. We had film badges that were used for exposure over time and dosimeters for immediate readout. They were like pencils and you could read them directly to see if you had been exposed to radiation.

My feeling about the company was that they were always very careful. They made sure you understood what you were doing. They had classes of their own for safety and other technical issues. For the licensing of the L-77 reactor, we were sent to a UCLA extension program for nuclear engineering. The company was keen on education and making sure people knew what they were doing.

My boss and I were trained by a guy that had been running the L-77. His training for us was essentially explaining to us which switches to hit and what gauges to look at. When the AEC came out to check our training, my boss and I both failed their test. Needless to say our initial training was not up to par. We were then sent to the UCLA extension program so the next time we were tested we easily passed. AI always tried to do right by their employees as far as I saw.
I am not aware of any issues with drainages, septic tanks, or leach fields. I never heard any rumors of anything being done that shouldn't have been done. You would have to talk to people that were assigned to dealing with the disposal of radioactive waste.

After I came back from Rocketdyne, I was assigned to a project that involved analyzing moderator material from the Organic Moderator Reactor Experiment (OMRE). Al had two reactors they were doing research on, the Sodium Reactor Experiment (SRE) and the OMRE. We were very careful in disposing the material we analyzed.

Areas at SSFL that EPA may want to look at for its sampling efforts are the burn area and the hot cell. I would assume the SRE area would be one of particular interest. The question is, "How clean do they want to get this area?" If you want to clean the site up to a pristine level then I guess you would remove the whole mountain. I would think for the people that live in the West Valley or on the Simi side that the trichloroethylene (TCE) issue is more of a problem. I would think solvents like TCE would migrate more readily than radioactive material. But I am not an expert.

I have heard there are certain areas in Simi with higher cancer rates, and some eye problems in the West Valley. You just don't know what to think.

Later on there were more buildings and more people, but he only people I interfaced with were AI personnel.

I was not aware of and did not see, but I have heard secondhand that during the cleanup of the SRE, some people did not wear their film badge because they would have exceeded their exposure limits.

I was not aware of any incidents with the AE-6 reactor. I don't know why I was even running that reactor, if it was because someone was sick that day or some other reason. I had no history with the reactor or anything like that.

I have heard some people say that we were never told about the SRE and that is not true. As far as I know, it was an open subject and there was no attempt to cover it up. I didn't know about it exactly when it happened, but shortly after I was aware of it. I don't know if the surrounding community was made aware of it, but those of us that worked there were aware of it. I wasn't really that concerned because I wasn't working on the hill regularly, but there was never anybody telling us not to talk about it. I know there were people in the company that weren't aware of it at the time though. I can only speak for myself, but it wasn't a big secret and we talked about it.

I was never told to do anything I felt was wrong. I was well trained. I did what they asked me to do. I don't have any complaints.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 3/16/2010

Interviewee(s): 2

I received my Ph.D. in physics from the University of Illinois in 1951 and my thesis was on the radioactive decay of ruthenium. I have worked as a Nuclear and Instrumental Engineer in various firms. I spent one year as a professor of physics at the University of Arkansas, but I don't think I was any good at it. I think you were here to ask me specifically about my experience at Atomics International (AI). I started at AI in November 15, 1955. I was laid off in 1965 or 1966 and was transferred to Rocketdyne. Then there was another lay off. In March 1968, I changed companies and worked for the Garret Air Research Manufacturing Division working on separating heavy and light uranium. I retired from Garret at the end of March in 1989.

The nuclear experience I had at the Garret Air Research Division had to do with designing and building centrifuges for separating heavy and light uranium.

At AI, I was an engineer in the instrumentation group involved in measurement devices. I worked on the development of an automatic shutdown device or fuse for a power reactor, which eventually led to a patent that was taken out after I left the company. Most of my time was spent at the Van Owen and DeSoto facilities. I spent very little time at Area IV on the hill, maybe a day at a time here and there. I do remember doing some work on the hill at the Kinetics Experiment Water Boiler (KEWB) reactor. I remember testing a piece of electronic equipment with a pulse of nuclear radiation from the reactor. The KEWB reactor is a water boiler reactor, which is essentially a big pot with water and a solution of uranium in it. If you pull the control rod part of the way it, the reactor goes critical and starts to generate power. If you pull the control rods all of the way out, the reactor goes supercritical and then "poof." It explodes and puts out a lot of nuclear radiation in a very short time and then of course it shuts itself down automatically. Then you have to wait 45 minutes before you can set it up again. I spent one day doing that. We eventually discovered a much easier piece of equipment to use for our tests that gave equally useful results to the reactor; it was a flash x-ray machine. We had the flash x-ray machine at DeSoto. It doesn't rely on a nuclear reactor. It is an x-ray tube with a cold cathode. The cathode has a lot of tiny spikes on it to generate intense electric fields at the points of the spike and draw electrons out of the cathode. Then the electrons slam into an anode and generate x-rays. It was a lot simpler to use than the KEWB and cheaper as well.

I was a member of the reactor safety committee at Area IV. We evaluated safety issues with the Systems for Nuclear Auxiliary Power (SNAP) 10 reactor. The SNAP 10 was a small reactor

with no coolant. The idea was to use thermoelectric conversion of the heat from the core and turn it into electricity, which could then be used to run a military satellite. The way the reactor operated was that you had this core of uranium and graphite. Surrounding it were pieces of beryllium. Beryllium is a good moderator and reflector. When the beryllium was close to the reactor core it increased the amount of neutrons that would reflect back to it and make the reactor critical. If you pulled the beryllium away, the reactor became subcritical and shut down. The reactor didn't have control rods. The beryllium was used as a moderator and a control device. I forget what they used for the thermoelectric equipment. The physical nature of the stuff was described as having all the strength of plaster, so it had to be held in compression, but it had a good coefficient. The reactor worked fine and the satellite was sent into orbit. It was shut down after a month or so because the rest of the satellite didn't work very well. As far as I know it's still up there circling the globe.

As a member of the reactor safety committee we tried to think of any potential issues that could arise and have a plan for dealing with them. The two big safety concerns we explored with the SNAP 10 rector had to do with shipping the reactor to Vandenberg Air Force Base and the potential for transportation accidents. We didn't want the truck carrying the reactor to crash into a gasoline truck. That would result in a big fire and the uranium in the reactor would burn up and spread and there would be a big radioactive mess all over. We persuaded the California Highway Patrol to not allow any gasoline trucks on the highway the day we were planning to move the reactor. The other potential transportation safety was if the truck tipped over and rolled into a ditch with water. If the reactor was in the water for a long period of time, the radiation could percolate into the water. I forgot what we decided to do about that other than make sure the truck driver was very careful. As far as I know, nothing happened to the SNAP 10 reactor and it made it safely to Vandenberg Air Force Base and was launched. It is still in orbit.

Another possibility was this. After 3,000 years the satellite is going to come back to earth. We postulated what would happen to it when it comes back. One fellow postulated that the very worst thing that could happen would be that the satellite landed in the middle of Rockefeller Center in New York City. Well, what could we do to prevent that? We excused ourselves from contemplating that scenario by saying that event would potentially occur 3,000 years from now and it wasn't our responsibility. I think we were pretty responsible. We thought about the first 3,000 years at least.

Going back to the scenario with the reactor in the water, the issue would be that radioactivity would get into the water and groundwater and be distributed that way. There wouldn't be too much in the air. A geologist or hydrologist could tell you more about the transport of radioactivity in water; I am not an expert in that. But I would imagine radioactivity travels faster in air than water. Dispersion of radionuclides depends on the chemical nature of the element, not the fact that it's radioactive. As far as being concerned about any particular radionuclides, that is really outside my area of expertise that would be health physics. I would be concerned about that I can think of off-hand are cesium-137, cobalt-60, a radioactive isotope of barium, uranium and its daughter products, and a gaseous form of iodine. None of them are very nice.

Going back to my one day at the KEWB reactor, I remember that the technician that was supposed to make sure the cameras had film in them forgot to load the cameras and we missed

the first shot. We didn't get any data on our first pulse of the reactor. I was waiting outside the KEWB building when we ran a test. It was a safety precaution. We didn't want to be near the thing when it went "poof." We would set everything up and get it ready to go. I went outside. I don't know how they got the reactor to go off, maybe there was a timer or something. I don't remember that detail. Maybe there was a timer with a delay so that we could leave the building before the control rods were pulled out. The system would pull the control rods out then put them back in. When the control rod came out you would get this "explosion" and then you would drop the control rod back in and wait for things to cool down. Then you set it up and do it again. The measurements would be recorded on an oscillograph or camera. An oscillograph was an oscilloscope with a camera looking at it. The "poof" is the release of radiation from the removal of the control rod. The reactor liquid is completely contained in the tank; it just expands to a greater volume when the reactor goes supercritical. The KEWB itself was below grade level and the reactor itself was in the cellar of the building. This provided additional shielding. The KEWB was a stand-alone experiment and not related to the other experiments at the SSFL except that Al was running all of them. I don't recall what the other buildings surrounding the KEWB building were used for. I was doing this in 1964 or 1965, so it was at least 45 years ago. I left in 1966, and this was one of the last things I did before I left.

I did have another concern with the containment vessel of one of the SNAP reactors. The concern related to a nil ductility transition temperature. Carbon steel at low temperature is brittle, but at a high enough temperature it becomes non brittle. If you irradiate it, you change the crystal structure so that the temperature at which the steel become non brittle gets higher and higher. This is the nil ductility transition temperature, the point at which the steel goes from brittle to not brittle. Below this temperature the steel is not ductile, it will crack. Above this temperature, the steel is ductile and will bend a bit. In this case there is a containment vessel around the reactor and they wanted to be sure that when the reactor was operating the containment vessel was above the nil ductility transition temperature. They measured that with a couple of thermocouples attached to the containment vessel. One time there was a disagreement between two of the thermocouple readings and I had to make a decision regarding what to do about it. Which reading was the correct reading? For safety reasons, I said you would have to believe the lower reading, that the lower temperature was the nil ductility transition temperature. Later on after they took the thermocouples out they discovered that the thermocouple giving the lower number was the one that was accurate. So I was justified in my decision. I can't remember exactly which SNAP reactor this issue pertained to, maybe SNAP 8. The safety committee I was a part of was based at the DeSoto facility, but we would occasionally visit the hill for inspections.

While at Rocketdyne, I was based at the research center located not far from the entry gate. I was there full-time for about two years as I recall. It was a large building that had a lot of cubicles.

I don't recall handling any radioactive sources. For a while I was head of a small group of engineers and some of those engineers worked on the Radiation Fuel Gauge project which used cesium or cobalt sources, but I don't recall exactly where the testing took place. The idea of this project was that you placed radiation sources on an aircraft fuel tank such that you can measure the quantity of fuel in the tank regardless of attitude of the tank. Normally fuel gauges consist of

probes stuck in the liquid of the tanks. They try to locate the probes so that when the gasoline what out of one probes range, another probe will pick it up. The Radiation Fuel Gauge project was supposed to be a simpler way of instrumenting the tank. You didn't have to put multiple probes into the tank; you could put radiation sources on the side of the tank. They worked on that for years and years, but never seemed to get anywhere. I don't know where the actual testing took place. I wasn't a part of the project, but a few of my engineers were.

I don't recall any disposal practices or any on-site disposal of radioactive waste. I only know what I have read in reports, but I didn't read that there was any disposal on the site. I do remember there was a plan to build a "Hot Laboratory" to reprocess fuel elements. I think they did build the Hot Laboratory, but I don't know if they developed the chemical processing to reprocess the fuel elements. I think at that time the U.S. Government decided not to reprocess the fuel elements; it was just cheaper to dispose of the spent fuel elements and buy new uranium. France takes a different approach because they don't have any uranium mines.

I have read accounts of what happened at the Sodium Reactor Experiment (SRE). It didn't make any impression on me at the time so if I knew about the SRE incident at the time I had since forgotten about it. After reading these accounts, I can see why I would have forgotten about it because it wasn't really something people that worked there would have thought was unusual. It was an experimental reactor. You operate the reactor to find out what is wrong with your design. Well they found out one thing that was wrong with their design. The lubricating oil for the pump motors leaked into the sodium. This plugged up some of the coolant tubes. As a result, the fuel elements overheated and burst. This was a problem because we had to go in and fish the fuel elements out. It was a job to get them out and we had to develop special tools to do it. But it was the sort of thing we expected to happen because the SRE was not a finished design. We were experimenting and this was one of the things we found out we had to change. I'm not exactly sure how they fixed the issue with the lubricating oil, but it was fixed. Some people are insistent on calling this a partial meltdown, which does not seem correct to me. To me a partial meltdown would involve melting of the coolant tubes themselves so that the whole reactor core would have been useless afterward.

Meltdowns have happened in some reactors in the world and when it does the reactor in question is simply abandoned. There is no attempt to repair it because it is too dangerous to get close to. Dirt is thrown over it and you wait for 200 to 300 years before it will be safe to work on. This certainly did not happen at the SRE. They were able to continue running the reactor with the damaged fuel elements. They finally realized something was wrong with the reactor and shut it down. I am familiar with this because I have read all the reports about the SRE incident.

Another thing that keeps coming up from time to time is the tritium in the water. For a long time I couldn't understand where the tritium was coming from because it has a half life of about 10 years and it has been maybe 60 years since any reactor was running up on the hill. I dug into it and finally figured out that tritium is created in the upper atmosphere - it is cosmic radiation and so it falls continuously. There is always a little bit of tritium around. It is a very soft beta emitter so it doesn't do much damage. You probably have a little tritium in you right now. It's always been around, it's just like you have carbon-14 in you that slowly changes to nitrogen and you have potassium in you that is slowing changing into argon. These have been around since

the beginning of the earth. So 50 years ago if they found tritium, I would say maybe that's the result of a reactor, but 50 years later I would say detection of tritium would be the natural background that results from cosmic radiation.

I don't know anything about the sewers or drainages at the SSFL.

There wasn't much occasion to go to other building on the hill other than the buildings you were working on unless it was for a social call at lunch to play bridge or something. The SNAP program was quite separate from the SRE program. SNAP was funded by the Department of Defense and SRE was funded by the Department of Energy. There were even classification issues with the SNAP, as things were secrete, but there was nothing specifically secret at the SRE, it was intended for commercial use.

The company had one other reactor problem in Hallum, Nebraska. You may have heard about it. Using the design as SRE, the company contracted to build and put into operation and sodium-cooled reactor. They made one mistake. They didn't use the same design for the moderator cans that they used in the SRE. They went to a different design and the darn things split open. They ended up with sodium mixed in with the graphite and it was a big mess. They were given the choice between putting up $4 million to clean up everything or $8 million to fix everything. They chose the cheaper option and that was the end of the SRE program. Although lately, I read that someone has come up with a new design for a sodium-cooled reactor.

I think the most logical areas of concern at the site for U.S. Environmental Protection Agency are the KEWB, SRE, and various SNAP reactors.

I know there are reports of groundwater coming from the hill that is radioactive. I don't know what kind of radionuclides are in the water. If it's simply tritium, I understand how that could be there from the cosmic radiation, otherwise I don't know. They may be some long-lived things still around from the soil being irradiated, but I just don't know.

There is also some hysteria associated with the whole site. There are a group of people that have been afflicted with cancer and they are convinced their cancer is a result of testing that occurred by North American Aviation, including the radioactive testing Al and the rocket testing Rocketdyne did. Rocketdyne used various poisonous solvents. They were not very careful about how they disposed of stuff.

One of my jobs at Rocketdyne when I was there was to measure the distribution of droplet sizes of a spray. The spray was something that I am sure would give me cancer if I breathed it. I didn't get cancer from it, so it didn't hurt me. I don't know what they were using it for and I don't know why I was measuring the droplet distribution, maybe it was to figure out how it would burn in a jet engine. There was some peculiar geometry involved in measuring the droplet distribution. The way you would assess the droplet size was to not measure the individual droplets, but to make measurements on droplets that were coming close to some sort of probe and how you interpret the voltage variation in the probe as the droplets come near it. This involved some tricky mathematics that I needed help with.

With regard to industrial wastewater being used to water areas of the hill, I don't recall seeing any watering going on up on there. It was a desert and they just left it. We had to watch out for rattlesnakes though. One fellow said it was a good idea to wear high boots so if a snake strikes it will hit the boot and not your leg. I never ran across any when I was there, but they are quite common.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 3/16/2010

Interviewee(s): 3

I was an operations engineer assigned to Facility while working for Atomics International (AI). I started as a forklift operator and at one time I was in charge of five test facilities. I was up there 35 years. The way that it worked at the AI Liquid Metal Engineering Center (LMEC) / Energy Technology Engineering Center (ETEC) side of the hill was that in a building or test facility you would have engineers that would be in charge of the engineering side of things. They would have all of their engineering staff. A project would come in and engineers would be assigned to the project, design engineers, electrical engineers, and a project engineer who would be in charge of the overall project budget. In each test facility you would have an operations engineer and then your operators; we called them operators and not mechanics. I was an operations engineer. The operations engineer would be in charge of that facility no matter what project was going on or what other group of engineers assigned to the project were going through. I never left my building, projects would come and go, but I would stay at the same building. I would be in charge of getting the project set up and operating it to whatever procedures were written. So we had a lot of input to how the procedures were written.

The operations engineers and the operators themselves were probably some of the most highly trained people you ever met. Out of a 40 hour week, we probably spent 8 hours a week in some sort of training. Training included topics such as hazardous material handling, water treatment, sodium handling, hydraulic oil safety, high pressure safety, and fire training. At one time I had my 40 hour hazardous material first responder certificate. I was a site manager and a first responder. All of my guys had the same type of training expect for the site manager training. These guys on the hill had so much training; we had enormous amounts of training. It was absolutely a requirement. We were always trained in any kind of regulatory requirements. We were always afforded the training and knowledge of the time. So they never held anything back from us, we knew what we were getting into with different projects. The company was very good about training.

I spent almost all of my employment from 1963 to 1999 on the hill. The only exception was for about 8 months when I worked in the fuel fabrication department at headquarters. I held various job titles at the Santa Susana Field Laboratory (SSFL) over my 35+ years including, forklift operator, mail boy, plutonium facility worker, and shift leader at the Sodium Components Test Instillation (SCTI) facility. I also worked in Building 13, the Earthquake Test Facility.

My first job was as a fork lift operator and heavy equipment operator. Materials would come up from headquarters on a truck and I would unload them, separate items base on their destination, and deliver the materials to the proper building. There were 5 of us that did that. Items would be packaged and have routing tags on them. It could be anything from a 500 piece of nickel to gaseous nitrogen in K bottles. At one time I had to unload a truck and load a truck every day for almost a year. And in each truck there would be 300 of those big gas bottles, 122 pounds each. They would be laying down, so I would have to go stand them up, roll two at a time, lay them down onto the forks, take them down and then pick up two more.

Then I was a mail boy dealing with secure mail, Q clearances and top secret clearances. Then I went from there down to headquarters for the fuel fabrication work. Then I came back up and worked at the plutonium facility. But it wasn't hot at the time, meaning there wasn't any fuel up there. We were fabricating the building at the time and all the handling equipment such as the glove boxes, etc. Then I transferred to SCTI and I was there for about nine years. I was a shift leader at SCTI. The shift leader was like an operations engineer, he was in charge of a specific crew for a specific period of time. We worked a rotating shift – six days working the day shift (first shift), then a day and a half off, then seven days of second shift and two days off, then seven days of third shift with four days off. It will destroy your family life. I was doing that and going to school at the same time. After I left the SCTI they increased the power level to 70 megawatts of power and they actually supplied power to one of the local cities out here.

After SCTI, I transferred to Building 13 and that wound up being the earthquake test facility. It was also a stress intergranular analysis facility. We weld different pieces of metal together to form a pipe. Then we would put measurement devices on the pipe to measure within a millionth of an inch any movement. We would put the pipe in an oven and put six hydraulic jacks between the two ends and we had as much as 750,000 pound s of pressure and we would heat it up to 900 degrees and then shock it to 500 degrees within about 16 seconds and see what happened. Our tests in that facility wrote the books for the engineers. They didn't know what the breaking point of something was. We developed the statistics for the engineers to use in their designs. In Building 13 we got to break things and get paid for it. It was a good job. Before I worked there Building 13 was also the Systems for Nuclear Auxiliary Power (SNAP) 8 and SNAP 10 assembly building. They modified the building later for the earthquake testing. I didn't work in Building 13 when it was a SNAP assembly building.

When I was a fork lift operator I hauled SNAP 8 and 10 fuels to a storage facility. I also hauled remnants from the SRE rupture to Building 64, "The Vault." I did not package the remnants; I just hauled the box from one area to another. I wore a film badge and dosimeter while doing this work though. In all the time I was down at headquarters working on fuel fabrication and on the hill, I never received a daily dose. Down at headquarter we had up to 750,000 dpm airborne contamination. You could see it floating. We knew what we were doing though.

Building 28 was the neutron flux generator reactor. I was a fork lift operator working at that building. They had to create a frame with lead shielding to put between me and the items I removed with the fork lift from Building 28. That was a neat building. They did things with mummies, motorcycles, and .45 caliber pistols. You could take a picture of a .45-caliber pistol and you could see the spring inside the gun, the bullets inside the clip, and the powder inside the

bullets. They did a lot of mummies and stuff for colleges and universities. Rather than disturb the outer packaging of the mummy, they could look inside it. They even did a dinosaur head in Building 100. I moved things within the building because everything associated with the reactor was heavy.

As a forklift operator I would go to any building and pick up stuff and deliver it to where ever they wanted. I would pick up a lot of things and take them to the old disposal pit. The sodium disposal pit, "the pit" as we called it, was where they would take pipe that had been excised out of the sodium test facility and had some residual sodium in it. At 300 degrees sodium is a liquid, but as it cools it becomes solid. But get sodium wet and you get big burning explosions. I wanted to make a bomb for Vietnam out of the stuff. We would take sections of pipe out to the pipe, chain it down, and we had a steam boiler out there with steam lance and we would sit behind a shield and steam the sodium out. It was the best way to get rid of the sodium. Or if we had smaller stuff we would throw it in the pit with water. So we took a lot of things up to the burn pit. One thing you are probably interested in is mercury. As far as I know, there was never anything radiological taken up to that burn pit. Radiological material was only taken to specific building with specific needs to have it. It was always loaded by procedure. Everything was always done by procedure, including all the smears and scans. Before I was even allowed to pick it up they would make sure I had my film badge and make sure all my training was current. They made us well aware of what we were doing. I transported waste material in "pigs" to Building 64, and sometimes to Buildings 21 and 22. I think an outside contractor took the waste from there to Beatty, NV. I am not sure what was ultimately done with the waste, I was just asked to move it.

We had the Apollo-sponsored spacecraft. A lot of people don't know that it had six discs that were 3 feet in diameter, some of them 6 inches and some 2 inches thick made out of depleted uranium at the bottom of that spacecraft. During launch if something went wrong, they could eject and this would help keep the capsule oriented until the parachutes came out. We liquefied the uranium, cast it in different configurations, and then coated it with epoxy resins so that the oxide wouldn't grow. It was the weight of these disks that kept the capsule in the proper orientation for deploying the parachutes.

Most files for Area IV, including as-built drawings, were stored in Building 57. So there should be records there for you to look at. Building 57 was part of ETEC, but as they started shutting things down it became a place to store filing cabinets and records. Building 57 was originally a SNAP 10 shipping container building. They would take a SNAP 10 after it had undergone all its shaker testing and everything was ready for flight. They would take it to Building 57 and open this gigantic can, like 25 feet long and 20 feet in diameter. They would take the top half off and put the SNAP 10 in a certain configuration monitoring it the whole time. Then they would close it up and I would go in as a forklift operator and put it on a truck.

Looking at a map of the site I can tell you the following building numbers and descriptions:

Buildings 13 and 59 were SNAP 10.
Building 19 was a SNAP 8 test facility and was a hot building.
Building 57 was the "canning building" for shipping.

Building 25 was a test facility for SNAP 10. This building I believe went hot.
Building 12 was a test facility for sodium potassium (NaK).
Building 28 was the neutron flux generator.
Building 27 was the shaker table for the SNAP 10. There was nothing hot here.
Buildings 32 and 42 were sodium test facilities.
Buildings 20, 21, 22, 24, 25, 19, 59, 9, and 100 were all hot buildings.
Building 64 had a loading dock.

I went in the hot cell with the fork lift to take out the windows. They were very long and stair stepped with lead-impregnated quartz glass, white oil, then another layer of lead-impregnated quartz glass. Those windows weighed 6,000 pounds. There was not much room to drive around in there. They were changing the seals on the windows and that's why I was hauling the windows around. The seals would deteriorate from exposure to the radiation. They had all kinds of stuff in that building like iridium and tritium.

I didn't really have a lot of exposure to radiological materials on the hill. My work with radiological material was primarily down at headquarters with the fuel fabrication there.

Building 64, "The Vault," was actually a very small building. It had this really neat thing, a scale. It was about 8 feet long, 4 feet high and 3 feet deep. The scale had engraved glass sides with teakwood or hardwood components. It had a balance beam that was gold. It was from the Oppenheimer project and came out of New Mexico. It was used at the vault to weigh items. Building 64 had a standard loading dock.

At one time all of the buildings were down and we were still maintaining surveys of the facilities, collecting the film badges, checking the security of the facilities, making sure there was no water leaking, etc. I was in charge of a crew that did that. I can't think of any issues with pipes, sewers, or drainages that stick out. As far as any internal water leakage, we saw a few roof leaks, but I haven't heard of anything else. All the vaults had sump pumps to pump through filters and scanners, but I didn't have anything to do with that and never heard anything about issues with those pumps.

The only radiological accident I can recall was at the SRE. As far as SNAP 8, SNAP 10, ETB, ETB Annex, I never heard anything happening with those. As far as the plutonium facility, they went hot with plutonium, but when I was there I was just helping build the building. I never heard of any problems there after it went hot.

Building 100 and Building 9 had the Organic Moderator Reactor Experiment (OMRE) and graphite reactor. They had all kinds of stuff going on there. They modified Building 100 so the roof pulls back and they could shoot a laser beam out of it and hit the moon. They left a target on the moon and they would shoot laser beams at it. I have no idea what they were testing. Building 9 and 100 were hot for a long time and they were hot when I was up there.

I was not really concerned about the hot buildings up on the hill. The only concern was for the deep pockets coming out of the valley looking for help with their maladies. There is someone claiming to have gotten cancer from the hill, but this person had cancer before even moving into

town. There are guys that have died up there because of industrial exposure. One guy I know real well because I gave deposition to his case. That was for asbestos. We worked with a lot of asbestos. We even knew how to do field tests for lead, zinc, short-fiber asbestos, and long-fiber asbestos. You just had to have a lighter. As far as radiological issues, I never had concerns at the hill. I worked with hotter stuff down at headquarters.

Those guys in Buildings 20, 21, and 22 had all the hot stuff. If anyone was going to get any exposure those buildings are where it was going to happen. I know one guy that died, I don't know if it was from cancer from working at the site, but he used to work in Building 21 and 22.

We had a test facility called the water loop (Building 463, the hydraulic test facility). We tested sodium components. It was clear off in the boonies. We had three separate gigantic pumps and we could pump water through different configurations. We tried to stall pumps. We would have a pump pumping water one way and then set up another to run the opposite direction to see if we could stall the pump. We had to make sure when we were doing a injection test for hypergolic fuel test. Rocketdyne hired us to do this. We built this big plastic box and we would shoot water through it. It had a laser array and as the water would go through we injected phenylthaline though it. It would react with lasers and you could see it, so they videotaped it. So they could see if they were getting homogenous mixing. It was a test for fuel development, but we used water first. We had all this effluent containing phenylthaline and to test for it we would dump some water into three 5-gallon jugs and put goldfish in there. If the goldfish hadn't died in three days we were allowed to dump it to ground. That was an Environmental Protection Agency-approved scientific test.

I have pictures of the water loop. It is not there anymore. It was a revolutionary type pump we were testing. I also have a picture of what happens when a valve goes the wrong way during a pressure test - you blow the side out of the building. That was Building 4013. We blew part of Building 4013 clear over to SCTI with the failure of that valve. That photo was from May 4, 1989.

At the earthquake test facility (Building 13) we could put a million and a half pounds of compressed pressure on top of the facility and we could squeeze it and we had a table underneath with rubber isolators. In fact most of your buildings and bridges sit on rubber isolators now. We could run tests on the building to see how it would respond to potential seismic events. The floor of that building is 10 feet thick, 40 feet long, and 20 feet wide, with 2 inch rebar every square foot. They poured continuous concrete for 2 days. Everything had to be bolted to the floor for testing and measurement.

We used to do to conduct check valve tests using a bowling ball. We took a bowling ball, cut it in half, filled it with lead, put it back together, and we had it in plastic piping and did high flow testing with it.

We would take the tops off buildings to remove pumps from the buildings. The roofs weighed 29,000 pounds. I was in charge of the crane that had to remove the roofs and pumps. I was certified to operate and train others on cranes. The crane sits on a 100 foot high building and it has a 125 foot boom. It could pick up 180,000 pounds. After the sodium pump was tested, they

had to pull it out. Sodium reacts with the moisture in the air so they had to lift it out in a bag. I was only operating the crane in the example, but they had a sewing machine in the building and they sewed a bag around the pump and they were lifting it out and filled it with nitrogen as they were pulling it out. The sodium pump weighed about 70,000 pounds and the clearance between the pump and the pump case was less than 0.25 inches. Handling the crane was pretty delicate business.

I thought some of the people up on the hill were some of the neatest people to work with. If you kept your mouth shut and just listened you could learn so much up there. It was so much fun working there. We were always doing something different. It wasn't boring. You had to know what you were doing all the time. It was a lot of stress too though because if you didn't do something right, someone could get hurt.

The average test took 16 seconds in the earthquake building. We had earthquake data on computers that we could replicate and alter as we wanted. The littlest earthquake that we replicated was 6.7 on the Richter scale. The highest was 25 times that. It is fun to see what happens to pipes under those conditions. The pipes would be filled with oil so I had oil all over my facility, but it never got out of the facility. We would go clean it up with soap-based detergents. We developed engineering data at that building. You can over support something. You are better off letting pipes move that attaching them too rigidly to a wall because if the wall moves one way and the pipe moves another, pretty soon you could have a bang. We wrote a lot of books up there using our test data.

Going back to your concern about radiological issues, I just didn't have much to do with that when I was up on the hill, only in the form of transporting packaged material.

I estimate that about 1,700 people worked in Area IV at one point. There were a lot of 24 hour operations running 7 days a week, such as at SCTI. I went nine years without having a Christmas because I was working. It was good money, but those shifts were hard.

If I had money and they let me I would build a house up there. I would have no problems living up there. There are some beautiful views.

There is probably some surface contamination still up there. And they are trying to get rid of it the right way. But you have Barbara Boxer and a few other people involved. I'm tired of all the "numb nuts" causing problems up there. They are egotistical and think they know more than the people that worked there. They are paid advocates looking for deep pockets so they can ride the wave. Barbara Boxer couldn't make a decision if she had to. They cleaned up the site by the rules at the time and sent all the contaminated waste off site. Give them a set of rules and they will do it. But whose rules are you supposed to do it by? I went to one of those public meetings in the hotel and the first 2.5 hours were people talking about their education. I don't care about that. When they finally started talking about their findings, they were talking at a level above so many people that no one knew what they were talking about. You had people from Van Nyes over at that stupid meeting all worried about getting sick from the site and these people are making them even more scared. Talk *to* the people, not *over* them. I get very upset about that, if you can't tell. They are inciting fear and that is the wrong way to do things. You want to relieve

the fears of the people. They have a right to know the truth and you should darn right tell them, but tell them at a level they understand.

Everyone up at the site worked extremely hard with lots of oversight to clean it up properly. But right now if one person doesn't like the outcome of something he or she is going to make a big deal to get the work done over again and get another opinion. It's like doing a curve fit; you can take data and make it come out any way you want. You can do that with these interviews you are doing – make them turn out any way you want. People get so technical that it raises concerns right away. You just have to do your job and talk to people in a way they can understand. There is always someone who will not be happy and swear up and down that they didn't get the truth.

I had one of the biggest sodium fires in the history of SCTI up there. One of my operators came in and said "I think we have a problem." We were at 35 megawatts of power throwing 3 million pounds per hour of water flow going out to make 900 degree superheated steam, which reacts with sodium and I had sodium sitting out on the floor of the building about 3 feet high and 6 feet wide in little cones, just drip, drip, dripping. We ended up isolating the sodium and coating it with calcium carbonate to starve the oxygen and put out the fire. It cools down and gets a crust on it.

Talk to the operators if you want to know about lots of buildings. The engineers tended to stay in one place, while the operators moved around. Wherever the test was the operators followed. We had 100 or so operators at one time. When I left there were only about 20. They would go from one facility to another. Sometimes you would work at one place for a while, like I did for nine years at SCTI, and then sometimes you would only be at a place six months depending on the duration of testing.

We had this Ph.D. physicist. She was a neat gal, so smart. She wore pants and it just blew everyone's minds. This was back in the days where women didn't wear pants. But they needed her and there wasn't a thing they could do about it. She started the trend of women wearing pants up on the hill. That tells you how long I worked there. At one time you could walk out of any building at any time of day and walk into a herd of deer. There were also mountain lion, bears, raccoons, badgers, and rattlesnakes up there. I made a lot of money on rattlesnakes. I made belts. It's all sandstone up there and there are sandstone pockets that fill up with rain water and the animals would use it during the summer for water. I had a friend who was security guard up there and saw a mountain lion and her baby, as well as bears, walk through the gates.

We would go scrounging for parts in old buildings. I walked up a loading dock one night looking for parts and as I went up a badger came out and started chasing me. The only thing worse than a badger would have been a bobcat. I've walked into buildings with bobcats before and when that happens you just leave.

The Rocketdyne pond was stocked with fish so there would also be blue heron and storks and other birds up there as well. And sometime if it rained really hard, the fish would come out of the pond into the spillway and we would have to go pick up the fish and put them back in the pond. I never saw any dead animals that would have resulted from contamination. They fared better up there a long time ago then they do now.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 3/17/2010

Interviewee(s): 4

I have a degree in mechanical engineering. I began working at SSFL in June of 1961 for Rocketdyne at Component Test Labs (CTL) 2 and 3. I did not work at Area IV. I was laid off by Rocketdyne in 1969. I was responsible for testing turbo pumps at CTL. I thought there may have been a retention pond at CTL 1 on the Rocketdyne side.

I worked for Atomics International following the lay off in 1969 from the DeSoto facility. In 1987, I was back on the hill in Area I at the Advanced Propulsion Test Facility.

In 1992, I returned to Rocketdyne and worked at the former Hot Lab until 1994. I was a supervisor at the Hot Lab and did not handle any radiological waste. I developed instructions for decontamination and decommissioning operations for the Hot Lab. I prepared the lab to be torn down and was responsible for cleaning the Hot Lab. I think that waste was shipped from the Hot Lab to another facility and then shipped off site for disposal. I don't remember where that temporary storage facility was located since that wasn't my responsibility. Perhaps the waste was stored temporarily at the Sodium Reactor Experiment (SRE). I think there was a concrete pad outside the Hot Lab for staging drums.

My main purpose in wanting to be interviewed was to pass on the following information. I was at a local bar and an "old time Simi Valley resident" was talking about Rocketdyne. The man had a garage and had found some cleaners (containing trichloroethylene) close to the Santa Susana Field Laboratory (SSFL) fence line. He took the cleaners back to his garage to use to clean auto parts and then dumped the cleaners along a fence to kill weeds. I had read an article about contamination found off the hill and wanted to pass the information on as a potential source of this contamination. I don't really have any more specifics in terms of where the cleaners were found or dumped.

Regarding the accident at the SRE, I was told by a co-worker that a gentleman had asked him some questions regarding the severity of the accident at the SRE. My co-worker did not provide the gentlemen with any information so the gentlemen left assuming the worst of the accident. I think this lack of information was incorrectly interpreted.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 8/23/2010

Interviewee(s): 5

I began working as a research engineer at Atomics International (AI) in January 1958, right after I graduated from college. AI was a division of North American Aviation, Inc. I became the responsible engineer for the Kinetic Experiment Water Boiler (KEWB) program within approximately a year of beginning work at AI.

As the responsible engineer, I was in charge of operations at the KEWB. I was one of three operators that ran the reactor. The KEWB reactor was a water-boiler type reactor. The originally designed reactor was a -solution fueled reactor designed for university research. It was a steady-state reactor and was very low powered, 50 kilowatts (kW). The purpose of the KEWB program was to demonstrate that the reactor was completely safe and that anything they could do to it in a college environment would be safe. We would run tests to try and simulate the worst kinds of accidents we could imagine and the reactor would always shut itself down as a safety feature. All of the experiments we did were designed to test the safety of the KEWB reactor. KEWB was used solely for safety demonstrations. Subsequent to the KEWB program, we used the reactor as a pulse reactor for pulse neutron radiation experiments.

We ran the KEWB reactor down to a 1 millisecond reactor period. So for every millisecond that the reactor was supercritical the reactor power would increase by a factor of e (i.e. 2.1714). We got up to a power of 4,000 megawatts (MW). This was a very short burst of power because the reactor would shut itself down as its inherently safe designed was supposed to do. After each power burst we would have to reset for the next tests, so we only did two to three experiments a day. This was to demonstrate the safety of the reactor and show that it would shut itself down under any kind of accident condition. We pulled all of the control rods out and let it go, but in a very systematic manner. We started our experiments very slow and then built our way up. That type of information would be documented in serialized logbooks and bimonthly reports. The logbooks were kept in the building, but I don't know where they went after I left. But they should have been tracked. There were also bimonthly reports that were issued and went into the AEC report system. Oak Ridge used to have a repository for these reports. All the tests would be documented in these reports. I don't know what happened to the logbooks. But I would look at Oak Ridge for archives. At one time Oak Ridge National Laboratory had the archives for the AEC. We gave a couple of reports to the American Nuclear Society (ANS) also. I gave a talk in the 1960s to the ANS.

There were radioactive gases and liquids associated with KEWB. The KEWB did generate fission gases. The fission gases were held in an underground storage tank and then vented up a

stack after a decay period. The only contamination that might still remain from that would be in the underground storage tank. I don't know what the status of the underground storage tank is after decontamination and decommissioning (D&D). I don't know if the tank was dug out during the D&D process or not. We had fission gases that were generated and sent to the underground tank. Then we had argon-41 that was generated in the reactor vault, but this was not held in the underground tank, it was just vented up the stack. We would have to ventilate the room anytime we had to do work in the reactor room because of the radioactive argon gas. The fission gases were held in the underground tank and decayed for a while and then slowly bled out the stack.

The reactor fuel was liquid, uranyl sulfate. The coolant was water. There were cooling coils. I think the coolant was recycled. There was essentially no radioactivity in the coolant and none was discharged to the environment. There were two different reactor core vessels at KEWB. The first was a 12-inch spherical core that used highly enriched (93%) uranium-235 (U-235). There was a stack on the reactor that was an overflow chamber. When we pulsed the reactor, gas would form and it would expel the fuel solution up and it would become subcritical. That was the shutdown mechanism. The solution would go up the overflow chamber on top of the reactor. It would get caught and then slowly drain back down. The control rods were reinserted before the reactor could become critical again. The fuel was fully enriched U-235. It would get fairly radioactive. There was a fuel and gas handling system for the reactor located in an adjacent room in the KEWB Building.

The stack ventilated the building, itself, and discharged the fission gases. The bermed area on this historical photo was where the reactor was located. There were three rooms in the concrete vault below grade. One room was the reactor vault, one room was the valve control room, and the third room was where the gas holdup tank, liquid drain tank, and associated plumbing were located. There was a hydrogen recombiner located in that room as well that we ran a few tests on. The radiation level in the fuel and gas handling room became very high. We hardly ever went into that room. The fuel would end up there and the piping would get highly contaminated. The reactor itself was in a separate room. It was a 12-inch spherical reactor with a 3-foot high chute on the top. When the fuel was drained out of the reactor it went into the below-grade drain tank. We also had precipitate material in the lines and we did some chemical flushing to try and recover the precipitate material. That process generated a lot of liquid that ended up getting stored in glass carboys. We would flush the pipes and drain the rinse into the carboy containers. The containers were stored outside Building 4123 across from the KEWB reactor building. Building 4123 had two underground cells or holes in the ground - two concrete-line holes in the ground. And over in that area is where we stored all those bottles of liquid. Did some of it leak out onto the ground? Probably some, I would guess, but probably not a signification amount.

Halfway through the KEWB program we changed the reactor vessel shape. We took the original 12-inch spherical vessel out and replaced it with a 12-inch cylindrical vessel. We cut the spherical vessel out and stored the reactor in Building 4123, which was a storage building designed for holding the reactor vessel. It was highly radioactive, highly contaminated. We all received significant radioactive exposures, getting our yearly dose just taking that spherical vessel out and moving it to storage. We were working right on the reactor vessel with our latex gloved hands. I don't know anything about the D&D program for the KEWB reactor because

that occurred after I left. The KEWB reactor did run as a pulse neutron source for a while. There are vents located in the bermed area of Building 4073, which were the vents that allowed us to draw fresh air into the building and blow the argon gas out of the stack.

Building 4123 was the building that the reactor core was stored in so that is an area that you would want to look at. That would be the most likely area to look because anything that was hot in our area was stored there.

I was the project manager on the Systems for Nuclear Auxiliary Power (SNAP) 8 Development Reactor in Building 59. The SNAP 8 Flight System Test was supposed to be in Building 56, but that was never built, it was just a hole in the ground.

Based on looking at the site map, Building 4123 is the location where the first KEWB reactor was stored underground. Building 4073 is the underground KEWB reactor cell, Building 4793 is the instrument building and Building 4643 is the stack/blower for Building 4073. Building 4093 is the AE-6 reactor. Building 4083 is probably the KEWB office building and Building 4103 is the control building.

The primary thing that went in Building 4123 was the first KEWB reactor. I'm sure some of that liquid that we drained out from flushing the pipes was probably stored inside as well, although most of it was stored outside the building. One thing I would look at is the underground part of Building 4123 because I don't know what they did with it in the D&D process. Building 4123 was not very big, maybe 8 feet by 8 feet or 8 feet by 10 feet. It was a small building. It was strictly a storage building and was built specifically to hold the first KEWB reactor when it was removed from the reactor building. There were two below-grade, concrete-lined cells. The cells were cylindrical and about 2 feet in diameter. Because the reactor was maybe a foot in diameter, the 2-foot diameter cells held the reactor vessel easily.

An incident report (A0504) associated with the KEWB reactor building noted that between April 1 and June 30, 1961, a research engineer received quarterly exposures to gamma and neutron radiation at levels greater than 3 rem. This occurred while conducting core experiments required for termination of the KEWB program and resulted in high radiation in the reactor room. The engineer was aware of his high cumulative exposure in early May, but because of the importance of the tests and lack of other qualified operators, he continued to conduct "unreflected" core experiments without prior approval to exceed the 3 rem quarterly limit. That incident report is referring to me. I was that research engineer referenced.

We used hand held dosimeters and wore film badges. We had pencil dosimeters to monitor our exposure during operations. We hardly ever went into the reactor building alone, only if we had something very quick to do that was relatively simple. Anytime we went in to manipulate the valves for the gas or liquid handling system we always had two people.

We did very little on-site storage of waste. I mentioned the first KEWB reactor vessel and the rinse solution, but there was little else. The reactor vessel stayed on site until the area was decontaminated and the rinse solution was eventually taken to the Radioactive Materials Disposal Facility (RMDF). I would look at the D&D report for the area to gather more details.

The spherical KEWB reactor vessel was probably packaged and moved to Building 4123 without being decontaminated. That would be my guess, but I am not positive. The D&D report would probably give more specifics.

We had some usual things happen while running our experiments, but nothing I can think of that would lead to radioactive spills or contamination. Our approach with experiments was to start very small and increase incrementally. We would try to predict the results of the next step, and if we were unable to correctly predict the results of the next test, we would regroup and try to figure out why our prediction was not met. A few times we missed significantly on a prediction. The issue was one of neutronics. The KEWB reactor ran on thermal neutrons, and there are delay groups associated with the neutrons. Some neutrons are generated instantly and some are generated with a small (milliseconds) delay. We ended up discovering a new neutron delay group.

When we ran slow experiments, the neutrons went out to the reflector and were reflected back. As we went faster and faster, the neutrons that went out into the reflector were not reflected back before the pulse was over with and the reactor was already shut down.

We measured the energy level of the pulse and plotted it as a function of reactivity. It was basically a direct relationship, a straight line on a graph, except when we started getting these neutron delay groups. We were "running away from the neutrons" and that caused a change in our measurements from what we were predicting. We finally realized that we were "running away from the reflected neutrons" and that's what was causing the change from our predicted outcomes. So we discovered a new neutron delay group, the fast neutrons from the reflector. We had seen this before in other thermal neutrons at lower power and reactivity levels, so we started to see some similarities in our measurements and realized we had a new group. So this was an example of an unexpected occurrence. But in this example, when we first saw that our predictions were not being met, we stopped to try and figure out what was going on before continuing our experiments in the same manner. We wanted to have an explanation for the unpredicted results that we were satisfied with before we continued on.

We used sulphurous acid, H_2SO_3, once over a period of a few days to chemically flush the plumbing lines at KEWB. We had a chemist that worked on the program at Canoga Park. We called him the "Mad Chemist." It was a fairly dilute solution. The whole idea was to dissolve fuel that had precipitated out into the gas lines or other lines. The acid also took off a bit of the steel from the piping. We were tense when we flushed the lines with sulphurous acid because the 1/8-inch drain lines coming out of the ¼-inch piping were getting plugged up and it wasn't draining fast enough. We didn't want the sulfurous acid to be in the system very long so we wanted to get it out fast. I never did learn exactly what caused the plugging of the lines. We had to go into the gas handling room that was highly contaminated to unplug the drain lines. We went in very quickly and closed the valves and cleaned out the drain lines with a wire. The drain lines went into the glass carboy containers so that is where the rinse solution was contained. We got our gloves contaminated on that work. We would take our gloves and overalls and anything contaminated from our work on the KEWB and throw the items in the radioactive waste. We were a good customer of the RMDF.

As I recall, we never had a spill outside the building, but I would check the area at Building 4123 where the glass carboy containers were stored outside. I think it would be prudent to reexamine Building 4123.

We did other flushes of the system, but not with sulphurous acid. The only time we had trouble with the drain lines plugging was with the sulphurous acid. We did some other water rinses maybe once every 6 months or a year, but we didn't rinse the system very often.

The reason we had to flush the system was because when the reactor was pulsed and the foam solution that included the liquid uranium fuel would rise in the overflow chute and it would splash and go into the gas piping. We were trying to recover the fuel, which is why we used the sulphurous acid. Using the sulphurous acid was a one-time situation. It was driven by material accountability. Since the fuel was highly enriched uranium, it had to be fully accounted for. Every so often we would have to calculate the amount of uranium in the core and things like that. We discovered that we had to add a little bit of fuel and our calculations weren't finding all the fuel. That's when we realized that a small amount was splashing into the gas lines. So our calculations of fuel in the core were always a bit low because some of the fuel was in the piping. So then we got into discussion about how to recover the fuel. We talked to "Mad Chemist" and came up with the idea to use sulphurous acid to recover the fuel. The fuel was recovered, but was not recycled. It was contained in the carboys. The first couple of carboys were pretty hot and went to the RMDF. We flushed the system pretty heavily to make sure we got all the sulphurous acid out, so we generated a lot of liquid waste from that process. The carboys were stored temporarily at Building 4123, but eventually it was all sent to RMDF.

At Building 4123, some carboys, the "hotter" ones, were probably stored in the building. But most were stored outside on an asphalt pad on the southern side of the building, near the road. I am not sure how long the bottles were stored here. That would be something logbooks would be able to tell you. The draining occurred before the spherical reactor vessel was removed, so it would have been sometime in the early- to mid-1959. I don't think you will see any residual contamination from this area, but it would be something to look at.

As a test facility, we documented everything since we were testing for safety of the reactor. We didn't have much company training back then. Training was on-the-job. We did a lot of on-the-job training and that was a good way to learn. There were some general company policies that dictated our work, but they were pretty broad. We had a health physicist (HP) stationed with us all the time. His office was next to mine. He covered us and the AE-6 reactor building. The HPs took a lot of training and we looked to them to help guide our work. Whenever we went into the reactor building for any purpose, whatsoever, we wore shoe covers, lab coats, and gloves. When we went in to do any work with radioactive material we wore coveralls, coveralls, gloves, gloves, respirators, etc. We would double up on protective gear. We were all very safety conscious.

I had one personal incident. We had to measure the liquid level in the reactor. To do this we dropped a dip wire in a stand tube and watched the conductivity meter to know when the circuit had been closed. The probe was covered in tape and we would cut the tape at the level our meter

indicated so we could measure the length of the dip wire and calculate the height of the liquid in the tube. One time I was cutting the tape with an Exacto knife and I had my finger behind it and I nicked my finger. I cut through the rubber glove. The tiny tip of the Exacto knife chipped off and I got a sliver stuck in my finger. It was radioactive. I went to the nurse and she didn't want to touch it at first, but she finally removed the tiny chip. The HP got his meter out and checked me, smeared me, and swabbed me and I was clean. After that though we changed the way we cut the tape. We eventually modernized our measurement techniques.

Everyone was pretty safety conscious on their own. We were all highly educated and knew about the hazards, but we were also running experiments and learning. We didn't depend on unskilled workers. All but two people were college graduates, most with physics or engineering degrees. We had a reactor technician and an electronics technician that were not college graduates. My boss was a Ph.D. There were basically two of us that ran the reactor, and then sometimes my boss would run the reactor once in a while.

There were no restroom facilities in Building 4073, so nothing was drained down any toilets. We used the AE-6 building restrooms. The general rule was that once anything was inside the fence it stayed there. I don't recall any problems with underground sumps, pumps, tanks, or piping. I can't recall any leaking tanks or pipes in our system. Most of the piping was welded, stainless steel.

I am aware of the sodium burn pit, but I can't give you any information on it. I know it was there, but that's about it.

The concrete pad located west of Building 59 is where we took the Building 59 reactor vessel and steam cleaned it. We were doing a non-nuclear check of the coolant system, so we filled it with sodium-potassium (NaK) and heated it up to 1,200 and 1,300 degrees Fahrenheit. When the welders put these systems together they use Kotex to stuff in the piping because they were running argon gas on one side of the piping and they didn't want it all to rush out the side they were working on. So they stuffed Kotex in the pipe to keep the gas from escaping. A welder forgot to take the Kotex out and it was welded into the pipe. We couldn't get any fluid flow from the pipe when we were running our non-nuclear test, so we cut the pipe out and quickly saw what had happened. We put the whole setup out on the concrete pad and took the steam cleaner to the setup and cleaned it out. We got a big bang when we cleaned the system because even though most of the NaK had been drained out, there was residual NaK in the Kotex. We used Kotex in the KEWB for cleanup. It worked pretty well. We ordered it by the carload. It made a great absorbent. There was no radiation associated with this event, it was strictly non-nuclear testing. And after the NaK exploded the vessel was perfectly clean, so the explosion got rid of the NaK. We swabbed it out and reinstalled the vessel in Building 59 and it ran as a reactor vessel later for 10,000 hours.

In addition to being the responsible engineer at the KEWB, I was the project engineer for tests in Building 59. I didn't run the operations. The project engineer was like a program manager, so I wasn't there on a day to day basis. I can't recall any radioactive leaks in Building 59 when I worked there.

Building 10 was a SNAP test facility. The SNAP 2/10 reactor was tested first in Building 10 and then it was moved and they tested the SNAP 8 reactor. The SNAP 8 reactor had a containment vessel, which was a steel vessel probably 4 feet in diameter and 20 feet long, and below grade. It had cooling coils on it because those reactors ran pretty hot. During the testing of the SNAP 8 reactor, the cooling system for the containment vessel developed leaks and so we built a Bar's Leak injection system. Bar's Leak was a radiator sealant. It was some kind of sodium solution product. We injected that into the cooling system to plug up the leaks and it did. There was residual sodium in the cooling system and it became radioactive. I suspect there may have been some contamination from leaks, but I don't have first-hand knowledge. I was the project engineer for that test. I didn't run the reactor.

There should be a fair about of documentation on the KEWB. I would look for bimonthly reports, topical reports such as D&D reports, ANS talks in the late 1950s and early 1960s, and logbooks.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 2/10/2010

Interviewee(s): 6

I began working at the Santa Susana Field Laboratory (SSFL) in 1962 or 1963 when I was 18 or 19 years old. Atomics International (AI) was still dealing with cleanup from the Sodium Reactor Experiment (SRE) when I started there. AI couldn't get the SRE cleaned. Every time they would start it up again it would re-contaminate itself. I was a health physicist at SSFL and had access to the entire site. In this position I conducted daily surveys, and would be called to any major nuclear incident. I worked at the SRE and Systems for Nuclear Auxiliary Power (SNAP) Buildings 10, 12, 24, 28, and 59. I remember that drainage from Building 10, 12, and 28 ran right off the side of the mountain. I think general site conditions were not good and there was sloppy housekeeping at the time. The site was somewhat primitive when I was there. There were rumors that the roofs of some of the buildings were not good and that the buildings did not have the best workmanship.

As a health physicist, I would be summoned to scenes of any fires or spills and evaluate the situation. I performed smear samples of buildings, which involved touching round litmus paper along building surfaces and mapping sample locations. I would generally take 50 to 60 samples this way.

I did work around radioactive materials and I was sent to a lot of training for radiation contamination and reactors. A flashing red light was used on buildings if a reactor in the building was operating. I remember several incidents where people were running out of buildings to escape potential contamination. Film badges only detect direct radiation and not radioactive gas or particulate matter. Contamination in the air would follow the wind direction. People could be eating outside and not even know that contamination was blowing in their direction. Surfaces of cars in the parking lot would sometimes accumulate radiological contamination from the air.

With regard to the SRE, I think the contamination there was huge and that the wind would have carried radioactivity to foliage, soil, water. There were gas holdup tanks on all or most all reactors. These tanks would eventually be vented and contamination would be on walls of stacks and then released to air. I recall a time I had to trash my clothes and shoes when I first started working because I was taking a core gas sample. Core gas samples would be counted at specified intervals to determine the half-lives of products in the gas and thus determine fission products in gas. Collecting air from around the core of the reactor was done via a tube connecting the core to the shield plug. One time I did this there had been a core gas leak and I had been exposed. I didn't realize I had been exposed at first, but upon checking my exposure

level I found all of my clothes were contaminated and I had to scrub down with a red/purple potassium manganate solution.

I think the Hot Cell was one of the most highly contaminated areas at SSFL because they dissected fuel elements after use there. If there was a fire or leak at the Hot Cell people would start running from the building as time and distance would help lessen exposure. When you worked in a tagged area where radionuclides were present you had to wear "Red Lines," which were coveralls with a red strip that indicated radiation work. Operators of the Hot Cell would be in street clothes though operating the "slaves" (mechanical arms) through the concrete walls. If there were any issues at the Hot Cell and cleanup was required workers may have less than a minute before receiving their monthly allowed radiation dose.

The Radioactive Materials Disposal Unit (RMDU) was a building where piping, tools, tables/chairs, etc. were brought for disposal. These items were highly contaminated and while they were decontaminated they were "not cleanable." Items would be decontaminated, tagged, and wrapped in plastic and then placed outside in an open storage yard where they would be exposed to the elements. I recall seeing rows of piping sitting on pallets. But the plastic could tear and contamination could get into soil or storm drains in the area.

Even empty buildings that once housed experiments remained highly contaminated. At one time my group was supposed to move into a building in the sodium test area, but the smell was so bad the group said it would not move.

I am aware that there was a burn pit where drums were dumped in water, shot with a rifle, and would then explode. Sodium-potassium (NaK) was dumped in the burn pit and any other liquids dumped in the burn pit could be contaminated with radioactive materials. There were other dumping areas for rocket fuel. Nak could cause burns and was highly volatile near water. Oil would be placed on drums of Nak to prevent moisture from getting in. I was always nervous when he saw large quantities of Nak drums. I recall the deaths in Area III from fuel test explosion and knew of two deaths in Area IV from burns/suffocation.

When he learned plutonium was up on the site I wanted to "get out" because it was so dangerous. I was called by UCLA for their medical studies and informed that I was on a list of former employees who received radiation overexposures. I know there are high cancer rates in the area.

I really think the Environmental Protection Agency (EPA) should focus on getting the Al logbooks, as these would describe all activities going on from experiments to incidents to dumping and burning activities. Boeing doesn't know where logbooks are unless it suits them. I think a review of the logbooks could resolve a lot of contentious issues at community meetings. The logbooks we used were clearly marked and each building had its own set. You could also look at fire department records or interview fire department personnel. I found a 100 page document on the internet describing day by day how drums of oxidizers were dumped and that this activity was signed by the chief of the fire department. I think EPA should also look at the DeSoto facility as it used enriched uranium and was near a residential area.

People may say they didn't see anything wrong while they worked at SSFL, but most people had restricted access and didn't know what was going on outside their immediate work area.

People may not want to talk to you because Boeing still holds pensions. I am a retired law enforcement officer and not dependent on my pension from my work at SSFL so I feel comfortable talking to you. I had to pay attention to details in law enforcement and my attention to detail is one reason I recall so much from my time at SSFL.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 8/31/2010

Interviewee(s): 7

I worked for Rocketdyne/Boeing from January 1987 to March 1999 in a few different locations. I started as a member of the technical staff (MTS) IV. I was a quality engineer throughout my 12 years. I was a quality assurance engineer auditor at first and then I became a lead auditor. The first four years I worked at Rocketdyne I audited Certified Special Processes, meaning that I audited our suppliers and vendors. Our suppliers and vendors provided us with parts and components, but we also had vendors for dry film lubrication and plating. I recall auditing a lot of plating shops. Some of those shops were extremely dirty with strong fumes. This work was for space shuttle main engine (SSME) and expendable launch vehicle (ELV) programs.

I spent intermittent time at the Santa Susana Field Laboratory (SSFL) from June 1991 until September 1998.

From June 1991 until May 1993, I was based at the Plummer facility. During that time, I infrequently visited the SSFL as part of my work duties. I was a quality engineer and we supplied hydrogen recombiner spare parts for nuclear power plants. Most of my activity was at Plummer, but we did store hydrogen recombiner parts on the hill for a period of time so I would sometimes have to go up to find answers to customer questions related to those parts. I don't recall the building number where the hydrogen recombiner parts were stored. I was up and down the hill infrequently and usually in Area IV during this time period.

Then from May 1993 to September 1998, I was stationed at DeSoto Building 105, but that is when the U.S. Department of Energy (DOE) was doing decontamination and decommissioning at SSFL. DOE was tearing down buildings in Area IV, clearing them out, packaging things in boxes. So I performed quality auditing of the hazardous waste packaging on the hill. I worked out of the Radioactive Material Handling Facility (RMHF) as the quality auditor of hazardous waste material. The boxes of material were big, approximately three feet square. My job was to verify that what they were taking out of the buildings and putting in the boxes was correctly stated in their documentation. The boxes had identification (ID) numbers for tracking and I made sure that the box ID and contents matched the shipping documentation and quality control records. Our office was in the RMHF, but what I think was Building 9 was an open-ended building with only a roof. That's where I was checking the boxes. There were rows of boxes piled up on top of each other. I had to go up and down the aisles, and crawl around to find the correct boxes. I didn't have to wear any protective clothing, but I did wear a film badge. I got a report from Rocketdyne/Boeing that had my film badge records. However, the only dates they had for me were from February 1996 to September 1996. I think I wore a film badge for work

that I did from 1995 into 1997, so I can't give you exact dates because I only have the record from Rocketdyne/Boeing for 1996. The report also lists my primary work location at SSFL was T034 and T020 in 1996. But I think I was up there beginning in 1995 and up to 1997.

Boxes were piled in the open-ended storage building, what I think is Building 9, west of the RMHF and the enclosed building attached to Building 9 (which appears to be Building 4075 based on the site map). There was also another building across the street that held boxes (which appears to be Building 4621 based on the site map). I am not exactly sure of the building numbers. But when I was auditing at RMHF, I was actually working out of four buildings, the RMHF, Building 9, the building next to Building 9, and the Building across the street. A little west of these RMHF buildings was a burn pit. I didn't have anything to do with the burn pit, but I could see it while I was in the RMHF area. I could see smoke from the burn pit. I don't know what they were burning, but sometimes we could see smoke.

I wasn't auditing at the RMHF every day. I would go up and conduct an audit of the boxes they had for two or three days and then wait for them to ship the boxes out and get new boxes ready for us to audit. I did that for about two years.

I was also in the Rockwell International Hot Lab (RIHL) once. I don't recall wearing a film badge at the time. We would get calls from customers and I would have to investigate and track documentation for hydrogen recombiner spare parts. Sometime the requests would be for parts, or documentation on parts. Other times a request required me to verify a part number or something like that. I was in the Hot Lab only once to handle a customer request. They were in the process of tearing the Hot Lab down, but the glove boxes and robot arms were still in place.
I think I wore a film badge from 1995 to 1997, but Rocketdyne records exist only for 1996. I did not have to handle any radioactive or chemical waste material. It was all boxed up and covered. I just verified the documentation. I did not unwrap anything in the boxes. We had to verify the shipping list with the box description. I think the boxes were ultimately shipped to Nevada for disposal.

I never saw any spills or accidents. It was pretty quiet while I was there. I don't think Rocketdyne, DOE, Boeing, or anyone did anything wrong. We were monitored and wore badges according to the standards of the time. You don't know if the standards were accurate. I have collected articles, such as this August 28, 2007 obituary from the L.A. Times for John Gofman. He was a physicist that warned about radiation risk. He worked at Lawrence Livermore National Laboratory. In 1969, he and his colleagues had data showing the risks associated with low doses of radiation were 20 times higher than stated by the government. They published the data, lost their funding, and were fired from the lab. Most of their conclusions have since been validated, but critics say the risks have been ignored by the nuclear industry. This article wasn't worth much to the Department of Labor and my health claim. But that's what I was working around, low-dose radioactive materials and I ended up getting cancer, so I just wonder about the connection.

I filed an Energy Employees Occupational Illness Compensation Program Act (EEOICPA) claim and after about 3 years of going back and forth with it, my claim was denied on October 21, 2009. That's why I have collected so many articles, for my health claim.

I don't fault Rocketdyne, Rockwell International, or Boeing. At that time we were working under the established standards. I just wonder about the standards and if they were safe enough. We also did work on Solar Two from 1995 to 1996. It was an electric power program that used mirrors to reflect sunlight and heat up sodium. You can see the tower now when you drive by on the U.S. 40 or I-15. I have a video describing the program called "Solar Two – Power from the Sun" dated March 5, 1996. I was at that job site and am on this film very briefly. We had to do the hydrostatic testing of the components with an American Society of Mechanical Engineering (ASME) code inspector present, which may have been why I was up on the hill then, but I can't recall. The system tubes and strongbacks that the sodium would have to go through would have to be tested to make sure there were no leaks and they could meet temperature and pressure requirements. We did some of the fabrication work for the Solar Two power project on the hill. I don't recall the building number where the fabrication work took place. I visited the hill for this project, but I did not wear a film badge. I don't recall if we were near any radioactive facilities, but we were on the hill in Area IV. I would have to go up and verify materials and tests witnessed by the code inspector. Also, I was the liaison between the fabricators and the suppliers and would have to do investigative work to answer any questions about materials or supplies that arose. There weren't any radionuclides associated with the Solar Two project. The nuclear association was that they were fabricating parts in a building up in Area IV. They may have done this simply because they needed an area with enough space to work in, I'm not sure. This project probably occurred before I did the low-level waste auditing at the RMHF.

I wasn't aware of any spills or accidents. I don't know of anything that was disposed on the site. I didn't work with any radionuclides, just the low-level waste that was already packaged.

Rocketdyne moved us all over the place. That's what they didn't understand when I filed my health claim. They gave me credit for my time on the hill when I was based in DeSoto because I was doing DOE work, but they did not give me credit for time on the hill when I was based out of the Plummer facility. It didn't seem to make sense that they only credited me for part of my time on the hill. I worked with EEOICPA, DOE, U.S Department of Labor (DOL), and the National Institute for Occupational Safety and Health (NIOSH) on my claim, but after 3 years and their calculations I didn't get anywhere and my claim was denied.

Anyone who worked at Rocketdyne could get up on the hill. They had guards at the gate, but all you had to do was show your Rocketdyne badge and once you were in there you were free to go to your destination. I was in and out of a few buildings for various meetings or to check on parts, but I spent most of my time associated with the RMHF area and adjacent buildings.

Company policies dictated how I did my work. As a certified lead auditor I went to a lot of nuclear vendors, including the DOE lab in Las Vegas. I would conduct audits of our vendors and determine if they were following all the required procedures and specifications. I would also have a technical auditor with me who would know more about the technical side of the work.

We had to put the vendors on our approved supplier list. I wrote procedures and checklists. The very last job I had was working with the Purchasing Department at Canoga on procurement inspection procedures (PIPs). We would define what we wanted checked and how we wanted it checked and then categorize the items based on importance. I did this the last 9 months before I retired.

I started at Canoga, worked at the Plummer facility and went to the SSFL, worked at DeSoto and went to SSFL, then went back to Canoga.

As an MTS IV, I had a background in mechanical engineering and work experience in industry. I did have radiation safety training at Rocketdyne. I was a certified special process auditor because I knew how to write procedures and do quality control auditing. I was knowledgeable in non-destructive testing procedures, including radiography, ultrasonics, magnetic particle testing, liquid penetrant testing, etc. I was level three in all of those so I could train others to do the work. As an auditor, I would make sure other programs and vendors had their training set up properly and they could show me proper documentation of training.

We had to have a storage location to keep track of quality control records. We had to keep very strict records for the nuclear side of things. The last I knew, all of my records as an auditor were maintained at the DeSoto facility.

I didn't handle any waste. I didn't have to wear any special clothing or equipment. I didn't notice any problems with the buildings I worked in with regard to plumbing, tanks, sewers, etc. If I had noticed something was wrong I would have reported it for sure. That was what I used to do as a regular part of my job as an auditor.

I know there were contractors doing the decontamination, decommissioning, demolition, and cleanup at the site. I think the non-destructive testing may have been done by subcontractor, Boothe-Twining. They did work all over southern California.

I can't think of any special concerns I have at the site. Like I said, I don't hold anyone responsible. I'm sure everything was done to the level it was supposed to be done at the time. Rocketdyne/Boeing was not lax. They had smart people working there and no one would have done anything intentionally wrong.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

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An interviewee whose full interview is presented in the U.S. Department of Energy's interview report, provided comments to the U.S. Environmental Protection Agency (EPA) specifically for the issuance of the June 2011 *Draft Technical Memorandum (TM) Subarea HSA-6 Historical Site Assessment, Santa Susana Field Laboratory Site, Area IV Radiological Study, Ventura County, California.*

In 1959, I was hired as a trainee operator and mechanic at the Sodium Reactor Experiment (SRE). I worked there approximately 2 year, and it was during that time when the fuel element failure occurred. I was onsite a few hours after it occurred, and was involved in the clean up. When the SRE shut down, that reduced the need for personnel, so being low in seniority, I was laid off.

I have knowledge of the June 4, 1959, wash cell explosion incident at the SRE noted in the TM. It did not happen on my shift. Talking with those who were there first hand, they said it was very scary. At a later date we had to wash fuel rods and we were very worried it may do the same. We were washing off sodium and tetralin.

The February 6, 1959, incident at the SRE notes two Atomics International (AI) personnel handled contaminated equipment without the proper use of protective gloves and mentions that one of the men was found to be new and had little knowledge of the hazards of radiation contamination. That was me and my supervisor. I had not been working very long at AI. I started in January 1959, and was on probation for 2 months. March is my official date.

I was working at the SRE from July 12 to July 26, 1959 during run 14 and I was there when the high bay increased to 14,000 counts per minute on July 14th. We had many scrams between the 15th through 26th of July.

During removal of damaged fuel elements, the TM notes a parted fuel element from core channel 12 became lodged in the fuel handling cask forcing the suspension of operations. This is when we broke off the first fuel rod, and it got jammed it the fuel transporter. The lead safety shield was accidently lifted up and contaminated the whole building. You can see the TM states that a considerable amount of radiation exposure resulted in the building. This is when the building was off limits for 2 weeks, and the office furniture went out in a junk pile.

The fuel element recovery plan shifted to modifying the handling cask. The modified moderator handling cask was then put to work to remove the last remaining fuel rod. All fuel rods and

broken fuel rod ends were out by first week of September. We worked on removing the two broken fuel rod ends with a cherry picker by hand. Both of the fuel transporters were not useable with fuel rods still stuck in them.

There was no equipment to remove the broken fuel rod ends in the reactor core....we had to make our own. We were working without proper equipment. The company decided to build equipment to pull out all the small pieces of fuel rods from the reactor core. That is what you see in the SRE Recovery Film. In the mean time, we risked our lives with homemade equipment to remove the fuel rod ends in the reactor core. They did not write records on what we had to do...it should have never been done. We did the impossible, so they could use the large equipment they brought in to remove the small pieces of fuel rod in the bottom of the reactor.

By October 19, 1959 the large equipment was brought in to remove the small pieces of fuel rod. The top of the reactor was being rotated so the large equipment could be set upon it. All the small pieces of fuel rod had been gathered up in the bottom of the reactor.

With regard to Table 2.1 in the TM that discusses damage to fuel elements, I have a few corrections:

Fuel Cluster R-10: We found only damaged fuel rods, not broken in two.

Fuel Cluster R-55: We found only damaged fuel rods, not broken in two.

Fuel Cluster R-68: We found only damaged fuel rods, not broken in two.

Fuel Cluster R-12: This cluster broke off when we were pulling it out of the reactor core. It contaminated the whole building. The lead safety shield was lifted up by the operator by accident and contaminated the whole SRE building. The broken section of the fuel cluster was not transferred to the storage cell, because we could not remove it from the fuel transfer cask.

Fuel Cluster R-21: Table 2.1 is not correct; the fuel cluster was never placed in the hot cell. It was still in the fuel transporter until I left in November of 1959. I do not know how they ever got the stuck fuel rod out of the transporter; we were not able to.

Fuel Cluster R-23: Table 2.1 is not correct; all fuel rods were out of the reactor core by the first part of September. The last two were pulled out with a cherry picker.

Fuel Cluster R-69: No fuel rods were withdrawn in October, they were already removed.

Fuel Cluster R-24: I think this is when we tried to pull out the two last broken off fuel rods with a cherry picker. We failed a number of times until we were able to pull the broken fuel rods out of the moderator can. Notice they have no date for this cluster's removal, There was very little said about what we did in getting those broken fuel rod ends out of the reactor core and the timing we did it.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 12/01/2009

Interviewee(s): 9

I worked for Atomics International (AI) at Canoga Park from 1956 to 1959, but I would go up to the hill, the Santa Susana Field Laboratory (SSFL) maybe twice a week. I would just get on the company bus to go up there. Sometimes I would just drive up and park my car up there. My primary office was the main facility building at Canoga Park. It was an office across the street from Rocketdyne. Both facilities were owned by North American Aviation (NAA). Rocketdyne was interested in making rockets for NASA and the military. We were across the street and we were the atomics building. So they were also interested in nuclear energy and developing nuclear power plants. They were funded by the Atomic Energy Commission (AEC) at the time. The next generation was the Energy Research and Development Agency (ERDA). That was there for so long. There was a gap. Then the next generation became the Department of Energy (DOE). Those are the three agencies that funded AI and I guess Rocketdyne.

AEC basically sponsored AI. AI was a contractor to AEC at the time, as well as Westinghouse and General Electric (GE) There were a lot of different people trying to do nuclear energy at the time and build power plants and so forth. AI was an oddball in the area. The two chief competitors for atomic energy at the time were GE and Westinghouse. Westinghouse finally won the battle. The pressurized water reactors were developed into submarines and then they modeled the power reactors after the pressurized water concept.

AEC sponsored a number of contracts, but the big contractors were GE, Westinghouse, and us, AI. We were working on different kinds of reactor concepts like the Organic Moderated Reactor Experiment (OMRE). AEC was also funding AI to do the Sodium Reactor Experiment (SRE). That was a whole different concept of heat transfer. The OMRE reactor used organic moderated fluid like phenols. It wasn't being done at Canoga Park. The actual plant itself was in the Midwest, somewhere in Ohio. The other big push was the SRE. They were doing NAK (sodium potassium) bonds for the core. They had two coolant loops. They had a sodium loop and another sodium loop. The first sodium loop heat exchanged with water to drive the turbine. That was kind of the sequence. The whole reactor was different because it was a sodium reactor; it was called a faster reactor. The "spec of neutrons" were a little higher than the moderated water reactors of GE and Westinghouse and even the OMRE. It was a different concept for reactors. I'm not familiar with all of them because I was only there 2 years.

For the OMRE, the organic moderated coolant itself was an organic material like phenol. It was an organic fluid, which meant that it was also a moderator as well as a heat transfer intermediate.

So it operated at a lower energy neutron spectra, kind of like water. AEC was trying everything and funding people to try different things. There was pressure on them to get atomic energy into things not related to bombs and war. It was a big deal called the "Atoms for Peace" program. Let's take that wonderful nuclear energy that we made bombs out of and make electricity. That's what happened as well as nice pressurized water systems for the submarines that Admiral Rickover developed. His work at Westinghouse preceded the pressurized water systems that we have today.

Unless there was some contract I'm totally unaware of, none of AI's facilities were used by other contractors. My basic function there was in Health Physics and also Radiation Engineering. I was doing radiation shielding, radiation transport, and all that kind of stuff. Nuclear engineering kind of things. I think my job title was Research Engineer or Radiation Engineer. I think I was in the Health Physics Department first and then I got into the Radiation Engineering Department. Health physics was more or less a service at the time. I had been fairly educated at Berkeley so I had a background in nuclear physics. Health physics is now a big deal. They have a journal and I've published many research articles in it. Basically a health physicist's goal in life is to protect people from radiation and to make sure they don't get over-exposed. They have rules and procedures set up to minimize radiation like wearing film badges, ionization chambers, little pencil things you can look through. The health physicist's function was to make sure operationally that radiation was a safe thing. He would collect and process the film badges and keep records exposures. At the time the AEC had come up with some rules that you can't have more than so much dose per year, so much dose per quarter, etc. The Emergency Exposure Dose (EED), which was one time in a lifetime. They were a very professional organization. There were some good people there.

There was also the National Committee for Radiation Protection (NCRP). That organization made rules, did research, and did all sorts of publication. They were part of the federal government and funded. I've got all sorts of books, pamphlets and guides that have been written. Radiation protection was a huge thing and it is today.

Health physicists followed rules created by the AEC, NCRP, and International Committee of Radiation Protection (ICRP). The AEC and NCRP were national organizations, but the ICRP is worldwide. The ICRP does research, radiobiology, radiation exposure, they do everything. It's a big organization that looks for cancers among other work.

Health physicists at SSFL did monitor waste removal and disposal. The thing that I was involved in was getting hot material like stainless steel that had been irradiated at the bottom of the reactor. It's a big thing; it looks like a bullet on the bottom that guides the fuel elements into the core of the SRE. When you pull them up they're hot with a lot of radiation coming off. They had to make sure you're not getting too exposed and work with it too much. What I used to do is design 50-gallon drums to put radioactive material into. I can sketch it here. It's a 50-gallon drum like this and it's got a pipe in the center, a real pipe that goes down and you pour concrete all around it and put your radioactive material in there depending on how hot it is. This is your 50-gallon drum that I used to design and work around and watched guys put the stuff in and load these onto a truck. Then the truck went to Port Hueneme. There was a huge number of

these things and we took everybody's waste – all the hospital's waste and various people who had radioactive material tracers. They paid AI or somebody to do this. This was called a 50-gallon drum waste disposal. I supervised a lot of design so you had enough shielding so that the dose on the outside does not exceed a certain limit.

The pipes used in the drums are usually steel, but could be cast iron as well. The designs were usually very simple and depended on how hot the material was. I used to do calculations to figure out the best design. I would get the dose on the surface and that was it. I continued with this container. You take all these containers once you accumulate them and they were being loaded in either Santa Susana or Van Owen. I don't remember how they got transported around. I used to supervise these things being loaded at a reasonable distance away. When you accumulated hundreds of barrels, you trucked them down to Point Hueneme. They were going to be dumped into the ocean.

The radioactive material was dumped off of the Farallon Islands. You had to make damn sure that the dumping ground was 1,000 fathoms or more – 6,000 feet. That was the requirement. All you had to do was find that depth. Down here it's off St. Nicolas Island on the other side one of the lone Channel Islands out there. We put these drums on a big barge and you tow them out with this ocean-going tug. I'd be supervising this stuff and the guys would be watching. The drums were all tied on the barge with a rope and you just chopped them and they all rolled off. The boat would be going around distributing this stuff. We were on the ocean going tug most of the time. It was kind of interesting and kind of fun. Some of these barrels would go down and most of them would sink. Some would be floating, either they weren't loaded properly and someone screwed up. We had a gun that we would used to shoot the floating drums until they went down. But that wasn't very often, maybe one time for every 1,000 drums. Those drums probably aren't there anymore. They are probably rusted and gone. It's against federal law now; you can't do any of that anymore. At the time you could. The rule was 6,000 feet or 1,000 fathoms and you could dump. It was kind of an arbitrary thing. Nobody did a lot of studies on it, just an arbitrary number. That's about a mile down.

The radioactive steel thing in the reactor looked like a bullet. It was hanging on the bottom. It's a fuel element guide really that hung down so you could put this into a reactor core hole. You can leave it in there after so much time and pull it up and it was hotter than hell since it was in the core. It got neutron activated. Stainless steel gets very neutron activated. There are a lot of elements in there that get very hot. I don't know what the official name for that steel piece is, but I called it the fuel rod stainless steel bullet guide since it looked like a bullet. It was hotter than hell after having been used in a reactor. I would say the steel bullet was about 2.5 feet long.

I never examined all the stuff that was going in the drums. I was just interested in finding out how many Curies would be deposited in there. I designed the drums for the maximum Curie levels. Many times the waste was just gloves and clothes. We never sorted it out that much. We just put whatever we thought was radioactive in that hole.

I mentioned we also took hospital waste and other people's waste. Any radio-pharmaceuticals people were using like cobalt x-ray stuff. Cobalt-16 was a big thing. UCLA had radio-

pharmaceuticals. Generally those things weren't that hot. The hot stuff was really Santa Susana. I don't know anybody else except these people using cobalt-16. When you wanted to disassemble a unit, I was never involved in that, you always know that all that goes in the shipment of hot stuff coming in. You just take that stuff - the GM tube, the ionization chambers - and see how hot it was and that was it.

There were several experimental facilities like the Kinetic Energy Water Boiler (KEWB) and the Systems for Nuclear Auxiliary Power (SNAP) up on the Hill. Any kind of waste that would come from those facilities was packaged and shipped in drums. I think at the time those things really got going. In earnest, I was gone. I helped design the SNAP environmental test facility. I wrote the hazard report for it, which you had to submit to get a permit to build it.

All this kind of stuff when you ask where else did waste come from, there are hot cells and all kind of facilities that had anything hot (radioactive). There was some experimental stuff down in Van Owen at the AI facility in Canoga Park. They had hot stuff too. I didn't get too much involved in that. Except one time and that was when we loaded what's called... There was a big glass sphere and we were loading this sphere with uranyl sulfate solution and we kept loading this thing until... We were plotting the reactivity as a function of how much source you put in. You put in a source and it would go up and up. We were plotting the loading of uranyl sulfate into this sphere to make it start multiplying. I was involved in that and I think I got a heavy dose from that. There were two guys involved, me and another guy. We were plotting this and showing everybody. It was like a fishbowl. Everybody watching and how wonderful, look at that experiment, we get to see it. That was an interesting thing. It became very radioactive too. It was a multiplying medium. It was going critical and producing fission products. I don't know what they did with it later. I just know I was involved in this plotting.

I don't remember the numbers of the buildings I worked in. This Sodium Reactor Experiment (SRE) building, I think I visited some of the other ones to collect film badges and take smears sometimes. We used to take these little round pieces of paper and smear it and read it to see whether contamination transferred. My work at SRE was health physics and radiation engineering/shielding work.

I don't remember where I was working when I was working with the waste drum loading. I think they would drum waste at the source, but sources came in everywhere before this. It might have been down in the Van Owen area. I remember there were barrels lined up.

As far as accidents or spills go, everyone knew about the SRE melting. That was the big one. I do not remember any others while I was there.

I can't remember a lot about the waste stream generated during my work. I don't know about cleaning liquids. Those things I can't remember. I just draw a blank. I never got involved in dealing with the contaminated clothing.

As for the test smears we would do they were just little pieces of paper. And you'd just take them and put them in a reader to see if you got some contamination/radiation response from the

detector. We took smears all over quite a bit. Generally, you didn't have many problems. I got a lot of these test papers and went down to the Santa Monica Pier during the time they were doing the atmospheric testing and got a higher reading of the upper railings of the Santa Monica Pier than that. That was during the days of open air testing – Russians, Soviets, and we were doing it. I got some interesting stuff. That was my own thing though, that was not part of my job.

I don't recall any stories about other accidents or spills out on the hill other than the SRE. And that was the big deal that made a lot of problems all over – this radioactive sodium from the loops and hard chunks of sodium. Mostly it was just sodium activation, sodium-24, and that would go away very quickly. Sodium-24 had a pretty short half-life. As far as testing for radionuclides on the hill, I would test for the fission products – sodium, cesium-137, strontium-89, strontium-90, and yttrium. Forget sodium, it has a very short half-life. You've got to look at the long half-life, so they've been around for quite a while. I'm not too familiar with all those half-lives. Iron-55 and maybe Iron-56. I can't remember whether these are all radioactive or not, but I think so. Iron-55 I know is. Nickel is a big one too. These basically are the fission products. I'm just getting involved with some guy writing a story for a movie script on terrorism and I'm just getting back involved with that again. If the terrorists try to get a hold of some radioactive material they're going to try and get it from a small reactor or some college like Oregon State and steal it to make a, not a radioactive bomb, but make it dispersive – a dirty bomb.

As far as disposal ponds on the hill, I remember a big pond at the back of the SRE. It was just a big pond that had water in it. We used to take the sodium and throw it in there during lunch time just to watch it explode. Eventually I'm sure it's pure sodium hydroxide because if you throw sodium into that, the reaction and such that you get sodium hydroxide because it combines with water. You get this explosion that's really kind of fun to watch and the smoke because it's an exergonic reaction. We used to throw pieces of sodium in there that we would find laying around, perhaps in back of the SRE. I don't think the sodium we picked up was active. Sodium-24 has a very short half-life. It may have a little bit of activity, so if I got some radiation from it, I don't know. It was more fun doing that than worrying about it.

The sodium in the SRE loop was probably more viscous than water, but I don't know exactly what the viscosity was. The loop was contained. There's a primary loop and I can't remember whether they had two loops or not. I have some drawings. Here's the reactor. Here's the SRE reactor. There are all these fuel elements and that's the core. You had the shielding around it and everything else. Then you had the inlet and the outlet. There was a heat exchanger that exchanged with the water. And a sodium pump to pump the sodium loop here. The sodium loop goes through the reactor. It circulates through the reactor. There's a heat exchanger here that takes heat from this and exchanges with another loop. I can't remember whether this is another sodium loop or not. If it is another sodium loop, then I think it's exchanging with the water loop here. That goes into a turbine that drives a generator. If it's not a sodium loop, it would just be a water loop. I think you had these two loops. This was always radioactive, this wasn't. That's why they were trying to separate them. They were trying to make everything from here on out non-radioactive and make everything here radioactive. This whole thing, the entire thing, would

be in the SRE. The reactor, the loops, everything and the turbines were inside. The turbines generated electricity. They lit up on one of the little towns out there.

Because it was a closed system, the secondary loop would not be contaminated. The only thing that connects to this is the heat exchanger. The heat exchanger is just transferring heat – nothing else. The primary loop is the hot loop. That's really hot. So you had all kind of shielding around it and on the floor. This entire area was down counter-sunk into the lower area of the building. I'm not that much of a nuclear engineer to tell you the replacement requirements, but the fluid in the loop would probably need to be replaced over time. I don't know for sure though. What you would need to know is what the characteristics of the sodium does when it gets hit by a lot of radiation. In the OMRE, the problem there was when you have this organic fluid coming in there, it gets really gunky. It's like tar. Sooner or later, you radiate it and it gets very viscous like molasses so it doesn't flow very well. The OMRE had failed, that experiment they said forget it.

Looking back at the drawing, this is the primary loop here and this is the secondary loop. I'm not sure if there's a tertiary loop here. Maybe it was a sodium turbine, I'm not sure. What you would do was drive the hot sodium in there and maybe vaporize it and turn a loop. In order to do any kind of work (work = pressure times the change in volume) you have to have something change (volume). This change in volume is a change of state like if you had hot water and then reduced the pressure, then you're going to get steam or gas. That gas is going to be able to drive the turbine. It expands. You have to have this expansion in order to make it work because the pressure's constant. The sodium could be contaminated with other radionuclides, but the sodium itself (sodium-24) was also radioactive.

When the core melted down this sodium picked up a lot more stuff than just sodium-24. The activation of sodium-24, you have to get a neutron and it goes into sodium-23 and that goes into sodium-24, which is radioactive and its half-life is really low. You can pick up all kinds of fission products if you get an open leak in here or if it's a meltdown. That whole thing becomes full of everything.

The question is what happens to sodium when it become further irradiated. Does it change the viscosity? The viscosity just went straight to hell on the OMRE. Whether you have to change it or not depends on what the radiation damage is if anything it does to it. Generally something like a liquid or inorganic like sodium doesn't get damaged. If you radiate something like organic, then all these things cross-link. Then you get different bonding and the viscosity goes way up. It changes to gunky tar, so it's no good anymore.

I don't know about any sodium tanks outside of the reactor buildings or waste sodium, unless it was some tests that they did. Maybe they did some side tests or sampled a loop. I'm sure they had facilities to sample loops. I wasn't part of that operation.

I don't really know anybody else you should talk to. I don't know if they're still around. I can't recall anybody I really knew at the SRE. Any of my friends didn't really do much work on the hill. I couldn't identify anybody there.

With regard to document collection, the only thing I produced there were hazard reports for the SNAP environmental test facility and I can get my resume and show you that. In fact, maybe I can download my resume.

[Looking at a 1959 aerial photograph, EPA points out the SRE complex and a drainage pond.]

Maybe that's the pond that we kept throwing sodium into. If it is the only pond near the SRE as you suggest then that's the one we threw sodium into. I know it was in back of the SRE. There might have been a place where I had these radioactive drums. They were probably "down in Santa Susana," we transferred some stuff down there. It was kind of like a sidewalk or road where they had these barrels that we would load. I was checking the outside of them because I designed the shielding for them. I never loaded the stuff, I just designed them.

There's a KEWB facility I think that was over in this area. KEWB and also the SNAP facility. Kinetic Energy Water Boiler, it's an experiment. I used to hang out over there too. I'm sure I picked a few rays over there. And then there was the SNAP Environmental Test Facility (SETF). I showed you that last publication that I did. They wanted to get a permit to operate this facility with SNAP reactors. SNAP reactors stand for Space Nuclear Aerospace Power I think. We launched satellites with radioactive material in it powering the equipment, that's what SNAP's about. They had contracts to build those reactors. One of them was built with sodium and potassium (NaK). They were doing sodium work at the SRE, so naturally they were also the people who worked with the sodium SNAP reactors. We did quite a bit of work for those. Those are the only two facilities, the KEWB and SNAP, I remember other than the SRE. There were probably storage tanks there. I just remember very vaguely the KEWB and SNAP environmental test facility. I don't think at the time they had any radioactive material in the SETF because they had to get a permit. That's the reason why I wrote the hazards report before you could get a permit. I did all kind of calculations on if stuff got loose where does it go in the air? I did those calculations in the surrounding area. That report would have my estimations of what the radioactive material would be and how dangerous it would be if it got loose. That was the requirement to get an operating license to use the facility.

The KEWB facility definitely had radioactive material in it. It was an experimental fission facility to see how much stuff you needed to make things go critical and to get multiplication and chain reactions. Experiments, basically. It definitely had radioactive material in it. I have no idea what the waste stream was. My only function was to go in there and smear around it and see if there was any kind of radioactive material around it, monitor it with the meter and whether there was any stuff around it that was radioactive that could be picked up by people that were working there that were hazardous. I don't recall picking up anything of concern there. I didn't spend a whole lot of time there. I was only there a few times. I don't know, I just remember that facility.

[Looking at the aerial photograph.] Is this the road that separates the Rocketdyne? The rockets are way over here. I remember we watched some of them. I don't know anything about the

ponds you are pointing out. I never hung around this area at all, maybe walked over there a couple times after a rocket firing and that was it.

I spent some time at the SETF and because I was involved in writing the hazard reports. I was involved in the KEWB and going out there and hanging out. That was it. Most of my time was at the SRE. You never got a whole lot of direction. You just did your own thing. I'm sure people with less experience got more direction. I can't remember how much supervision they got, but I knew just as much as those guys. They were older and had been around longer, but I subsequently did a lot of other stuff they never did.

They tried to put a big chill on this SRE. It's a big PR thing. The head of the AEC came out. He threw the switch, the Jacob's ladder. It was a big deal like that. I remember when they had that meltdown. They were scurrying around like rats. I forgot the guy's name that was head of the AEC at the time. It was a big deal. We all sat around. He would throw the switch and they lit up one of the little towns. They were trying to get the job. Sodium and fooling around with those loops, they weren't going to get that. The reactor industry wasn't going to go for sodium reactor experiments. Water is simpler, pressurized water. Shove that into a submarine and beat them out.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 12/11/2009

Interviewee(s): 10

I went to work at the Santa Susana Field Laboratory (SSFL) in August of 1956. I left in December of 1959 to go to the University of California, Los Angeles (UCLA) to work on the reactor there. I have my clock number and the serial number that they gave me if you're interested in that

My original boss, the man who interviewed me, a guy at Van Owen at their office in the valley, was redacted. And he was my boss probably for the first year at least – direct boss – but I never worked at Van Owen. I always worked at Sodium Reactor Experiment (SRE). And when I first went up there my title was a Junior Engineer. I did not have a degree at that time. I took pre-engineering in high school, I had four years of math, and I had physics and chemistry and I went to USC for a year as a civil engineer.

I was 21 when I went to work there. I had a little time in the service after the episode at USC and I had some electronics there. That's probably part of the reason I think he hired me.

My first job because of the electronics background was to supervise the contract electricians who were doing the wiring and particularly the thermocouples. There were thousands and thousands of thermocouples on that particular plant. And I understood about changing the types of wires on thermocouples and they did not. So my job was to supervise all the hook-ups of thermocouples from wherever they set them and make the measurements up to the control room where they were read out.

I've always worked in the SRE building. The whole time I was there I worked in the SRE building. I also trained on that instrumentation, the parts of the instrument I had not been familiar with before. I was familiar with scopes and meters and those kinds of things. The specialized nuclear instrumentation, the people who had the experience, the older guys, were training me on that instrumentation because when the reactor went critical I went on the operation ship. I hated that. It was a week of swing, a week of graveyard days, and then you had a week off. And I was trying to go to school at night and I was married. It was a nightmare for me, so I didn't last maybe 6 or 8 months or maybe a year on doing shift work. And then they moved me into what they called their experimental section because there that's where I was sort of much more valuable to them. A fellow named redacted. He came to Atomics International (AI) and I think he came to SRE was to do a transport function measurement. Transport function measurement is where you put in a system input to the reactor. In this case there was what they call a pile

oscillator and you put on a known sinusoidal wave and then you measure the output of the function of the reactor – the temperature change, the neutron level change and all that. They sent me because of my background at Sanborne, which was in Boston. And then I came back and set up the oscillographs for measuring the outputs of the transport function. I'll show you some pictures of that. They were able to measure the neutron characteristics, the dynamics of the plant, whether it responds, what the frequency response is. Mathematically it gives you a really long large number of things. In fact that was the first time I'd ever seen it and it was probably the first time it was ever applied to a nuclear plant – this mathematical concept. From there we actually when I went to UCLA, we did it on the UCLA reactor. I can show you a couple of pieces. As a matter of fact there's one sitting right there of a used transport function.

These measurements were to figure out the output and characteristics of the reactor, what the frequency response was, how fast it would respond to the control rods. How the delayed neutrons affected where the delayed – I mean the average time of the delayed neutrons, so how much time did you have for them to make these changes before the reactor would respond to those changes. Ramp up and shut down. We did it with sine waves. We had a poison, which absorbed neutrons which went behind a shield that didn't absorb neutrons and ran it down the reactor and as it rotated around, it changed the reactivity so that the reactor power was doing this at whatever frequency we wanted to run that thing. Then from the ion chambers, which were measuring the neutron output and the power output of the reactor, we hooked those up to our oscillographs and then we had an input and an output on the same piece of paper. I could show it to you for the UCLA reactor. I can't show you for this one, they kept them all. They didn't do the mathematical analyses up on the Hill. They took that down to Van Owen. There weren't many computers in those days, so I don't know they must have given it to the mathematicians to do the analyses.

We put the pile oscillator down into the sodium – into the reactor itself. You'll see pictures of the thing operating.

You won't see the ion chambers because they're down in near the core. They're under the big concrete shielding. That particular reactor, in addition to the activity coming from the fissioning of the uranium – the sodium becomes extremely radioactive (sodium-15). So everything that was measuring the actual reactor itself was down underneath and you wouldn't see the chambers.

Compensated Westinghouse, Compensated Chambers – they were this long and maybe about that big around. They had both compensated and uncompensated. The compensated were used to log in the linear power meter. The safety amplifier was used on non-compensated ionization chambers. We used exactly the same ones that they used on the UCLA reactor. I got a spare set when I went back to Oak Ridge [National Laboratory] from that helium reactor that never went critical. They let the university have some of their electronics, so we had an extra set of them to do experimental things with. The people that I worked mostly with were [note a series of contacts was provided and has been redacted for privacy].

This guy [pointing to name on paper] went to General Atomics and he was big in the health physics society. He did some consulting afterward and he was always involved in the reactor

emergency response things. I ran into him all the time there and I've stayed at his house too. I'll think of it, but he… Okay, remember we're talking about the 1950s and this was only the second power reactor in the world as far as I know. So there was a lot of training. They trained us probably a couple of weeks in health physics procedures alone. I had special training in instrumentation because my area/background was in instrumentation and just had to be converted... They even gave us lectures on understanding the reactor itself and what we're dealing with and that aspect. And I did get to operate it on the ship, although I was not an operator. I was the electronics technician on the ship. If something went out I could put new vacuum tubes in. I kept the ink running in the recorders. Anything that was instrumentation-wise that was on the ship that was my job. Because it was back-shift and not a lot to do they put me in a high stool because I couldn't stay awake sometimes. I'd fall off if I went to sleep. They also let me sit and run the reactor on occasion. Even, maybe not to take it critical, but to bring it up to power and stuff like that. Everyone on the ship was supposed to be able to do everyone else's jobs. I think that's a good measure. You know, I don't remember the trainers' names. The health physicist (HP), as soon as I come up with him and I will come up with him because I've known him for all these years.

The focus of experiments was to work towards a commercial product. As a matter of fact they were building one at the time. It was being built in Nebraska and it was a sodium reactor. It was a full size. This was one of the five pilot plants. It was a helium cooling reactor. This was across the border. And I'm not sure if it ever went critical. It may have or it may not have. They had two fatal accidents there as we had two fatal accidents. Nothing to do with radiation. All the primary sodium was underneath these huge concrete vaults that were high density concrete and you lift these great big tonnage blocks off because of the sodium radiation. The tubes were thin and the guy just fell of the edge. You fall 15 or so feet before you hit the tubes and it just slices you up like a big cutting… and he died. The one that died at SRE – when you go down there those pits are very hot and the air circulation stopped for a little bit and there's an inner gas filling when the thing is not there so that the sodium doesn't burn when it comes out into the atmosphere. They just passed out from that. One guy passed out and the guard was supposed to be his mentor monitoring him crawled down to get him and of course he went to and there was no one to see them before they died from asphyxiation.

Redacted. He was one of the main HP's up there. Redacted did some of the training, HP training. I was an engineer, I wasn't an HP at that time. He just recently passed away. Last Christmas or before. Not much older than me. When he retired from General Atomics, he went to work for the state of California. By that time I was with the Nuclear Regulatory Commission (NRC) and overseeing the state of California. One of my jobs was to go out with each inspector and he was one of their inspectors so we always made a joke out of that. He had trained me 30 years before and I was supposed to be taking him out training. It was a good laugh for us. We enjoyed that aspect of it. Yes, we had film badges from before the reactor started up. Everybody wore them. They were very conscientious about wearing them. There was hand monitoring as well. People like me did not do the monitoring because if you went down into the pits or anything like that you always had a health physicist to check the thing out before you went down. Or maybe even put extra dosimeters on you depending on what you were going to do and monitor you when you came out or even sometimes go with you. So Frank went with us a few

times. I got used to it. Working in the pits was really hell. It was 140 degrees in the pits and you had to make sure that the air was going so you didn't suffocate from the inert gas. I think the inert gas was probably argon.

My work down in the pits was doing the sensor thing for the endothermal couples. They were tacked onto the piping for instance. If they come loose, I need to go down and spot weld them back on. Or the flow meters – I would go down and see if they got jammed up or not really working. The sensors for the instrumentation were all down in the pits and somebody had to go down and look at these.

Thermocouples you can always leave a little slack and strip back reattach them to the pipe. And you mostly do it with a tack welder. There was not a lot of waste material/waste electronics coming out of that work and the thermocouples are radioactive. Sometimes I pulled the asbestos off myself to do repairs. And it was asbestos, there's no question about that. If you asked most of the people that did this type of work asked, you just wore a piece of paper over your nose because if you wore a hooded thing and you're working in 140 degree temperature you couldn't see and the glass would fog up.

The other thing as long as I was down there, all the pipes had 240 volt heaters and sometimes the wires on the heaters came loose and I would fix those too. And many of the days I got 240 volt shock, but you can live through it. Health wise, the absolute worst thing… and we all had to take turns at it because they don't want you exposed for a long period of time…In the earlier days we used toluene as the pump cooler, not tetralin. And we had a lot of leaks and sometimes the big rotating pumps would seize up on us because the sodium would solidify. And we'd pull the pumps out and take them outside. With a little steam generator and just a face shield and nothing more, we'd take turns steaming the sodium off the pump. That vapor coming off as the sodium was going "boom boom boom." That vapor coming off there would take the mucus right out of your throat as you're breathing that vapor down. Talk about a hazard, that was probably the greatest hazard I was in.

Toluene was a coolant. Not a lubricant. The tetralin was a coolant. The way a shaft is turning and comes through a seal – the way that they made seals for the sodium was that they froze the sodium. Freezing to you means ice, but freezing to sodium is about 200 degrees or 180 degrees. The sodium would come up through and freeze and that would be the seal. The way they made it freeze is by having it circulating a cooling material around where the shaft came through the seal. The cooling material in the beginning there was toluene and then they switched to tetralin. And somehow the tetralin leaked into the sodium is what caused the initial thing. And by the way I was there when - we didn't realize that the tetralin had turned to tar and plugged up one of the channels to the fuel elements or a couple of the channels. The reactor just acted kind of strange. We didn't shut it down, we just kept on running. This is an experiment and we didn't know what was going on down in the core. Even after we did know what was down in the core, we put fuel elements back in it after we pulled those others out and tried it. But officially we didn't go back to power until after I had left. We went back to power several times while I was still there. There were no rules against it remember. We were under the Atomic Energy

Commission (AEC), an AEC reactor those days. The AEC had people out there almost daily to see what was going on.

The pumps that we steam cleaned were not radioactive. It was before we took the reactor critical. And by that time we learned about the tetralin and switched. We didn't have those same kinds of problems with tetralin that we had with the toluene.

Regarding sodium on pumps or pipes that was taken over to a pond a half a mile west of the SRE that was not radioactive sodium that they took over there. It was after the sodium-15 decayed out. If there was extra sodium or sodium leaked out of the system they'd clean it up and dispose of it in that pond, in that waste pond. But that was on Rocketdyne property I think. I don't believe that was on what we considered to be Atomics International fenced in area. I think that was on Rocketdyne. But it was our sodium, no question about it. They did dispose of it there. In terms of the fission products that were released from hot sodium, iodine immediately went into it. The xenon, xenon's an inert gas, so it built up in the top of the core, but it was released. There's no doubt about that. The radioactivity that went in the high bay didn't seem to be infected all that high and we were still walking around the high bay most of the time. The only time that we didn't walk around the high bay was when we put a fuel element in our cleaning facility before we put it in the hot cell. One of the cleaning facilities I guess they didn't get enough inert gas in there and it caused the sodium to explode when they flushed it with water. It blew the element, this is a hot element out of the core, up into the room and the activity there – everyone ran out of the building. The activity there was extremely high. As far as exposure to the people, it was only for seconds and many feet away from it I think.

I was not involved in the decontamination operations at SRE. We used toluene as a decontamination agent at UCLA a lot, but I learned about it up on the hill. You put it on concrete. It actually pulls the moisture out of the concrete and put the stuff in solution. I thought we used that up there too. Maybe I'm remembering from my time at UCLA. I thought I learned about it up there. It was a decontamination agent. It was fairly new at the time.

Going back to the sodium removal from pumps. They wouldn't do that kind of cleaning operation until the sodium-15 had almost completely decayed away. If we had to work in the pits or with anything in the primary loop after some hours of operation, we had to sit there 2 weeks until sodium (sodium was a 15 hour half-life I believe) completely decayed away before we did it. After the fuel melted – the strontium, cesium, and iodine – all of those things go immediately into the sodium, combined with the sodium so they are not free. We had clean up systems. We had filters. Probably ion resin exchangers and we'd run the sodium through that and we could clean out the fission products that were in the sodium by using those filters. If it was solid, the filters would take them out and so we can clean up the primary loop pretty well. I think the primary loop was on a somewhat continuous cleaning cycle during operation, but if we stopped we would increase that. So we'd get the fission products or whatever happened to be in the sodium out of there and that was all in these pits too. The pits may have been external to the building because the one thing that you could do with this reactor is that we had tanks that were big enough that you could put the entire primary loop sodium into a tank outside so that your sodium loop was empty.

Those were underground tanks, they're in big concrete blocks. Huge concrete blocks. The high-density kind. The concrete blocks that they had to lift off of these pits, they were kind of stepped, smaller at the bottom so they're stepped down because of the radiation. We hired a crane operator to lift one of the blocks out. They were trying to tell him this concrete weighed such and such per square foot. And he says look I've done this all my life; don't tell me what to do. And of course he picked the thing up and turned his crane over and probably a half a million dollar crane or more because he just wouldn't listen. He was too smart for all that.

So when the pipes are cleaned out, the fission products are cleaned out and that material would be in the cleanup part of the system, which sometimes was outside. I don't know what happened to it the radioactive waste after it was removed from the system.

With regard to the SRE incident in 1959, it didn't melt down. I think the cladding failed on it. The stainless walls that the pellets were in got hot enough that they weren't getting enough cooling and melted the stainless. My understanding is they did pull one of the elements apart and part of it stuck to the bottom. They eventually got it out of there. When they pull those up keep in mind they had to go through a big tank of sodium. So any volatile stuff is going to go in that sodium as they're pulling it up. Sure there's going to be fission products that come with it. They had two fuel handling machines, both of them heavily shielded. And they pulled the fuel up in there. It'd have been nice if the fuel was all together but that one fuel rod. I think they only pulled one of them apart. I think the other damaged rod came up as a whole fuel rod. It went right up into that machine. Yes you're going to contaminate that machine and you're going to have fission products in it, but they're still contained and they're still contained in the inert atmosphere. They move them over and put them down in the fuel cell [or holding area], but they're still contained. The reactor itself, the vessel – nothing melted. When we finally got that element out we put another new element down in the hole. Got the hole cleaned out so the sodium would flow through and start up the reactor again. We couldn't have done that if we had a Three Mile Island.

We had air monitors in the high bay, control room and outside that were continuously monitoring the air and recording it on chart. They had particulate filters in them as well as looking at gases and they had recorders. That was part of my job too. They had recorders in, so we saw an elevated amount of radiation, but not elevated to the point where we couldn't walk in there.

No, I don't know anything about offices getting contaminated and files being taken outside. The high bay itself was under negative pressure compared to other offices in the buildings and the control room so that any airborne contamination would come into the high bay and go up the stack. It would not flow the other way. I've never heard of an incident – and there were multiple fans, so a power failure on any reactor – we had a battery room, generators. I worked on this system too. They turned continuously, there were motor generators that turned continuously and kept the batteries on flow. You wouldn't lose one cycle. If the entire power shut down the line going into the place or going out of the place, the batteries would turn the generator as a motor, the same thing it does on my Prius, turn the generator as a motor and you wouldn't even lose one cycle of AC. They would stay on long enough for the diesel generator, which is a 100 kilowatt (kW) diesel generator. It wouldn't be one cycle off from the switching over so that you never

lost power for anything. You never lost power for your fans, to your instrumentation to the reactor room, to your control rods, to your pumps. If you were in a situation like that, you didn't demand – you were in shutdown position if that system came on. You wouldn't be running your major pumps, but you can run your minor pumps. That reactor, the beauty of sodium is the heat transfer coefficient is so high that if the whole thing solidified, it still would not melt down. It would carry the heat out to the heat exchanger and either blow it to atmosphere or send it to the generator which made steam and water – I mean steam and electricity. The sodium occasionally in some of the secondary system – the primary system was all under the concrete blocks so the secondary system is the one that shipped the heat over to the pipes.

We didn't have World War III. Between Christmas and New Year's on a midnight shift when it was raining cats and dogs all of a sudden we hear this "boom boom." We go running outside and the whole sky was lit up. One of the seals on a sodium loop had broken – so the 1,200 degree sodium was shooting out into the rain. It was exciting. It was the most exciting thing I saw out there.

As far as the activists at the site go, I know [redacted] personally. I've sat at a bar and had a beer with him. I'll tell you exactly what he told me. He said, "I'm making a living on this. I'm going to become somebody famous on this. I don't have to have the right idea. All I have to do is convince the right people." That was when he was trying to shut down the UCLA reactor.

With regard to the allegation on the SRE is that there was an unmonitored release of radioactivity because it exceeded the equipment at the time, there may have been. First of all I don't disagree about the probability there was a release and we may not have known how much, but I can guess. It was inert gas and it was released out of the stacks so the people who worked there were not exposed to it. It was a Santa Ana weather condition at the time that this happened, so it all went out to sea. If you look at the population density of the path of it in those years, you don't look at the population density of the path of it today, it was maybe the little strip of land in Malibu, the sand, there were houses, but between there and the ocean that's about the only place there was any population whatsoever. By the time it got there, I'm sure the concentration was insignificant. And yes I've heard a million theories. But you're talking about being shot up a stack at a high velocity. The stack was way above the roof of this thing, which is about three stories up.

As far as releases, it would be xenon gas. No iodine as far as I know. The hot sodium becomes sodium-iodine instantaneously. You're not going to release iodine, strontium, and cesium. What you're going to release is xenon because xenon is an inert gas. Once it's out in the environment, the concentration is way down.

Argon has no body uptake. Xenon has no body uptake. So the only radioactive exposure you'd get is when you breathe it in and out and the time it's in your body, in your lungs. It doesn't stay in your body whatsoever. So the exposure still would have been fairly low even though the concentration at the point of release would have been very high.

Moorpark is the town we isolated and gave it nuclear power for a month. It was the first city in the world to exist on nuclear power independently. We even beat the reactor in Pennsylvania (Shippingport) that was the first reactor online, we were second.

With regard to the SRE and steam cleaning the pumps and the underground storage tanks, there was a cement pad on the north, big double doors, and that's where we took the pumps and did it right on that cement pad. The tank that we're talking about that holds the primary sodium was just to the east, right up against the building, and east of that pad.

As far as Area IV went. They had some little reactors. The operators and including myself – I am not an operator. I had 20 years of senior operator license at UCLA, so I've been through the program. I taught the program a long time myself. There were some NaK experiments going on in some of those buildings too. A combination of sodium and potassium, it melts at a much lower temperature than sodium did. The sodium melted at such a high temperature that was one of our problems, keeping everything to heat to that sodium would stay liquid.

Working there you also meet people from Rocketdyne. They had some pretty serious chemicals over there that are hazardous too. In reading, redacted has kind of just pushed those things all together and made it one. He doesn't distinguish those chemicals from what is going on in the nuclear plant. He makes it one big issue. There may be this pond you're talking about. Yes, groundwater from this pond soaked into the ground. That would be chemical problems. I don't think anything radiological. I think we took sodium that was radioactive.

Regarding finding cesium and strontium in a 1980s excavation of the pond, that's fission products. Oh, let me tell you something. I was also responsible for monitoring the UCLA reactor. I do wipes on the campus because people are concerned about releases onto the campus. One day I wiped and I got cesium and strontium. There's no other reactor could be putting this out. When the Chinese did their bomb testing, a lot of it drifted here to the U.S. Fairly high levels, levels that we would require decontamination if it were on the streets at Westwood. On other streets, I would just wipe it down and I would consider it to be decontamination.

I do think you can analyze the material and know whether it was from weapons or from a reactor.

With regard to what happened to the primary loop sodium from SRE, it would be hell of a lot of truckloads if it were sent to Hanford. When I first got there, there was no sodium on site at all. We're talking about dozens of 18-wheelers with 55-gallon drums of sodium on them. We had a special place where we would put the drum and put heaters around it and put asbestos around it. It would heat the drum up and run it into the system. The sodium was packed in drums. I was there when they opened them. It was solid though. I don't remember any oil being used to pack the sodium. It was just an inert gas that was used. You set the drum upright and you put your fittings on it with the valves and everything in the upright position. The room was very dry and then you'd set the drum up here and you wrap it with the heaters and asbestos. You start heating it up and you got to a certain temperature. You open the valve and you had to have a vent at the

other end. We did have it hooked up to a cylinder of argon to push it out. We'd flow the sodium out and into the main tank for when we're going to fill the reactor.

With regard to filtering the sodium in the primary loops, it's just like water on a reactor whether it's a submarine or the UCLA plant we had filters and mix bed ionizers. You could drink the water that ran through the core. It was a lot cleaner than the water you got out of your tap. What do you do with the filters? You shipped them as radioactive waste normally, but there was very seldom much stuff in them.

Once they decided the end the experiment, they probably put the sodium back in 55-gallon drums would be my guess. I never got to the pond [sodium burn pit], but I knew we had one and that when we had contaminated, dirty or leaked sodium we'd scrape it up and put it into something to take it over to the pond and dispose of it. I thought the pond might have had a liner.

Looking at an aerial photograph of the site I can point out some little reactors. There was the L-77, which they were going to sell to schools. There was one more. And then there was the organic moderator. I don't know if that was a zero power reactor or if they got that far or not because one of the companies in the east did build an organic moderator reactor. We were going to go that route, but they beat us to it. It never progressed. The sodium pump cleaning would be right about here on the map. The pit that I'm talking about that has a tank for the core reactor sodium would have been right here.

There were some pits outside that were pretty deep, maybe 20-30 feet down. The hot cells were in a building, which was underneath the building in this corner. They all had drains and they had to drain somewhere into a tank. I think that stuff was on this side. I remember I had to suit up to go down in one of those holes one day to do some fix on instrumentation. There was concern about contamination. I had to climb down a rope ladder with booties and gloves and totally covered up with a face mask and all. No harness, not in those days. I know there are pits along there. They're quite deep.

What were they finding in the soil? At what concentrations? Why don't they put a fence around the whole thing and walk away? The level of contamination where somebody lives and particularly if they also farm versus the level of contamination where you would have a day-use thing is different. The cleanup levels you are at are almost down to the level where we're talking about background radiation from other things. You have to find background levels beyond 50 years ago? We're getting close to 50 years on this reactor.

Let me show you some pictures. One of these is the input to the transport function and then it goes through the reactor and then one of these is the output. This is the first use of Sandborne equipment, primarily electroencephalogram (EEG) and electrocardiogram (EKG) machines. The first use in an industrial setting, especially in nuclear. That's the control room. They had a little room for experimental material. This is the reactor console right here. This is the engine behind from the sodium reactor. Here are pictures of the console. That's me, they set up an external

thing so I could go down and make measurements in that area. Here are pictures that are mostly taken shooting down the Hill from behind.

This concrete thing here, that's where the primary sodium tank was located, was emptied, was reacted, was running and it was full and when they'd work on the reactor they'd pump the sodium back into this tank right here. This pad right here is where we cleaned the sodium pumps. We had a portable crane and we shipped them from internal crane to portable crane and come out here and shoot them with hot steam. The stuff would blow.

On the base of the pump if the toluene was not efficient and the pump would seize and the sodium would solidify. We had no way of getting that off of there. So we'd bring it out here and shoot it with water.

It's sodium from the primary loop before the reactor started. We did a lot of testing. I was there for most of the construction. We did a lot of testing of the pumps. At first we didn't completely understand sodium being used in this fashion before. This is totally new engineering. This thing right here is where we put the drums to melt the sodium that came up in the trucks. This is the secondary loop where the heated sodium from the pit. The heat was transferred from the secondary. There's a heat exchanger in here. If we needed to get rid of the heat because of a shutdown or something and the power plant couldn't take it – this is the steam power plant – then it would go out of the heat exchanger right there. The secondary pumps are in this area. The primary pumps are underneath the concrete and the sides. Did you know about the steam generator? They were worried about 1,200 degree sodium and water. There was a layer of mercury between the water jackets and the sodium and what happened to that mercury I have no idea. We're not talking about a small quantity of mercury here, we're talking about maybe a few hundred gallons. I do know that there was mercury in there, so if the pipe corroded through the sodium would either go into the mercury or water corroded through it would go into the mercury. The sodium wouldn't go directly into the…I just don't know the volume of mercury.

The heat exchanger I heard had mercury in it. It had to be a unique one. The first submarine was the Nautilus. The second submarine started out to be a sodium cooled reactor, but the guy who headed that program, Admiral Rickover, was really scared of the sodium underwater. So he had them pull that whole system out and put a water system in. We got the steam generator up here and plugged that as the secondary steam generator, which did not have the mercury transfer in it. I think that was used towards the end, too. Two conversions from the sodium to the steam to turn the turbine. That's redacted. He and I worked close together, he was another technician. This was on the reactor floor. This is the pile oscillator and it has a shaft that goes right down to the reactor core. These are control rods. This is our oscillator. This is the motor for it and the sinusoidal input – we got the input information on the top. The right angle shaft goes down into the core of the reactor. It spins around on itself. That's how we create the sine waves of the power. Here I am at the end of the oscillator. We have the Sandbornes set up. This is the power supply to the chambers that we're using. These are the Sandbornes to look at the output/input of the information that was going on. They didn't like us out there in the reactor core. So they moved us into that room – you saw that other picture. You can't really see the vertical shaft down to the core.

We built it in the shops. You're right this whole system us custom made and we built one similar to the UCLA reactor.

You couldn't call up a company and say send me a pile oscillator. There's no such thing, so we had to build it. This is the paper coming out. I think this is a four-channel, so we had a lot more information coming from that. This is redacted, he's out on the floor. They didn't want us on the floor while the reactor was running at full power. We did transport function at full power. I gave lectures on the Sandbornes. This is the trip report from sending me back from Sandborne. This is a procedure for the hot trap and this is one of the traps of the sodium reactor, you're cleaning up the primary sodium and how to do that and operate it. The ship supervisor was redacted and I worked for him at this particular time when I was on the ship.

26th of June 1957. This is a long time ago. This is the head of the experimental unit personnel. I told you I don't get along all too well on the ship. So they moved me over to the experimental unit. This is where we started doing the oscillator test and things like that. I still did a lot of instrumental repair. That was primary job. [Review of people in experimental unit who were in the photographs].

[Looking at UCLA reactor photographs] That's the UCLA reactor console. When I went to UCLA we were brand new too. There were just three of us. I worked under redacted as a technician, but I quickly got promoted to assistant supervisor. After three years he resigned and went someplace else and I got his job.

I'm not sure that it's helpful for you. Because I went to UCLA, I saw my radiation records and I never got more than 100 milliroentgens (mR) at any time. You get more than that when you take a CT scan these days. I was there when it melted down probably on the ship because we didn't know it melted down. All we knew was some of the instruments – in fact they had me take that recorder off and put a signal in to make sure that recorder is working right. We don't believe that recorder's in. That the kind of thing I was doing when they were trying to figure out what was going on with the reactor. Yes the fuel did heat up because it wasn't getting coolant from the sodium, which was blocked because the tetralin turned to tar at the bottom and it melted through the cladding. I don't call that a meltdown, a cladding failure. We were an experiment after all. There were no other sodium reactors in the world at that time. There were a lot of good things about sodium. Like I said, you couldn't have the problem you had with pressurized water reactors like they had at Three Mile Island because if sodium even solidified it would carry the decay heat away from the reactor and cool down by itself. We could blow it out the air blast heat exchanger we had outside. There were a lot of good things. The other thing is when we were producing electricity for Moorpark, our temperature of our sodium was 1,200 degrees so we were 40 percent efficient. Even the best water reactors today are only 30-35 percent efficient so we were more efficient than any of them because we could carry a higher temperature. When you get water at that temperature, you're talking about 2,200 pounds per square inch and you've got a lot of problems to deal with. We're talking about with the sodium reactor that's atmospheric pressure.

The whole idea of research reactor is you put things in to be irradiated or manufactured, so we had a lot of handling things that came in and out of the reactor. Up there it would be only if something failed and they had to take it out of the primary loop and repair it. If it was failed beyond repair, they'd put something new in. That would be contaminated. They let it sit around until most of the radioactivity decayed away. It was primarily – I was wrong, it was sodium-24 that had a15 hour half-life. They let it sit around along as they could and it was primarily decayed away. You didn't see a lot of fission products because on that particular reactor the sodium picked up most of the fission products. In the release of the fission products when the fuel melted, it went into the cover gas, which was argon, and it would mix with fairly high concentrations of xenon. They didn't want a lot of pressure on top of the reactor core. They want enough to force the sodium down, so they would release it up the stack. During normal operations, the cladding didn't leak.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 2009

Interviewee(s): 11

I was hired in 1956, and from 1956 to 1974, I worked as a mechanic for North American Aviation. Then it became Rockwell and later Rocketdyne. Our office was down in Canoga Park, but I worked up on the Hill all of those years. I worked in alpha area, bravo area, coco area, delta area and Component Test Labs (CTL) 1, 2, 3, 4, and 5. They had three shifts in that area or two shifts rather. They didn't believe in three shifts, so they had the guy working 10 hours a day over in Rocketdyne. All we were doing up there was testing rocket engines for space. We had big water buckets, bigger than this house, where the flame will come out and then shoot out this way. I can't really say. Everything was fine up there. I worked different shifts there for a while. I was a mechanic. Then I went into inspection.

From 1974 to 1986, I was at the Energy Technology Engineering Center (ETEC). As an inspector at ETEC, I checked on everything there and made sure they were running all the tests. I had to do a leak check with a machine up there, checking on any of the nuclear stuff for any type of leakage. I inspected everything they had there for testing radiation. One place there we had to go down in the basement, I don't know how many steps, and check for leakage on any of the nuclear stuff down there. I inspected all of ETEC for any type of leakage all around.

We buried a lot of stuff. There at ETEC. I was an inspector up there at the time. We only had the one shift. We didn't have a second shift or third shift. Evidently they felt there that the guys would be better off learning all this stuff on the one shift because there were sometimes when I'd working Saturdays and Sundays and we'd have to talk all kinds of samples. What they ever did with them, I don't know. I can't answer that.

We didn't have to wear any sort of hazmat suits at the time. I had to wear a mask/respirator and a hard hat all the time. I can't remember if I wore a dosimeter or film badge. I don't think so. It was all new to them. We were just getting into it.

My job as an inspector involved checking for leakages and pipes. We had a leak detect machine we'd run in there and put in liquid nitrogen or hydrogen and check all the piping and fitting for leakage. I tested sodium, helium, hydrogen, nitrogen pipes, and liquid oxygen pipes. We had to be careful of liquid oxygen because that did the most damage. I didn't work in any one building more than another, we just had to go to one building one day and another building another day. We'd get a call and the supervisor would say, "Go up there and you've got to check for leakage in there."

I can't remember any accidents of spills. If it happened, we never paid much attention to it if you follow me. Oh we got a slight leak going there. We'll just get a shovel and bury it. You know what I mean? That's about all we did. We didn't know too much about it at the time. As far as what we buried it would be leakage from the type of testing we were doing. It's been so darn long now I've forgot a lot of it. The mechanic would bury it. We made sure to bury it out in the ground or something like that. At that time, they didn't know what to do with it either. It would be small volumes, smaller than a bucket or drum. That would happen maybe once a week, maybe once every two weeks or something. They were pretty careful about pipe connections and stuff like that to make sure they weren't leaking.

The mechanics would just dig a hole, 1.5 or 2 feet below the surface and deposit stuff. They took it over to one area out there. Don't ask me where it is or where it was then, I don't know.

Nobody could believe my serial number. I was hired on with North American before the war, out in Inglewood. They were looking for workers, so I went to work. I said all right and I got in. They had the draft, but I enlisted in the Navy. My number was three digits and when I'd go through security at the gate they wouldn't believe it. I said that's the number. They had to call down to Inglewood, "This is the man's name, what's his serial number?" They couldn't believe it. Everybody else had five or six digits in their numbers. So then when I hired in with Rocketdyne in 1956 I had the same serial number and nobody would believe it. When you went through the gate, you'd have to give the serial number. I told the guards this and that. No it can't be. Call Inglewood, call Canoga Park. Oh okay, you're in. Those days it was a gated community. Guards at the gate. I don't know how it is now. If they still have guards at the gate.

I might have handled radioactive materials, but I can't recall really. It was so new to us then that we didn't know.

I didn't do any work with the removal of drums or waste because I was an inspector and all the drums were taken off by a company of fork lifts and moved someplace.

The mechanics that worked there may be able to help with more information. I can't remember where they are or who they are. One guy right now, he lives up in Tehachapi. My nephew was working at ETEC. He spent quite a time over there in radiation. He was a mechanic. My son was over there, but Rocketdyne sent him down to Canoga Park and he worked on Canoga Park. He was a manager down there in college.

I couldn't tell you what my nephew did because he's still working there. Forty years he's done with them. He works out of the other side of Palmdale and all that stuff that's up in there. He put in 40 years and he retired and they said no we want you to keep going. So they said you will be a "job shop" and if they want a job up here in Palmdale, he'll go over there. He lives out in Tehachapi and he goes to various jobs up in the desert.

The mechanics would take the piping apart, repair it, put it all back to together, and we'd all go inspect it for leakage when we did the test.

The mechanics worked out of the building. I don't remember all the building numbers, but they'd have all their equipment in a building and work out of it. They'd be working at the building that had the piping problem. This was in the days before all the computers came out. They would work in the different areas that needed repairs. And we were able to drive our vehicles up in there. We'd drive in being to the main office and if I had to go out on the job, I'd take my vehicle out to a certain building.

We had an area up there where they dumped a lot of that stuff, but don't ask me where it was. It was kind of on the side of the hill. They had to dig it out and bury this stuff. To tell you the truth, then, we never paid any attention to it. They said okay we have to bury that stuff over there. Whatever came out of the piping if there was a leak was buried. I think pick-up trucks came in there if there were ever large things needed to be disposed. I never paid much attention to it.

If I were to try and guess where the mechanics and people would bring the small volumes of waste for disposal it would be in Area IV someplace, but I can't say where. I think they were called Maintenance and Maintenance would come down and pick it up. The barrels and stuff. They may have called Maintenance for small volumes as well. Being in inspection, I had nothing to do with it.

I can't remember anyone's name in Maintenance off hand. I could tell you guys from Rocketdyne side, engineers. They were test-hand engineers. We did the firing of the rocket engines. We had a great big piece of granite material and we did a lot of inspection on that for leveling. Most of his work was inspections of materials coming in. We had this great big granite plate that was all leveled out and we had to check it for leveling. It was a regular great big piece of granite. It was all leveled. Shipped that from Italy.

Building 59. That's an awful familiar number. They had a reactor in there. I worked at all of the buildings. We had to do a leak check down there and go over there. When you quit working you forget. Those buildings were familiar. Small Component Test Loop (SCTL), Sodium Component Test Installation (SCTI). I was in both of them quite a bit. Being an inspector, they had all the mechanics in there doing all the work and we'd get a call to have a leak check or putting this and that together. We had paperwork to buy it all off. I don't know where that paper work ever went. It went someplace. It was paperwork of what you've done. Kept in folders. They'd have it all down – inspected this, inspected that. Then we'd have to sign off on it.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: _____

Interviewee(s): 12

I was a construction inspector also known as a labor 17 inspector and began working at the Santa Susana Field Laboratory (SSFL) in November 1974 and retired in 1995. I worked throughout Area IV for Atomics International, Rocketdyne, and then Boeing. I worked throughout Area IV, including at the Liquid Metal Engineering Center (LMEC), which then became the Energy Technology Engineering Center (ETEC).

I have worked to build new buildings from the excavation up, including piping systems and refurbished existing structures. I have worked on sodium piping, steam pipes, and power plant systems. I inspected aboveground storage tanks and underground storage tanks. As an inspector, I did a little bit of everything including non-destructive testing. Some tests, for example, were to ensure the quality of concrete and required breaking apart the concrete in labs, whereas other structural integrity tests were done by x-ray using cobalt-60 and/or radium-192. Most tests were related to sodium pipes and steam generator pumps. I also worked on excavation water pumping. I wore a dosimeter and/or film badge when working in "hot" areas or potentially hot areas. All film badges were collected every 3 months. I never worked on any detail that required use of the borrow pit located on the south hill, but I am aware of that borrow pit. Excavated soil and broken concrete would be dumped along the border between Area IV and Area III, near main road. Some construction crews would also dump concrete and rebar, such as the concrete floor from the Sodium Component Test Installation (SCTI) removal (Building 356), in "that small pond."

I think the safety procedures were very good at SSFL.

Fuels were fabricated in Buildings 20 and 25. Most reactor buildings had been dismantled before my time at SSFL, with the exception of the SRE. Building 12 was where my radiographic testing lab was located and prior to that it was a "power source for NASA."

All of the liquid waste I am aware of, such as dowanol and other non-radioactive liquids, may have been reused, but were eventually drummed and "taken away." I do not know where the waste was ultimately taken to.

I would collect solids that accumulated in the cold traps, which were the lowest portion of sodium piping. The steam pipes I worked on were as high as 2,000 pounds per square inch and one way we would test for pin holes would be to slowly move a broom in front of the pipes and

if the broom suddenly burst into flames, we knew we had found a leak. Most "mini-fires" from sodium pipes were contained by the operational crews before the fire crews would arrive. The firemen were not well trained in sodium fires. Security and fire protection were one and the same and the firemen were armed.

All film badges and dosimeters were tracked by, and assigned by, the Health and Safety Department. All spent badges were sent to them every 3 months.

It was common knowledge that "stuff" was dumped into the Sodium Burn Pit. A cache of mercury was found in the pit once. That lake in Area III (that was drained to) was used for washing out the flame buckets at the Rocket stands.

An area next to Building 59 was excavated for a new building, but then the plan was abandoned and the pit filled with groundwater that was subsequently contaminated with radioactive liquids released from Building 59. I learned this second hand though, so I don't have any other details on that, but I can point out Building 59 and the pit on the aerial photograph. There was a dumping ground near the pit as well. Construction maintenance personnel would dump along the two roads next to the pit area. It was common to see dark stains in this area.

A bermed area located along the boundary of Area IV was used as a small arms shooting range. I can point this out on the aerial photograph. To my knowledge there was no indication of dumping here.

I assisted in the construction of drainage ports in the concrete foundations of buildings that would redirect groundwater trying to seep into deep foundations to an interior trench that would then be pumped out of the buildings.

The only release I know of first hand was an alcohol spill (dowanol). I had heard there may have been a radiological release in the 1960s during the construction of a reactor for satellites, and then the previously mentioned leakage from Building 59 to the pit occurred in the late 1980s and1990s.

I can indicate on the aerial photograph you provided a general area that was used for the disposal of miscellaneous debris. It was this general area along the southeastern side of G Street. I don't know if any irradiated material was ever disposed in the area.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 2009

Interviewee(s): 13

I worked for Rockwell/Boeing in all areas of the Santa Susana Field Laboratory (SSFL). I was an Environmental Technician for 28 years from 1981 to 2009. In that position, I was in charge of the hazardous waste yard area and later testing standards.

There are some areas of potential areas of concern I want the Environmental Protection Agency (EPA) to know about for its sampling effort. I can point out a number of these areas on aerial photographs.

Pits 1 and 2 near southern portion of SSFL. This is the "million dollar hole." I think these pits are from the years 1990 and 1991. They are "sodium burn pits" and among the various things that may have been put there, the sodium reactor experiment (SRE) primary sodium loops were found in these pits. I think there is Channel 2 archived footage of pits 1 & 2.

Up near the fire hydrant "NaK Bombs" were disposed of (cylinders of sodium potassium).

Building 204 (or possibly 209) was a maintenance building. Barrels of waste oil were stored here that were used to suppress dust on all the roads. The roads would be sprayed with oil to keep the dust down. In the 1960s, at least one time that I know of, a barrel of waste oil was determined to be "hot" with radioactivity and it had been used on the roads. That waste oil may have come from Building 26.

There was a large fire in November 2005 and I was assigned to sample ash from the fire all over the hill, including outfall 3 and its leach field and holding pond. There may have been some "hot" readings of samples, but I can't remember any details. I can point out the general area where I sampled on the aerial photograph.

Building 65 was a lab that I remember a certain scientist did "weird stuff" and worked with sodium and potassium.

There were two, small concrete-lined pits about 6 feet by 10 feet deep for rinsing sodium parts. I can't remember where the pits were located, but they were open pits. I remember dowanol (non flammable alcohol) was used for rinsing sodium parts.

Building 10 had high groundwater hits. This building may still be "hot" and that no one was allowed in during the 1980s and 1990s.

I also recall Building 5 or Building 30 being posted as "hot." I can't remember which, it may be that Building 30 was next to Building 5 or an AI warehouse, but one of those buildings "had something small in it that was cleaned up quietly."

I can point out the missing uranium slug area on the aerial photograph and an area where grid lines were laid for a radiation survey. I do not know why a survey was done in this area though.

Redacted

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: November 2009

Interviewee(s): 14

I was a contract health physics technician from 1977 and 1978. I worked 1 year for Chem Nuclear Systems, Inc., a contractor to Rockwell, and then was hired on for the sodium reactor experiment (SRE) decommissioning. I also worked one third of the year at the Radioactive Materials Disposal Facility (RMDF) and also worked at the Nuclear Facilities Development Facilities (NMDF).

My job was to survey materials and surfaces, such as parking lot pavement and building walls and floors, prior to the material being removed and sent off-site for disposal. Sampling included swipe tests, air sampling, surface contamination (walls and floors) and dosimeter surveys. I can provide names of people who may have more information related to these activities.

Using a "GM2 Device" I would survey the asphalt parking lot surrounding the SRE for gamma and beta radiation and mark any areas with readings for removal. They would chip out the "hot" areas and remove the asphalt to a separate area. After the "chip out" of the contaminated areas and a resurvey of the parking lot, the excavated dirt, rock, and asphalt were put in a "clean dump area" on the hill. I would also double check the "clean dump area" where all clean removal debris was stockpiled. One time I found some of the "hot" parking lot asphalt mixed in with the clean debris. I was told that some of the asphalt was contaminated due to "spills" and that after each spill, it would be paved over. From the looks of the asphalt, it appeared that at least three spills occurred because there were three distinct layers of asphalt. As far as I know, the lower levels of asphalt were not surveyed. Up to 10 millirems per hour (mrem/hr) was detected in asphalt, soil and rock.

Excavation of the parking lot and under the SRE went down 10 to 20 feet below ground surface. Excavation went to bedrock and then they began chipping and removing bedrock that was "hot." They tried to dig down far enough to see the end of a crack in the bedrock that was "hot," but finally had to stop. I can indicate this area on your aerial photograph.

The bedrock was first sampled by cores then a removal plan was devised. I do not have any concerns with the soil and rock that was dug up. I think it was all sent offsite to a proper facility.

I do not know how radioactive water was spilled to the parking lot, but I figure it to have been hundreds of gallons. My main concern is that "hot asphalt" may have been mixed in with the

clean dump area at SSFL. There could be 10 or so areas within the dump area that are hot. I will point out the possible "clean dump area" on your aerial photograph for reference. The "hot" asphalt could be between 1.5 and 10 mrem/hr. I would look for pieces of it in layers, probably less than 3 feet in diameter. [EPA's aerial photograph depicting the dump area was passed on to sampling team.]

Redacted

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 11/10/2009

Interviewee(s): 15

I started working on the hill for Atomics International (AI) in 1958 when I was about 28 years old. I worked there for 7 years and then moved to the DeSoto facility and then a few months later I went to the Downey facility to work under a National Aeronautics and Space Administration (NASA) supervisor of North American Aviation (NAA). AI was a division of NAA. I started as a laboratory technician and did that for about 1.5 years and then I became a radiation disposal facility supervisor at the radioactive disposal facility. As a lab tech I worked in a small lab south of the sodium reactor experiment (SRE). My duties included fabricating and refinement of nuclear materials (uranium carbide, plutonium, and beryllium) and annealing and hydrating uranium isotope test pellets. Waste from the lab consisted of dust and chunks from machining operations. I am not aware of any tritium waste.

Oil was used in sodium containers as well as argon to prevent sodium reactions with the atmosphere.

I had good interactions with the health physicists during my work.

The radioactive materials disposal facility had underground storage in the high bay building for irradiated fuel. I can indicate that location on your aerial photograph. I don't think this fuel was protected. I had a supervisor that heated uranium carbide in a cement mixer in a shed at the radioactive disposal facility to dispose of it. I can indicate that on your aerial photograph as well. When I worked at this facility there was some high level waste material there. We always knew what and where the waste was coming from. All of that information was logged, but I don't know where those documents are now. The records were all sent to the Atomic Energy Commission (AEC). If you look for these documents at AEC, I would recommend using keywords searches such as "unusable" and "unrecyclable" at AEC.

I don't know any details about any onsite waste disposal. I know low-level waste was sometime concreted or fixed in place. There were reactor grade materials buried on a plot of ground near the hot cell [EPA notes this area is now excavated.]

There was also lab equipment (pressure vessels) and parts storage on the ground across from the gate. These parts might have been hot.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 11/23/2009

Interviewee(s): 16

I worked on the Hill from 1967 to 1983 as an atomic reactor inspector. I worked in the Quality Assurance Division. My job involved testing components for reactors, mostly fast breeder reactors. I would x-ray components using cobalt or iridium in a 350 kilovolt (kV) x-ray machine. I remember spent fuel rod storage in the floor of either Building 27 or Building 22, I can't remember. As an inspector, the main building I took care of was Building 32, which contained sodium test loops. I would use a "pill" of cobalt or iridium mostly. The iridium pills were about 1 centimeter diameter. They were kept in a depleted uranium "pig." The "pig" holds the pill until it is used. Iridium had a 75 day half-life, so when the pill would get depleted we would a new one. The switch was made safely and depleted pills were reclaimed.

I knew someone, who is now deceased, who worked in the Sanitation and Radiation Laboratory (SRL). He had lots of stories. One story I heard from him that occurred before my time was when an "SRL tank" that collected radioactive liquid overflowed into an adjacent gully. It was cleaned up with spoons. The tank may have been underground on the side of a hill; I have no idea where this was exactly.

I recall a lake near Building 27, which housed a photo lab I used to use. The photo lab appeared to have been plumbed to the lake instead of the sewer. I used to take a lot of pictures. I used black and white and also color film and used typical developer chemicals. I don't recall any radioactive materials ever being stored in Building 27. Prior to being a photo lab, Building 27 was used as a shaker building to test equipment by physically shaking it. I do not know of any other buildings that were similarly plumbed.

Building 20 was a lab where they reclaimed spent fuels. I had been in there for testing leaks and bolt testing. I tested bolts that that had radioactive material in them designed to keep space instrumentation warm. "Bolt work" was done in a glove box. I don't recall any spills there during my time.

I was on the hill when the 3-foot tall reactor was placed in a vessel/tank in Building 59. The concrete vault the reactor was placed in was 40 to 50 feet deep and required sump pumps to keep it dry since groundwater was only about 20 feet below ground. I guess the pumped water went to the sewer or possibly to a lake, but that water would have been groundwater and not radioactive.

I can point out some of the building uses for buildings I remember:

Building 22 had fuel storage
Building 32 had a radioactive "unit" in vessel
Building 10 had reactor
There was a small reactor building north of Building 13 and four vertical pipe structures (indicating the steam turbine from Sodium Component Test Installation (SCTI)) were built right over that building's foundation.

I don't have any knowledge of dry wells. I recall a spill in the Sodium Reactor Experiment (SRE) building, but it was contained in the building.

The only protective gear I ever had to wear were booties in the hot buildings and they were taken as you left the building.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 11/10/2009

Interviewee(s): 17

I worked in the Sodium Reactor Experiment (SRE) building in the early 1980s. At the time I was employed by Penhall Company. I recall that they were working for one of their branches or subsidiaries - Nuclear Control Corporation (NCC). At the time NCC was working as a contractor to Rockwell. My job was to cut the concrete wall that separated the reactor area from the loading cells, and cut another wall so a sodium contaminated 20-inch pipe could be removed. I never saw what they did with the concrete slurry, but I do recall the foreman for Rockwell said it was not radioactive. The crew from Rockwell seemed to be truly concerned with my safety and we reviewed our safety procedures every morning. The only thing that struck me as odd was every guy on Rockwell's crew was a chain smoker.

The load cell room was where pellets were loaded into rods. While I was there I could see pockmarks all over the ceiling, floor and walls from chipping and cuts that had been made from previous removal of radiologically contaminated concrete and rebar.

Penhall (Anaheim office) did the reactor core removal at SRE using the "stich-drill" method of over drilling (by 8" core bit) the reactor cores down to 30-foot depth then drilling directly next to it a second hole to facilitate core removal.

I estimate about 300 gallons of slurry were produced from 60 holes. Slurry is the water that cools the drill bit and gets mixed with the ground concrete and rebar and usually contains tiny pieces of the metal and diamond drill bit. At that time, the disposal practice for the slurry was simply dumping it into pits or on ground. This was the usual practice up through the 1980s. Now pits must be lined prior to disposal in this manner. I do not know how Rockwell dealt with the concrete slurry, but this is why he called, in case the Environmental Protection Agency comes across the light grey, dried, slurry material in our investigation.

I wore a film badge throughout my work there, but was never told the results. I assumed I would have been told if any bad results came back. "Naval D" personal protection was the only thing necessary with a film badge while I was working.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 11/12/2009

Interviewee(s): 18

I worked with Rocketdyne at the Santa Susana Field Laboratory (SSFL) for 22 years from 1965 to 1986. I have nothing against Boeing whatsoever and I don't want to be involved in the community disputes over SSFL, but I do want to share information that I think could be useful to the Environmental Protection Agency (EPA).

I don't have any information about Area IV, but I can tell you about hazardous materials at the site. EPA may want to consider the following issues.

Alleged depleted Uranium projectiles: Projectiles found in Area I were not uranium. I, myself, manufactured the projectiles using lead from tire/wheel weights. I can't describe the specific location well enough to pinpoint on a map, but these projectiles have been identified during a cleanup effort and I want EPA to know that they were not depleted uranium.

Beryllium contamination: In Area I, on a hill overlooking Happy Valley is or was a "mix building" where beryllium projectiles were manufactured. There was a tank set down in the hill to catch excess beryllium attached to the building by a hose. I worked there with a crew and we cut off that hose and let the beryllium go to the ground because of a structural issue with the tank.

Diaboron/Pentaboron contamination: Downhill from the beryllium contamination described previously in the "PRE building," where propellant research occurred there was a tank that contained diaboron that frequently leaked. The tank was kept surrounded in dry ice, but it still leaked. When exposed to air, diaboron became pentaboron and ignited. This occurred frequently.

TCE contamination: Between the "Area 1 road" and the "PRE building" was a leaking concrete-lined pond that mixtures containing trichloroethylene (TCE) were pumped into. This area was known as a "Fluorine Area" and fluorine dumped in the pond would be burned off during "Toxic Firings," which was only done when wind came from the west. A subsurface tile pipe between the "PRE building" and the pond would have to be frequently repaired or replaced due to explosions in the pipe from the fluorine.

"Fuming Sulfuric Acid" and Fluorine leaks: There were "fuming sulfuric acid" and fluorine leaks, but I don't have any details.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 11/15/2011

Interviewee(s): 19

I worked at the Santa Susana Field Laboratory (SSFL) from April 1979 to May 2003 as a mechanic and propulsion systems technician. During my first year, I worked on engine testing equipment in Area I including work in Building 301. I worked with general maintenance at the Sodium Pump Test Facility (SPTF) facility in Area IV. I also did metallurgy work on cladding in the Hydrogen Lab, which was also known as the Environmental Effects Lab (EEL).

I don't remember any accidents other than a big sodium spill at the SPTF in 1995. I never handled radioactive materials and I didn't need to wear a film badge until 2004 during remediation work I assisted with. (Note that this year conflicts with stated career time frame at SSFL). I worked in Building 24, a Systems for Nuclear Auxiliary Power (SNAP) building, removing concrete plugs out of ground that were used for storing fuel rods. I also recall that there may have been groundwater flooding in the basement of Building 9. I can also think of some other people who you may want to talk to with information at the site.

I recall that blueprints were kept in a safe in Building 38. And plutonium and uranium pellets could be found in Building 20. I think Building 55 may have been used for plutonium enrichment. A number of building foundations often had holes in walls for drainage.

There were some cleanup efforts at the gun range, outfall #5, and outfall #3.

There was a "Northeast Debris Field" where drums used to be stacked, but that area is clean looking now. There were "concrete ponds" that have been removed. During the late 1970s, grey water used on site came from Silvernail Pond, but then the source was switched to a city municipal source.

There was a "burn area" with an incinerator for badges and "secret" documents. The only employees I think that worked across the different areas of SSFL were maintenance folks. Radiological work was only in Area IV so if anyone had to wear a film badge in other areas of SSFL it was because they had worked in Area IV. I don't ever recall seeing radiological work outside of Area IV.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject:	SSFL / HSA	
Date / Time:	11/12/2009	Page 1 of 1
Interviewee(s):	20	

I read the article in my local paper about the Environmental Protection Agency (EPA) seeking information and thought I would pass this on for what it's worth.

I used to live in Bell Canyon, which shared the property line with Rocketdyne in 1981-1984. I was much younger then, actually a teenager then.

We used to go hiking all over the area, one in particular. This hiking area was near a stream, we followed this stream up the canyon; it topped out in the property of Rocketdyne. I remember seeing the water change, in an area where the water pooled. It was very brackish, brown, with a film on it. There were many blue barrels laying around. I just remember the stream being very polluted.

I remember the way to get there to this day and have always wondered why the stream was polluted. The locals called the area "Stoner Den." It was a big tunnel/cave along the north side with two exits and parts filled with water.

Note: EPA discussed the information provided by interviewee. The approximate location of a cave with pooled water that may have been polluted was located. It was along a popular hike up to the southeast corner of Bell Canyon. We identified the approximate location by both reviewing "Google Earth" while on the phone. The coordinates are: 34° 13′ 16.63″N by 118° 42′ 02.75″W. It also may be near 34° 15′ 27.80″N and 118° 39′ 36.45″W.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 2/11/2010

Interviewee(s): 21

I worked for Atomics International (AI) on and off at the Santa Susana Field Laboratory (SSFL) from 1955 to 1970. I started as a Senior Engineer and watched the Sodium Reactor Experiment (SRE) being built. I became a Supervisor and Assistant Group Leader at the SRE and was in charge of planning test programs and maintaining the plant. I also prepared test programs for the Hallum reactor in Nebraska. I moved to Nebraska in 1961 to work on the Hallum reactor for a few years and then I came back to SRE at SSFL. Then SRE went into a holding pattern and I moved on to the Energy Technology Engineering Center (ETEC) sodium facility.

Most of my work was in planning test programs. I was around for fuel loading, start up, and operation of the SRE and was at SSFL during several incidents, but I was down at the DeSoto facility during the 1959 fuel element damage at SRE. I worked around radioactive materials and observed waste disposal during my time at AI.

I thought the work at SSFL was successful and a lot of hard work went into enforcing safety rules. I think lay people lack the knowledge to understand the actual risk and typical radiation exposures that happen every day. People start spreading scare stories to get grants.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 2/11/2010

Interviewee(s): 22

I worked for Atomics International and Rockwell from 1959 to 1989, but I was never permanently stationed at the Santa Susana Field Laboratory (SSFL). I started as an engineer and did nuclear analysis and fuel development for the Sodium Reactor Experiment (SRE), Systems for Nuclear Auxiliary Power (SNAP)-2, and SNAP-10A. I then became the head of operations and oversaw everything from people to purchasing. When I was the head of operations I would go up on the hill and visit or oversee my crew. I also spent 1 month on the hill running and experiment. Over the course of my 30 years, I probably spent 6 months total time at SSFL. I later went on to work at Hanford and at reactors in Idaho.

My work involved nuclear analysis and fuel development. I worked on the decommissioning of SRE and was up on the hill during that period as I had a number of people on my crew working on the decommissioning. I also worked on a uranium oxide (UO_3) experiment that used a closed loop system that not did involve fission products.

I did work around radioactive materials. The biggest "incident" that occurred when I was at the SSFL was when I was at the Hot Cell and an alarm went out. Everyone evacuated and the Radiation Protection Technicians came in to determine the problem. They determined residue from hydrogen testing in China (fallout) had been tracked in on the shoes of employees and the alarm sensors were sensitive enough to detect it.

I observed waste disposal at SSFL and as far as I know it was all handled properly because the Atomic Energy Commission (AEC) was all over us. The director of nuclear safety was one of the sharpest radiation protection experts. I never observed any improper disposal of materials.

I thought the work at SSFL was successful and we should be proud of the many firsts that occurred there. The U.S. was a leader in nuclear technology in the early years. I was treated well my entire career and still do some minimal consulting (1 or 2 weeks a year) because of my extensive resume in nuclear operations.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 2/12/2010

Interviewee(s): 23

I retired in approximately 2007 after 30 years at the Santa Susana Field Laboratory (SSFL). I worked for the Energy Systems Group, formerly Atomics International (AI). The last 8 or so years I worked with Rocketdyne. I was a research mechanic for most of my time. I did all kinds of work ranging from setting up equipment to running and operating the facilities. I worked in both Area II and Area IV of SSFL at many different facilities. I worked at Building 20, the Hot Lab, for 1 to 1.5 years.

I worked with radiological material and dealt with waste disposal, but I am not aware of any waste that was mishandled. I am not aware of any radiological releases in areas I worked in, but I do recall that a cleanup crew found radioactive shavings in the Sodium Burn Pit that were probably dumped there in the 1950s. That's the only area I can think of that you may want to look at for contamination.

Any documents or photos I have from my work in Area IV have been packed away, but I am not sure I have any more useful information for your investigation.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 2/12/2010

Interviewee(s): 24

I worked for Atomics International (AL) at the Santa Susana Field Laboratory (SSFL) from 1974 to 1997. I worked in the Engineering Department and in the Construction Management Department at the Energy Technology and Engineering Center (ETEC). Out work was funded by the Department of Energy (DOE). I wrote procedures for the cleanup of radiological facilities and managed outside contractors working at the sodium facilities. I had offices in Buildings 9, 26, and 487.

I did not have hands on radiological cleanup responsibilities, only supervisory responsibilities, but I did have to wear film badge and protective clothing if I was visiting a building with residual contamination. Any materials collected during a cleanup operation were removed and packaged then shipped off-site to proper disposal location.

I am aware of the previous history of SSFL in terms of radiological accidents and disposal issues, such as the Sodium Burn Pit, but I don't recall any issues during my time there. I don't think I have any useful information for you and I do not want to participate in any further interviews.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 2/12/2010

Interviewee(s): 25

My father was a test engineer for Rocketdyne. He died from kidney cancer about 25 years ago. He worked for Rocketdyne and then left during layoffs and came back to work at Rocketdyne's Seal Beach facility.

My father was a chief engineer on a test that "went bad" and he went in to shut down the test. He had to go through a decontamination procedure and get washed down. The accident happened probably between 1962 and 1964. I am not sure of the specific test my father was working on when he had to shut it down. I am not sure which area of the Santa Susana Field Laboratory he worked in, but he did a lot of rocket testing and later went on to do rocket testing at Vandenberg Air Force Base.

I am not sure if my father worked with radioactive materials, but when the accident happened he seemed to go through a decontamination procedure similar to someone involved in a radiological accident.

You may want to examine employment records to determine where my father was specifically located and what really happened with regard to the accident.

When I was in Thousand Oaks a number of years ago, I met an FBI agent that did a public records request with the City of Thousand Oaks. He told me a story of radioactive water inadvertently being placed in Sparkletts water bottles and placed next to drinking water. I wonder if EPA could find FBI reports or contact the City Clerk to examine public request records.

My mother still receives benefits from Rockwell, so she does not want to get involved with issues at the site, but I wanted to pass on the information I had to see if it could be of help.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 2/15/2010

Interviewee(s): 26

I worked for Atomics International (AI) at the Santa Susana Field Laboratory (SSFL) from 1969 to 1990. I was a quality assurance engineer and eventually became a manager of other quality assurance engineers. I oversaw activities at the test sites. I worked at the Sodium Pump Test Facility (SPTF), the Sodium Component Test Installation (SCTI), the Small Component Test Loop (SCTL), and at Trailer T486.

I didn't work with any radiological material and did not wear a dosimeter. I don't recall any incidents or unusual occurrences during my work at SSFL. I am aware of the Sodium Burn Pit and its use as a disposal site, so you may want to look there for contamination.

I do not wish to participate any further with the Environmental Protection Agency's investigation.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 2009

Interviewee(s): 27

I worked at Santa Susana from 1955 to 1970. Beginning in 1958, I worked in Rocketdyne Fire and Security until this department was "split" and discontinued in 1961. During this time, I and other firemen would get weekly or biweekly deliveries of sodium in chunks (in barrels or bags) to dispose of in the Area 1 burn pit. From 1961 or 1962 until 1970, I worked as an electrical technician in the Electronic/Instrumental Department until 1970. During this time I performed equipment tests ("vibration/pressure testing") but nothing on equipment that dealt with radioactive material. I have no knowledge of any radioactive waste handling, storage, or release and never was required to wear a radiation badge/film badge. The "Area 1 burn pit" would regularly receive solid chunks of sodium and drums of hydrazine, but I do not know the source of these materials. I recall 3 to 5 explosions related to the burn pit, but I don't have any information on radioactive materials.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject:	SSFL / HSA	
Date / Time:	November 2009	Page 1 of 1
Interviewee(s):	28	

I worked for Rocketdyne for 20 years at Canoga Park. I did not work at the Santa Susana Field Laboratory. I was a purchase agent for Rocketdyne, but I also spent time cleaning barrels at Canoga Park. I have some medical conditions I think were related to this work. I have a friend who is in his mid- to late-80s who worked with me at Canoga Park. He worked for 35 years in a clean room, where they cleaned parts. He ended up getting cancer. I have a case file with documents on Canoga Park operations regarding the clean room that I will mail to you for review.

[The case file was never received and further telephone calls were not returned.]

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 11/16/2009

Interviewee(s): 29

I was a Rockwell employee, but I don't recall the years I worked at the Santa Susana Field Laboratory (SSFL). The labs I worked in were already cleaned out. I worked at the Rockwell Experimental Laser Lab ("RELL") and was sent to "the Hill" frequently, but I just can't remember the building numbers or Area numbers I worked in. I don't remember working with any radiological materials or conducting any radiological operations. I am sick with a rare disease and I think it has to do with exposures I received in the building I worked in, but I just can't remember a lot of the details of my work at SSFL.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 11/30/2009

Interviewee(s): 30

My husband worked for Rockwell/Rocketdyne and was laid off when he "pointed out something that was being done." I can give you the name of the supervisor that laid him off so that you can follow up. [EPA Notes: Implication of call was that husband saw something that would cause a release to ground, air, or water]. Upon further conversation, EPA learned husband did not work in Area IV and no further follow-up was conducted.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 11/25/2009

Interviewee(s): 31

My father worked up at the Santa Susana Field Laboratory (SSFL) and was an operator that buried barrels. He was a bulldozer operator that was contracted to do work up there. I remember being told one day when my father came home that "today we dumped some barrels that were filled with yellow stuff into a trench up at SSFL." I don't know the name of my father's construction company or even if he was an independent contractor/operator. My father is deceased. The incident took place during the 1970s. I remember my father saying that one or two barrels opened up and spilled the dry yellow material out. He said it was all buried in a trench along a curving road on a downhill slope. I don't know much more than that and am not sure what part of SSFL my father was working when the incident occurred. My father was not an employee of Rocketdyne (or predecessor/successors) but was only hired to do one odd job that day.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 11/12/2009

Interviewee(s): 32

My father worked for a period of time at the Rocketdyne site. My father has since passed away, but I had Power of Attorney over him and my mother. I understand there is possible settlement for former employees or their family/survivors. I would like more information if possible. Please contact me at this email address or via phone call. Thank you

[EPA inquired about the interviewee's father and his job at the Santa Susana Field Laboratory (job title, years of employment, documents, knowledge of releases or dumping), but the interviewee had no further information.]

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject:	SSFL / HSA	
Date / Time:	11/19/2009	Page 1 of 1
Interviewee(s):	33	

I was an employee of Rocketdyne and worked for Rocketdyne from 1955 to 1970. Much of that time was in the Rocketdyne Fire & Police Security Division.

I was assigned to the burn pit in Area 1 where chemicals were disposed. I don't know what types of chemicals were put in the burn pit. I don't recall any radioactive material use, storage or release. I also worked in Areas II and IV.

I have no recollection of fires related to radioactive handling or reactor operations, or of any other dump sites or release areas.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject:	SSFL / HSA	
Date / Time:	11/16/2009	Page 1 of 1
Interviewee(s):	34	

Years ago I did concrete work as a member of the Cement Masons Local 741 out of Ventura, California (Local 741 later changed to Local 600) and was dispatched to work at the Santa Susana Field Laboratory (SSFL).

I remember seeing a pit, or a small pond, with pipe draining "really nasty" stuff into it during the "Reagan years."

I was assigned to help construct a concrete wall near the test area for rockets. I do not recall the name of the area I worked in (i.e., whether it was Area I, II, III, or IV). The pit or pond I recall was a man-made pond and had a thick viscous brown-green color. Pipes came from a nearby building and went straight to this pond. I wore a radiation badge and had to leave the badge at the end of the day. That's about all I can remember. I don't remember any locations well enough for it to be helpful to review aerial photographs of the site.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 11/09/2009

Interviewee(s): 35

Voicemail received that caller's father worked at Santa Susana Field Laboratory in the 1960s for Rockwell/Rocketdyne and was involved in a radioactive spill/accident. The Environmental Protection Agency returned call with no further response.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 11/11/2009

Interviewee(s): 36

My father was a former Atomics International employee who died of cancer and I think it was caused by the work he did at the Santa Susana Field Laboratory (SSFL) and Canoga Park. I don't have much detail other than the fact that my father worked at the "Conservation Yard" at the Canoga facility and was part of a crew that went up to SSFL to retrieve disabled, decommissioned, or older parts of equipment used in Area IV and bring them to Canoga for cleaning and reassembly. I know that is not much to go one, but I am willing to help any way I can in the future.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject:	SSFL / HSA	
Date / Time:	11/30/2009	Page 1 of 1
Interviewee(s):	37	

My husband, who is deceased, worked at the Santa Susana Field Laboratory (SSFL) between 1962 and 1967, but he only visited Area IV a few times for several months at a time. He primarily was involved with Shuttle and Rocket Engine projects in the other areas of SSFL. I think "radioactive stuff" was put in Lindero Canyon and the Bradley Dump in Van Nuys, but I don't have any other details about this. I don't have any more information on my husband's work in Area IV or radiation issues at SSFL.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 12/07/2009

Interviewee(s): 38

I have asked my father whether he would be willing to help the Environmental Protection Agency (EPA) gather information about potentially hazardous activities at the Santa Susana Field Lab (SSFL). He has indicated he is willing to be interviewed by your project team.

My father was involved in the testing of rocket engines and rocket engine fuel mixtures during the 1960s, and possibly other activities.

Please feel free to contact him via email or by phone at his home in San Rafael, California.

[Note to file: Interviewee had no further Area IV rad information.]

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: _____

Interviewee(s): 39

I started with Rocketdyne in 1953 and worked there for 50 years, until I was laid off in 2003. I don't recall any information on dumping or releases and I don't ever remember heading about that sort of thing except for the sodium burn pit, which I took photos and video of. All negatives of my photos should with "Iron Mountain Archives" and are probably under ownership of Boeing now, or possible Pratt Whitney or UTC (other Rocketdyne successors). I don't have any photos or negatives myself that I can share. Look for a logbook at Iron Mountain Archives to locate my photos. But, I never photographed any incidents or spills.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: _____

Interviewee(s): 40

I was a laboratory technician at the DeSoto facility from approximately 1960 to 1963. I tested uranium pellets there. I never worked on the hill. I don't have any knowledge of releases, storage or use of radioactive materials at the Santa Susana Field Laboratory. I can give you the name of a colleague that you might want to contact.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 3/7/2011

Interviewee(s): 41

I worked sporadically at the Santa Susana Field Laboratory (SSFL), including temporary, part-time, and full-time to fill in for other mechanics on the hill from the 1980s to 2010. I was a full-time mechanic at Canoga Park and DeSoto. I think that SSFL has the usual "sloppiness" seen throughout the industry at the time (in the 1980s), specifically in the maintained areas.

I wore a radiation badge, but never when I was up on the hill. I recall a 30-foot by 20-foot body of water on the hill that always had an oily sheen on it, but I would not be able to locate it. I was probably a dumping area of some sort.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: _____

Interviewee(s): 42

I worked for Rocketdyne and its predecessor/successor companies for 32 years beginning in 1978. I was primarily a jig-bore machinist/metal machinist. I was also a propulsion mechanic for a while. I never worked at the Santa Susana Field Laboratory (SSFL), only at the Canoga facility. I don't have any information relating to radioactive material use, storage, or release at SSFL.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: _____

Interviewee(s): 43

Email from an undisclosed sender mentioned that someone present at the Santa Susana Field Laboratory (SSFL) during the "partial meltdown" had "fallout" on his car in Area I. Many cars had to be repainted as a result of the incident. The "fallout" went everywhere.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 11/11/2009

Interviewee(s): 44

An anonymous voicemail said person was a neighbor of a former worker at Santa Susana Field Laboratory (SSFL) in the 1960s and 1970s. Contact information for the former worker was provided, but found to be outdated. No callback number was left. Former worker was later found to be deceased.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: _____

Interviewee(s): 45

Handwritten note that interviewee worked in Financial Department, Account Assignment from 1956 to 1974, and reviewed all documents for purchases and travel assistance. No radiological information.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 5/20/2009

Interviewee(s): 46

Interviewee sent a letter notifying the Environmental Protection Agency (EPA) that he and a number of neighbors had gotten prostate cancer at the same time and on the same neighborhood block. He just wanted EPA to know for its investigation. No other information was provided in the letter.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 9/13/2009

Interviewee(s): 47

Interviewee left voicemail stating that he had four cancers over the years and his mother and father both died of cancer. He stated that his uncle "fell into a pit of plutonium or whatever." There was a class action lawsuit. No information on the location of the pit was provided, nor radiological materials used, stored or released. No other information, including caller's name or contact information, was provided in message.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 2/15/2010

Interviewee(s): 48

I worked for Rocketdyne in the 1960s and 1970s as an engineer. I worked in Area II doing rocket engine testing and rocket fuel testing. I did not handle any radiological materials or wear a dosimeter. I did not work in Area IV and don't know specifics of activities there.

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Appendix E

DOE/EPA Joint Interview Summaries

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UNITED STATES DEPARTMENT OF ENERGY

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 7/14/2010

Interviewee(s): 8

I never actually worked up on the hill at SSFL. I worked at the Van Owen facility and went up occasionally to the hill for visits. I worked with budgets, planning, project administration, acquisitions, and finally data processing.

I worked for Atomics International which was a division of North American Aviation. Projects that I was involved in included the Sodium Reactor Experiment, the Pyroprocessing Refabrication Experiment (PRE), and SNAP. I worked on another project for AI that was called Project Pluto – but that project was never up at SSFL to my knowledge. I handled the paperwork for all of those projects. I knew a fair amount about them. All of my work was documented in project reports. I do not know where those reports went once they were submitted.

I handled radioactive materials, but that was before my time at Atomics International. I worked for General Electric at Hanford, up in Washington State. I started there in 1951; I started with North American Aviation, Atomics International Division at the Van Owen facility on July 16, 1956. I never handled radioactive materials at SSFL. By 1955, handling radioactive materials was becoming routine. There was a way things were done and I doubt it was much different from what we did at Hanford. I am sure things were done the same way everywhere.

I also did not handle any chemicals in my position. I am not familiar with the location of where any radioactive or chemical materials were stored or disposed.

At SRE, things were by the book as long as they were working on the specified project objectives. However, they did not shut down once those project objectives had been completed. A project engineer who worked up there told me "things were getting pretty soggy in there." I interpreted that to mean that they were getting near the safety limits of the materials they were testing, but that is just my interpretation, I have no firsthand knowledge of that.

Things were quite different back in those days. Atomics International was a cost plus operation, and the amount of money the company made depended a lot on how good the relationship was with the client. Once the work that was supposed to be done had been completed, the AEC was interested in learning about the safety parameters. In other words, they wanted to know how much the design could be passed beyond the operational guidelines and still operate safely.

It was my impression that AI had been given verbal instructions (never written down) from the AEC to test the reactor to destruction. It was common in the aerospace industry to test to destruction – that meant you ran conservatively until you had met all the project objectives and then tested beyond that to determine the safety limits for the particular object being tested, and see how consistent the actual results were with what the modeling predicted. They were pushing the limits on purpose.

I am not aware of any other situations at SSFL that were similar or that had similar results.
The PRE was developed to re-process spent reactor fuel into new (metallic) fuel elements. This was accomplished through metallurgical processes that were conducted using remote handling equipment in a hot cell rather than via wet-chemical processing of the kind we used at Hanford in the "purex" facility to extract plutonium. Hanford reactors used metallic fuel which we discharged after relatively short exposure to fission because the weapons program wanted plutonium-239 but didn't want other isotopes of plutonium which would gradually accumulate after longer exposures. Work at other sites (not at AI) revealed that metallic fuel elements swelled after fissioning for a long time, so that metallic fuel could not be used in power reactors. This discovery resulted in a decision to terminate the PRE project. Work at other sites (not at AI) subsequently developed oxide fuels.

We had a lot of exotic materials up at SSFL. The SNAP reactors at SSFL used beryllium reflectors. I don't know that they ever had any problems with that, but beryllium is pretty toxic stuff.

I am confused why they think the tritium that they are finding up there now could possibly be attributable to operations on the hill from the 1950s. Tritium has a very short half-life. Even if tritium was released from a reactor at SSFL, it would be long gone by now.

Frankly, I think the tritium is there because someone screwed up their measurements. Tritium is what I call a "soft beta" – it is not energetic. When I worked with it before coming to AI, I had to put tritium in a counter to detect it. You cannot detect tritium with a hand-held detector due to its classification as a "soft beta."

I have no knowledge of any spills or leaks.

In reference to the SRE accident, radioactive iodine could not have been released. Iodine reacts strongly with sodium, so if it were released, it would have bonded with the sodium and it would not have gone anywhere. I would believe it if there were some noble gases (krypton, xenon,

etc.) released in that accident. They would not have chemically combined with anything so they would have been sure to escape. If they were released, they would have begun decaying immediately. Radioactive isotopes of those elements could, after escaping, have decayed to radioactive isotopes of halogens.

I have no knowledge of any chemical or radioactive materials being disposed on site.
I was trained to do my job mostly through on-the-job training. We learned as we went. Things were changing under our feet. Everything was done manually when I first started up there. Things changed rapidly though and things were beginning to be computerized.

People with clearances were working right next to people without clearances. I had a "Q" clearance. It carried over from my prior work at Hanford. The numbers that I was working with might have been considered classified. The only real use I found for my clearance level down here was when it helped me buy a car.
I do not know anything about policies for handling chemical or radiological materials. I was involved in monitoring project costs. I am not saying that there were not policies; I just do not know what the policies were. Everything that was done related to SSFL was documented.
I do not know anything about any liquids being disposed of down any drains.

Beginning in 1951, I worked in the 100-B/D/DR/F reactor areas at Hanford. I was familiar with 100-H but didn't work there. 100-C was being built when I left. Reactor control was via horizontal control rods which could be moved in measured increments. Emergency shutdown ("scramming" a reactor) was via vertical control rods which were an all-or-nothing operation. When we shut a machine down, a decay chain that passed through a radioactive xenon isotope began to accumulate an inventory of that isotope, which had a very large neutron capture cross-section. If we didn't get back up before too much of that isotope had accumulated, we had to stay down for 12 hours or so, until that isotope had in its turn decayed away, after which we could start back up.

After an emergency "scram," which stressed components, (not after normal shutdown to re-fuel) we tended to experience random fuel element failures necessitating additional shutdowns. The galvanometer power level indicator measured in-core radiation. The integrating unit instead measured bulk coolant temperatures and flow. When we shut down to push fuel, or to clear out a tube which contained a failed fuel element, operators had to uncap the coolant pigtails for the selected tube(s) on both the front face and the rear face of the reactor. Refueling was strictly a batch operation with the reactor shut down. Increasing or decreasing production levels was done when the machine was up, by adjusting horizontal rod(s) position.

Hanford was a production facility. All the people who sat at the console were union people, paid by the hour. However, the operator, who was very interested in how much power the reactor was producing, wanted to maximize power production. Shutting the reactor down was something he was trying to avoid. Every once in a while a fuel element would get stuck in the pigtail. If that happened and it did not come out, we would have to shut the whole operation down. Well one operator in charge of the reactor figured out a way to handle it. He would take

his film badge off, hand it to someone else, run to the back end, kick the pigtail and get the works flowing again, and then go back up and put his film badge back on. That kept the whole operation running. The B reactor was a production facility.

By contrast, AI was like a graduate school. SSFL had a completely different set of incentives. I experienced a bit of culture shock when I moved from Hanford to SSFL.

Unfortunately, at the end of the day, Atomics International's strategy was not successful. The consumers public power district (CPPD) sodium graphite reactor at Hallam, Nebraska was built, but failed after operating for a while. I don't think the decision to go with (untested) stainless steel cans for the graphite moderator was an attempt to reduce cost. I think they thought they were being conservative in going from an exotic material, zirconium, to a more conservative material, stainless steel.

Atomics International then built the Organic Moderator Reactor in Piqua, Ohio. The design had been tested up in Idaho. What worked under lab conditions failed a short time after it began operating. When they went to replace the reactor fuel, the oxygen atmosphere got to the coolant and turned it into a tar causing blockage of the coolant channels and the reactor was damaged. The designs worked on a small scale but not at production scale. They were trying to scale things up by a factor of 100 and that is not realistic. They did not want to hear that. They were too conceited. They didn't know what they didn't know. They had PhDs but they did not really understand how to scale up the idea. They knew the science, but not the engineering.

Many of the designs that they looked at were good designs, they operated at low pressure and did not require containment domes. We thought we were being innovative here – everyone else was using designs using water as the coolant. We were using sodium. Humans have thousands of years of experience using water; we do not know that much about sodium or organic coolants.

After the Three Mile Island accident happened, they had a hydrogen bubble as big as a boxcar, and it was under pressure, 100 times atmospheric pressure. That is a lot of hydrogen. The hydrogen was not caused by radiation. It came from the water. We knew they had a meltdown, although it was years before they admitted it. Atomics International sent them a hydrogen recombiner – an emergency shipment – to help them avoid having an explosion. The recombiner exposed the hydrogen bubble to oxygen using an oxidizer, which effectively turned a potentially explosive situation back into water. We knew the only way that could have been caused was by a meltdown. It took years for them to admit they had a meltdown.

As part of the SNAP program a critical assembly test facility was to be built at SSFL. A critical experiment is sort of a zero-power reactor used to measure reactivity. The SNAP reactors didn't use in-core control rods to control power levels but instead were reflector-controlled by varying the number of neutrons allowed to escape from the reactor versus the number of neutrons reflected back into the core. The reflector was beryllium metal. The designers,

seeking perfection, didn't want their measurements compromised by having anything other than beryllium in the reflector. They requested beryllium bolts. Unfortunately, beryllium bolts were very hard to machine. When they estimated the cost for the experiment, the beryllium bolts would have cost more than the entire rest of the machine. The idea worked in principle, but it wasn't practical.

As a junior member of the unit doing chemical process engineering for the designers of the "purex" reprocessing facility, I was responsible for maintaining a very large schematic drawing which indicated all vessels and piping, etc., and listed quantities, temperatures, compositions, etc., for every vessel, pump, pipe, etc., and was responsible for heat and material balance calculations for the design project.

One of the listed properties was viscosity. That line was blank because the chemical research people hadn't yet suggested any viscosities. A staff assistant for the guy in charge of the plant asked to use my drawing in a meeting (to which I wasn't invited). He noticed the blank viscosities row, and said he didn't dare take it to the meeting with any lines blank. After a certain amount of discussion I agreed to see what I could do, hit the books, fudged up some numbers, and filled in the row with one-significant-digit guesses.

I carefully erased those numbers when I got the vellum back. A year or so later, when I was on the road as a vendor inspector, while carrying out an inspection on large agitators at an automatic signal company division of Eastern Industries Incorporated, I was astonished to recognize my viscosities in the contract specifications.

I have no knowledge of the liquid materials being disposed of using toilets or floor drains; the sodium burn pit; the surface disposal area at the western edge of Area IV; any leach fields, septic tanks, or drainage discharge locations; the old conservation yard; any storage tanks, gas holdup tanks, etc.; nor any underground pumps, sumps, storage tanks, piping, sewer, or drainage systems.

I remember one time a guy wanted to develop new instrumentation to measure sodium flow. He needed a sodium tower so he could take advantage of gravity flow. He submitted a proposal requesting two kinds of funding, expense (wages, purchases, etc.) and capital (buildings, etc.). The expense portion was approved. The capital portion was rejected, leaving him with approval to proceed, but no facility to proceed in. He got a guy in facilities engineering to design him a tower made up of a small variety of standardized components, submitted purchase requisitions each just under the amount which would have been routed to me for review, personally hijacked a cement truck intended for another project on the hill, had PhD's out working with wrenches and trowels constructing his tower, and got the job done - which made him a hero within the technical community, but not to me. Once the new building had been built, an AEC guy saw it on a new aerial photo and said, "What's this?" He obviously hadn't approved the construction. The scientists were forever trying to figure out a way to work around the administrators. The sodium tower was located in the AEC Triangle.

I think that a lot of people are overreacting. There is not that much to worry about up there. I enjoyed working there. Altogether, I worked for Atomics International and the companies that bought it from 1956 through 1997. I retired on January 31, 1997. Three days after I retired, I went back to work as a contractor. I was a contractor until 2007. The Rocketdyne Division was sold to Pratt & Whitney in 2005. They had a two-year rule. No contractor could stay on longer than two years. Therefore, I finally had to stop working in 2007.

I liked working here a lot better than I liked Hanford. I went to Harvard Business School after working at Hanford, and I wanted to get away from weapons and into energy research. I was single when I lived in Richland, but it was a company town with plenty of rules. All the housing was controlled. Single people had to live in dormitories. Even the waitresses in the local restaurants had to have clearances. If you lost your job, you had to leave town because there was nowhere to live.

I moved here and I am glad I did. The culture here was a lot more relaxed.

UNITED STATES DEPARTMENT OF ENERGY

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 6/2/2010

Interviewee(s): 31

I worked for Atomics International as an electronic tech from 1959 to 1960 at the SRE and SNAP reactors in Area IV. I measured radioactivity on samples used in reactor tests. These tests involved placing the rods in different positions to expose samples to varying levels of radiation. The position of the rods had an effect on the output of the reactor. Sample material consisted of various metals, approximately 3 to 4 inches in diameter, and enclosed by a resin casing. Beryllium was one of the sample materials I specifically recall handling. I was in charge of taking the irradiated samples to the laboratory, measuring the amount of radioactivity, recording the measurements, and returning the samples to the physicist in charge of the experiment.

A photo multiplier tube and a scaler were used to count the radiation given off by a sample. Data from the sample analyses were recorded on data sheets and maintained with the samples. Duplicate copies of these data sheets were not generated by me. I can't remember if I used a logbook and do not know where one might have been kept. It is possible that sample numbers were recorded in a log book, but I can't verify that information. I likely initialed or signed the data sheets following sample analyses. I measured samples from the SRE and SNAP reactors. The testing and measurement data would be used to make improvements to the reactor.

Once the samples were analyzed I would place the samples and their corresponding data sheets on a work bench shelf. The samples would sit on the shelf until a physicist working on the experiment picked them up. Sometimes I would have to remind the physicists to pick up samples left on the shelf for long periods of time. Samples were not thrown in the trash. The samples were either in the laboratory or with the physicist.

Sometimes a sample result would show more radiation than expected, but this was not considered an accident or incident, as it was part of the experimental process. Sample results that were outside the expected "norm" were further evaluated to determine if there had been an error or if the results were valid.

I wore a dosimeter, but no protective clothing. My dosimeter was taken once a week by a "safety person," presumably for monitoring, and was given back to me.

I received on-the-job training. They told me what they wanted and showed me how to use the equipment. There were not really any written policies for the work. One other electronic tech worked the same shift, but his duties were different than mine. There was not much oversight and I was left alone to do my job for the most part. The culture was such that the techs had a certain amount of camaraderie. During lunch or break time, we would talk, maybe have coffee, and sometimes watch the rocket engines firing.

The physicists talked about non-work a little, but most people were too busy to sit and gather for any long periods of time, except as it pertained to work. The work was standardized and there wasn't much variety in it, it wasn't that interesting or exotic. Everyone knew their jobs and did them. People stayed in the area they worked in and would not be moving between buildings or walking around the site.

I had Q clearance in progress while working at the site, but left before it was finalized.

Samples needed to be kept clean for accurate results. Pure alcohol, as opposed to denatured alcohol, was used to clean any resins, dust, dirt, fingerprints, or other deposits off of the samples. Special signatures were required from a Ph.D. physicist in order to obtain the pure alcohol. I think it came in a one pint size bottle, but it would not have been more than one quart. I think I used Kimwipes to clean the samples with pure alcohol.

Used wipes and/or rags were placed in a trash can, but I don't know if it was a controlled waste container or special depository for waste wipes. The alcohol evaporated quickly and was only used in the lab in small quantities. I don't recall any waste alcohol that had to be disposed of. There were no written procedures for cleaning samples that were given to me.

I would examine samples under a magnifier to ensure they were sufficiently clean before taking measurements.

I am not aware of liquids being dumped down drains or toilets. I don't know why anyone would do that. The toilets were kept very clean and nothing went down the toilets that I'm aware of. I am not aware of any liquids going down any drains. I have no recollection of any problems with pumps, storage tanks, pipes, sewers, or drainage systems.

One of the smaller reactors, possibly called the SNAP reactor, was for the Germans. The work was being done through Atomics International, but it was for German reactor development.

UNITED STATES DEPARTMENT OF ENERGY

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 7/16/2010

Interviewee(s): 34

I worked at SSFL from 1953 to 1987 as an engineer in the Facilities department and Purchasing department. Initially, I was involved in building test stands. Over my 34 years, mostly at SSFL, I was employed by various entities including, North American Aviation, Atomics International, Rocketdyne, Rockwell, and Boeing. I worked at Area IV from 1969/1970 to 1981/1982. After that time period, I still went up to the hill but my office was at the DeSoto facility.

I am a graduate engineer and was the 330th employee hired on at SSFL/Rocketdyne when I started in 1953. I was in Test, but I was not a button pusher. Everyone on the hill was in Test, but I was in a support organization, which later became Facilities Engineering. In 1956, I became the youngest supervisor in North American Aviation Corporation history at 24 years of age.

Between 1953 and 1958, I was on the hill. After that, my office was no longer on the hill, but I would still make trips up there. We built 17 test stands. When I started on the hill there were two test stands. We went from 2 to 19 test stands while I was involved. Atomics International didn't really have a presence on the hill until about 1956. I had nothing to do with AI. I didn't know much about them in my early years.

I spent a lot of time interacting at corporate offices from 1958 onward, when I was in Facilities and Purchasing, because we were building and growing. I had a lot of knowledge of the site history because I was involved for so long.

I have testified on Boeing's behalf in court regarding contamination issues three or four times since 1987, but not recently. The lawyers involved in those cases cautioned me that it was alright "not to remember things" if they incriminated Boeing. I understand that you would like me to remember everything for this interview to support the investigation and the final cleanup. I will do my best to be candid and forthcoming. All the press coverage now on the rocket and

reactor side is stretched beyond the truth and a lot of the history isn't told. I have experience over the entire SSFL site, the whole 2,500 acres.

Even after I left the company in 1987, I worked for Facility Design firms that did work for Rocketdyne and Atomics International. So I stayed involved for another 10 or 12 years and made many other trips up to the hill, but not as an employee.

I have a lot of information on chemical contamination in Area I, II, and III. Maybe you could pass my name along to NASA as I am sure they could use this information when they move forward with their cleanup efforts. I also know about some contamination in Area IV and at DeSoto having to do with Atomics International.

We used certain chemicals, including trichloroethylene, in monstrous amounts. At that time there was no concern over its environmental impact because we didn't know how "dangerous" it was. We used hundreds of thousands of gallons of solvent in Area I, II, and III.
Trichloroethylene was used in Area IV as well. Trichloroethylene was used to clean things. Other cleaning chemicals, such as toluenes and ketones, were used as well. We were experimenting with how clean we needed to be. Many solvents were used experimentally. Trichloroethylene (Trichlor or Trike as we called it) was used in huge quantities over the whole site because it proved to be the best cleaning chemical we used.

Liquid sodium explodes if you introduce water to it, but it dissipates. It is not, in my opinion, a contaminant. There are claims today that it is a contaminant if other things get in it, but I don't believe that.

As far as radiation, I had offices throughout Area IV starting in 1969. The Big Reactor was shut down by then. I was in the Facilities section of LMEC, which later became ETEC. I had full access to everything all the time. I don't use those words lightly. There was no place I couldn't go. I had the top clearance, above top secret, this was called Q clearance. I wasn't denied access anywhere. This also includes my time in Purchasing. They wanted engineers in the Purchasing department that knew what was going on so that, for example, when we ordered a certain grade of stainless steel we knew why it had to be so certain. There are lots of varieties of stainless steel. The engineers knew the exact type of material that was required for each job and that's why they wanted us in Purchasing. I was one of the first engineers in Purchasing for both Rocketdyne and AI. I later brought some engineers in with me as well.

I had little or nothing to do with the nuclear side of the business. When I first came in, there were no nuclear facilities left to be built. The nuclear facilities had already been constructed when I joined. We were building liquid sodium test facilities. Liquid sodium was dangerous, but not a contaminant.

The radiation hazards from 1969 on only existed in small laboratory areas because the Big Reactor was shut down. It has since been demolished and the site filled in. The test runs over the years, which I was not involved in, reportedly showed that there was some residual

radiation, but DOE, AI, North American, and Boeing revealed the level of contamination. They weren't trying to hide anything. I think the contamination at the site has been overstated.

I was involved as the Principal Construction/Facilities Engineer at North American's facilities in Nevada. We built test stands there. In 1960, concerns were rising in areas of SSFL regarding potential hazards and noise and the effects they had on the adjacent communities. The noise hazard was exclusive to rocket testing in Areas I, II, and III. We built the facility 40 miles north of Reno because Boeing/North American didn't want to subject the Southern California community to any "more" hazards from SSFL. Pentaborane was awful stuff, but it was a superb rocket engine propellant. It was only tested on a very small scale in Area I at SSFL. It was tested more thoroughly near Reno because that facility was a "safer" testing location; it didn't have people living nearby. Other "dangerous" propellants were also used there.

Many of the propellant chemicals did not get tested at SSFL because North American, Rockwell, Boeing, and NASA were always very concerned about hazards to the ground, community, and employees. But there are many things we did in the 1950s, 1960s, and 1970s that we did lawfully because there were no laws against them, such as using Trichlor. No one said we couldn't use it – it wasn't against any laws. Once it was made "illegal," they stopped using it. I used to wash my hands in Trichlor in the early years. We all did.

In 1971, when I went into Purchasing at SSFL Area IV, our office was in Building 30, which was 200 yards by air from the reactor, the big one that "over-reacted" and had the big incident. I was in charge of many things when I was in Purchasing, including packaging and warehousing, in AI. My Box Shop was in one of the buildings right next door to the reactor. We built crates, boxes, and shipping containers. I had a guy, ABC, who worked there full time for the entire time I was there. He lived to be 87. He had no history of radiation "poisoning." People in Simi Valley are concerned about being subjected to radiation and ABC worked right across from the reactor and never had any problems. I don't glow in the dark. I'm sure the radiation hazard was there. I'm sure there were people who had problems, mainly the guys and girls who worked down in the reactor itself before the incident happened in 1959. There are many things we did at Rocketdyne that, from a chemical hazard standpoint, were way worse than the radiation hazard. I mentioned pentaborane, a very hazardous chemical. We tested every chemical known to man in order to find the combination of oxidizers and fuels that would produce the greatest thrust (ISP).

Much experimentation was done in the early 1950s. That's when we were so concerned with cleanliness, and Trichlor was the best cleaner. We tested all sorts of solvents, including some that would "burn your toes off." Trichlor was a solvent we used when we worked with liquid oxygen because liquid oxygen (always the main oxidizer) would react with anything and things had to be exceptionally clean to prevent this from happening. Liquid oxygen was never used other than in "test-tube form" in Area IV. We did a lot of testing with liquid nitrogen in all areas where you needed extreme cold. But nitrogen is completely benign.

I mention liquid oxygen because in Areas I, II, and III not every test was successful. Many tests ended in explosions. We had a full time weather station at SSFL and had it for years and years. Explosions could have released clouds of hazardous chemicals that went over Area IV, but the fact that they went over Area IV hasn't been in the news and should not be a concern. But it may come up if someone is claiming that Rocketdyne contaminated Area IV. I don't think any of the explosions contaminated anything in Area IV.

As far as liquid sodium, there was an area called the Sodium Burn Pit in Area IV. I went by it many times over the years. That area was used to dispose of contaminated liquid sodium, so there are probably other "contaminants" in that area. So many things were used, there could be over hundreds of different chemical contaminants. West of the Sodium Burn Pit there were other buildings where I think spills may have occurred.

There were 13 active water wells at SSFL over the years. The wells were used for everything but drinking. The water was not potable. Some of the wells were near Area IV. The water had too much calcium for it to be safe to drink. It came from deep in the crevasses of the rock and it has been "proven" many times that the water can't get out. Many of the contaminants that were used, kerosene for one, seeped down into the crevasses, but could not escape down into the valley because the crevasses were too tight. I think that has been proven by Boeing, North American, Rockwell, DOE, and NASA. As said, in some of these crevasses there was naturally occurring water, how it got there I don't know, but that's where we drilled the wells. Some of those wells have been sealed off and they may have "contamination." There were a few wells bordering Area IV.

I can identify the Big Reactor, Box Shop, Building 30 (where the Purchasing people were), a Warehouse, Clean/Unused Liquid Sodium Storage (storage was in barrels), Chem Lab, Machine Shop, and SPTF (Sodium Pump Test Facility) locations on the 1978 aerial photograph. There was a well just outside the aerial photograph's view. I would look at the Chem Lab for contamination. There could also be chemical contamination in a deep hole/pond near Buildings 40 and 59. The warehouse stored valves and parts like that, never any chemicals.

The Sodium Burn Pit stayed in the same place. We had other disposal areas in Area I and in Area II near CTL-3. We would get a lot of our chemicals in gaseous form. Once you finished what was in a gas cylinder bottle (called a K bottle) you couldn't just get rid of it and throw it away. We had a marksman from the police department/plant protection. He took his 30-06 and set up a K bottle 50 feet away and shot the valve off the K bottle to let the gas escape, but this has nothing to do with AI. The only disposal facility that I knew about at AI was the Sodium Burn Pit. I don't know exactly what they put in the Burn Pit because I was not responsible out there. I knew they disposed liquid sodium, but I don't know about any other chemicals poured into that pond.

The Area 1 disposal area could have had radium from instrument dials. Radium was then used to make instruments glow. I don't think there was any other radiation per se in this area. I don't think it had anything to do with AI, but I cannot say that as fact.

There were many things in the early 1950s that went on at SSFL that occurred before AI and the reactors were built. They did jet engine testing at the entrance to the facility. They brought jet engines up from the Los Angeles Division to test there. There was a "lot" of kerosene used. This had nothing to do with AI, but I wanted to make the point that a lot of things happened on the 2,500 acres of the entire SSFL site over the period 1947 to today that are not related to AI. AI was in a big corner that we "drove by" for years before LMEC. LMEC started in the mid-1960s.

I have the most experience at Rocketdyne in Areas I, II and III. We were pioneers, doing things that hadn't been done before. Some people probably thought that the people in AI are nuclear oriented and don't know what happened up here in 1947 or 1951, the early years. Although there wasn't a physical fence separating the areas, there was a technical separation between the rocket and nuclear side. There wasn't any technical interaction between the sides until the 1970s when some of us from the Rocketdyne side helped build test facilities for liquid sodium components. AI needed our experience from building rocket test facilities to help build the sodium test facilities. SPTF was a huge structure with a big derrick that we got from Peenemünde, Germany. That is when the relationship between Rocketdyne and AI warmed. A lot of guys came from Rocketdyne to AI with test experience that AI needed at the time. Many people at AI (in Area IV) were scientists and had little test experience. As engineers, we got our hands dirty. The scientists didn't. They did things at AI that we didn't need to know and we did things at Rocketdyne that they didn't need to know. There was technical separation between the two sides because of the work each side was doing. That is my opinion.

Our Maintenance people got into everything all the time. We worked very closely with them. We wore green and yellow hard hats, they wore green hard hats. All the different departments had different colored hard hats. They wore whatever they wanted at AI – they didn't have just one color. That illustrates one of the basic differences in the divisions.

We had a lot of camaraderie on the rocket side. We were "brothers of the spear." We all knew what could happen if things went wrong because of our years of experience. Safety definitely was part of the reason we had a lot of camaraderie. But there are many incidents, explosions, and things that happen that there was no track record for and once something bad happened then we knew we couldn't do that again. The scientists were nuclear scientists and they knew what made a nuclear reactor, but we on the rocket side didn't know about that. When I moved over to AI, they put a "velvet" rug down because I carried with me all my years of experience on the rocket side. They were grateful to have the experience of the rocket people that crossed over. In 1969, I was at the Downey Division working on shuttle facilities, but AI needed people with hands-on experience and they asked me and others to come up to Area IV at SSFL. The supervisors at AI knew of our test experience and they wanted it, so we crossed over into AI to help build the sodium test facilities. Eventually, the divisions merged and became

Rocketdyne/AI, but I think the "schism" was still there. I call it a schism; you call it a cultural difference in the two sides. It was a technical schism in my mind, not a cultural difference.

The scientists at AI were doing small scale experiments, while we were doing mostly full scale work. When AI needed large scale structures for the sodium test facilities, they called on our experience with large scale structures. By the 1970s, we had built 19 test stands. They wanted to marry test experience with science. Initially, in the 1940s we knew nothing about rocket engines, but the Germans did, so we later brought the Germans over. This is what AI was doing, bringing in the people with the experience and knowledge they needed.

A lot of people at AI knew of explosions. We had a guy killed from an explosion in the Area I Research area and another guy lost his arm from an explosion, but those were the only two serious incidents I can recall. The people in AI knew of the explosions and incidents and thought that Rocketdyne was unsafe. That's the reputation we had from AI's perception because of the "hidden fence" or schism between the rocket and nuclear sides. I had a friend who came from the AI culture and there was a technical schism between us, but we remained friends. We were learning as we went along, doing things that had never been done, even in the 1970s and 1980s.

I know very little about how radiological materials were handled in Area IV. I did wear a film badge when I went in certain places. Wearing the film badge was very strictly enforced. I had to show my badge, and often they would check my clearance before they would even let me in certain buildings.

I am not aware of any "off-normal" events that dealt with radiological materials. I don't know anything about the storage or disposal of radiological material. I knew radiological storage existed and that is was disposed, but I do not know anything specific.

Just about everything that came into Area IV went by the building I was in (Building 30). We could see trucks carrying barrels and cylinders coming into the site. There were a few buildings in the heart of the LMEC where the so-called "hazardous materials" were stored. They did little testing with hazardous chemicals. They tested valves and pumps that pumped liquid sodium. There were a couple of small buildings that stored the chemical gases, but I am not sure which buildings specifically.

The Sodium Burn Pit was used on a "daily" basis. I don't know if anything "off-normal" occurred at the Burn Pit. I had nothing to do with the Burn Pit per se. I knew where it was and I would sometimes hear the explosions when the sodium hit the water.

Company policies dictated how material was handled. We had a large Facilities Manual that dealt with that kind of stuff. People followed these policies. I don't think there were ever any intentionally unsafe practices. If we had a bad result from something we had never done before, then we knew that practice was unsafe. We were learning about and improving our knowledge on safety as we did tests. The policies and procedures evolved as we learned. The

Facilities department included 130 engineers in my Design department and nine environmental engineers that reported to me. From 1980 to 1978, the nine environmental engineers were responsible for making sure that environmental hazards were monitored and controlled, such as disposal of chemicals. But by this time, there was no disposal of anything nuclear because the nuclear operations were shut down on the hill. There were some incidents in Building 103 at DeSoto, where there was a radiation lab doing some bench-type research. My nine environmental engineers were responsible across the entire site, Areas I, II, III and IV. They would disseminate any new rules in writing and ensure the people that needed to know received the information. There was wide dissemination in manual form.

I don't think anyone ever intentionally disregarded the procedures or rules to my knowledge. It would be sabotage or subversion if someone didn't follow the rules. We had accidents, but they didn't necessarily occur because a procedure was violated.

I don't know if any radiological or chemical material was ever left or disposed of in Area IV drainages. We had a big pond on the Rocketdyne side that residual kerosene would flow into in the 1950s and 1960s. We would sometimes burn it off at night, like they are doing in the Gulf now. When it would rain, there was nothing we could do and the kerosene would flow down South Canyon just south of Area III. A lot of chemicals left SSFL, but I don't know of any chemicals that left Area IV in quantity. There was a creek that flowed north of well 13. There were some chemicals I'm sure that left Area IV, but not in large quantities in my opinion. Although there are those who will say that's how Simi Valley became "contaminated."

Any incident, large or small, had to be documented. In the 1970s and 1980s, it was documented by my environmental people. Every test that was done was documented. I don't know where those records are or how they were kept. There were probably things that were not documented, but these would be routine things. Anything related to a test was documented. That's what we were there for, scientific history.

The Sodium Burn Pit was used pretty much all the time. I always felt it was used properly and with some level of guidance. There were always certain personnel involved and I saw them, they wore white uniforms and masks. They knew what they were doing, and what they were doing was not illegal. They were not doing anything at night, like when we used to burn off the kerosene from the pond in Area I and II. We knew we weren't supposed to burn off the kerosene and that is why we did it at night, but it was a better alternative than letting it flow down the hill in a rain storm.

I am not aware of any surface disposal area on the western edge of Area IV. There was a pond in Area IV (noted on aerial photograph) that you might want to look at. I don't know if it is still there. I recall a leach field (noted on aerial photograph) in Area IV.

There were conservation yards/junkyards in Areas I, II, and IV. The junkyards contained steel, pipe, and other parts that were cut up. Eventually, things were hauled off and sold. We would

recycle things from the junkyard, if possible. When the tests stands were eventually torn down, a company came up and took the old steel. I wasn't there at the time, but I know about it.

I don't know of any liquid material being disposed down floor drains or toilets. We had toilets, but they went to septic tanks, we didn't have sewers. Maintenance people can tell you more about that than I can.

We sometimes had problems with our piping. We had a lot of "cross-country piping" in Area I where we transferred gases, (gaseous nitrogen and helium), water, and kerosene.

I look at my experience on the hill as one of the most wonderful experiences I could ever have as an engineer and as a person. To work up there for 34 years, doing things that had never been done before was something special for a lot of us. We didn't do anything that we knew was unsafe. Many incidents that occurred at Rocketdyne and AI occurred not because we were doing things that were unsafe, but because we were doing things that had never been done before.

UNITED STATES DEPARTMENT OF ENERGY

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 7/19/2010

Interviewee(s): 57

I worked at the Santa Susana Field Laboratory from 1953 to 1956. I worked all over the site. It was a long time ago so it is hard to remember my experience there.

I did not work with any radiological material. I mostly worked with sodium. I worked with sodium, primarily in capsule form, in a glove box with remote handlers. The glove box had an inert atmosphere to allow us to work with the sodium safely. I felt pretty safe working in the glove box. I had to wear a protective apron and a dosimeter, but that was about it. I didn't have to wear any breathing protection.

When we were done with our work, we would throw old sodium capsules into the Burn Pit and let the sodium dissolve away. Anything that wasn't good was put in the Burn Pit. A guy worked up there and he would take care of stuff at the Burn Pit and make sure everything went as planned. He would help us out if we needed it.

I primarily worked with sodium, but I also worked with some associated cleaning chemicals. All the chemicals were stored in a location that was convenient for us to use. When we needed to dispose of anything, including the chemicals, it usually went to the Burn Pit. I do not recall any chemicals being dumped down the toilet or drain. I didn't see anyone dump any chemicals on the ground.

I received some training when I first started at the site. The lead men and other bosses would assign me jobs. They would tell me what they wanted done and how to do it.

We had rules and regulations that we had to follow. Sometimes the rules would change and I would have to read the new procedure to learn what had changed. Most everything happened as it was supposed to though and we followed the rules. Procedures were written down and we followed the procedures.

I also worked with asbestos. I would cut asbestos off of sodium tanks and piping.

I documented my work by filling out forms. I don't know how the forms were used or where they were stored after I turned them in to my boss. If anything went wrong it was noted in a report.

I was involved in an accident once on the hill, but I do not recall the details of it. My eye was burned by sodium and I had to go to the hospital for a while. On the way to the hospital, they flushed my eye with water to remove as much sodium as they could. It was painful, but my eye got better. A report was made to document the incident.

I heard about the "meltdown," but that was after I left the hill. I heard about it after the fact, but we didn't get involved in a lot of stuff that happened. It was a dangerous accident. Things were classified and secret, so if we didn't need to know about something, we didn't know about it.

We probably did things we shouldn't have done, but we shouldn't condemn the company for that. It was not the company's fault. It was our fault. I don't remember anything happening that was the fault of the company. I have no regrets or bad feelings about the company. We tried to always do things by the rules, but when the rules changed sometimes we could no longer do things the way we used to. Sometimes we made mistakes or had accidents, but no one ever did anything wrong on purpose. We made sure everything was documented and we would correct any problems. In all the time I was on the hill, everything was done according to the rules.

I would look at the Burn Pit to make sure it is cleaned up.

I really enjoyed my job and liked working on the hill. We always had things to do. I was on the hill for three years and then I left to work for Rockwell at Canoga Park. I liked the people I worked with. The bosses were good guys and never did anything bad on purpose. I really want to stress that the company was not to blame for anything. If something went wrong, it was our fault and not the fault of the company.

UNITED STATES DEPARTMENT OF ENERGY

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 7/21/2010

Interviewee(s): 58

I worked in a sodium building in 1978, it may have been called the Sodium Component Test Loop. We were running transient studies involving liquid sodium. Sodium melts at about 200°F. The sodium came in looking like Styrofoam. We would heat it up and pump it through various pipelines ranging from 1" to 12" in diameter. There were vertical and horizontal pumps. There were heaters along the lines. We would vary the temperatures from 250° to 1250° F. We would heat the pipes up, and then cool them down. The whole point was we were trying to see if we could break the line. It was a heat exchanger/heat transfer system. We were testing the pipelines to see if they could handle the changes in temperature. We were trying to see if we could break a pipeline, but we were not successful in that. I remember being told that they were running the tests to see if the pipes could be used in a breeder reactor. I don't know if that was correct, I don't honestly know. I am not an engineer. But that is what I was told.

Part of my job was to open the pipes to examine them. When we wanted to do that, we had to let them cool down so the sodium wouldn't be liquid any more. Then they would plug up the pipelines and I could open one up to examine the pipelines. Sometimes they would plug up a vertical pipe; sometimes it would be a horizontal pipe. If a pipe was still warm enough, the sodium would still flow down once the pipe was opened.

I don't know for sure what happened all the time, round the clock. I know what happened when I was on duty. I just worked one shift but the facility operated all the time.

One time they told me to cut one of the lines. They seemed to think the line was plugged up for some reason. I said it was a bad idea; that the pipeline was too warm and the sodium would flow out. They told me to do it anyway. They thought the pipeline was plugged up and that nothing bad would happen. I didn't want to lose my job, so I did what I was told. I cut the line, and liquid sodium started flowing out all over the place. A fire started immediately. We shut the pumps off, turned the heaters off, and used NAK to put the fire out. We called the fire department and they came. We had the fire out in about ten minutes. The engineers wouldn't even talk to me. I think they wouldn't talk to me because I had been right all along. We had to

use NAK to clean the mess up. Once we got the mess cleaned up, it was back to business. That is the only time anything like that happened. It was frustrating to me because they didn't listen to me. We cut a horizontal pipe. The sodium was still liquid and a lot of it came out because the location of the cut was close to a vertical pipe and the liquid sodium flowed downhill. The only thing that went right was that I made the cut in the pipeline away from my body. This was smart because if I had cut it towards myself, I would have caught on fire. I told them it was a bad idea, they didn't listen, and I had to clean the mess up. They wouldn't talk to me after that happened. It was a frustrating experience. I think they were trying to see how I would react to the situation.

There was a pool of water outside the sodium facility. They used to throw things that were contaminated with liquid sodium in there. Then the water would blow up. The item that had been thrown in there would explode and burn.

I left my job on the hill shortly after that. My brother got sick. He lived in Las Vegas and I quit to go be nearer to him. Eventually, I went back and asked for my job back. They hired me back, but from then on I worked at the Canoga facility. I didn't work on the hill again. I was only up there a year, or maybe even less.

The only time I ever handled radioactive material was one time when we were told to go out and pick up some pieces of equipment that were on the ground. Then the Health Physicists figured out that the equipment was contaminated with radioactivity and they told us to stop what we were doing. I had only been picking up the equipment for about one-half an hour.

I know they had a glove box that they used to examine items that were radioactive. I saw it done once, but I didn't do that ever.

I didn't handle any hazardous chemicals. The only thing I ever did that seemed hazardous was when I cut the sodium piping. That was the only problem that I was ever aware of. Things really ran pretty smoothly up there. I did handle the NAK. I don't know if it is considered a hazardous chemical. It was disposed in a dumpster right outside the building. After the explosion, I just swept it up and then we threw it in the dumpster. It wasn't a normal dumpster. I used the dumpster that I was supposed to use. The dumpsters were easily accessible.

I don't remember any written procedures. As a general rule, people did what they were supposed to do. They had procedures down at Canoga, but I was not aware of procedures when I was on the hill. Our supervisors told us what to do and we did it.

I was a janitor before I started working in the sodium facility. The only training I ever got was on-the-job training. I didn't handle any waste.

I didn't submit any documentation for what I did. The engineers in the sodium facility probably documented what we did there. I think the supervisor was probably responsible for the paperwork.

I never saw any liquids disposed of down any drains or in any toilets.

The Sodium Burn Pit may be the place I already told you about. We didn't call it that back then. I don't know how it was used. It was there. I saw someone throw something in it once. It was like a show-and-tell. It was probably when I first started working in the sodium facility. It was a good thing for me to see that, it was a good experience, a learning experience. I was glad to know what I was up against in handling the liquid sodium. It was very easy stuff to handle and it was surprising how dangerous it could be.

The only incident I know about was the time I cut the pipelines. They thought the pipelines were plugged up. I was the last one hired and that's probably why they asked me to do it. I told them I didn't want to do what they told me, but that I would if they told me to. I didn't want to get blamed if things went wrong.

I don't know anything about any surface disposal area or any leach fields. I don't recall anything about any conservation yard or junk yard. I didn't even know those things existed.
I was a janitor for the first 90 days after I was hired, during my probationary time. They wanted to see if I was okay.

One day they asked me to go work in another sodium building. The working conditions were not as good in that building. I filled in for a guy who wasn't there, just one shift. I didn't like the place. My intuition wasn't good about the place. In my normal building, the layout was clean. I could see everything I needed to see. I was not interested in finding out what was going on in the other building.

I was a janitor before I went to the sodium facility. I swept the floor. I emptied the garbage in the dumpsters. I washed floors. I worked all over the hill. I did what a janitor would do anywhere else. Occasionally, I would have to sweep up these chips off the floor and put them in a big drum. When the drum would get full, someone would come pick it up and haul it away. I don't know where it went. No one else was around while I worked except security. There was this one guard who would sneak up and watch what I was doing. He seemed to want to catch me doing something wrong. He wouldn't talk to me. I was minding my own business, busy doing my job and suddenly, I would feel someone watching me. I was all alone, but there were bobcats and mountain lions up there. It would startle me. I told him I would take his gun from him and use it on him if he kept doing that. He stopped after that. I was only a janitor for 90 days.

They were good to me and I have no complaints. I have no concerns about the site.

We did not have any leaks in the sodium building. There were not any containment trays under the pipes, but there weren't any leaks. Our pipelines were very tight. I never saw any leaking or spills. NAK is like a fog. When we sprayed it to put out the fire in the building, I couldn't see anything. I called out to my partner. He didn't answer. It was scary. He was okay. I think

he didn't respond because he didn't want to say anything. He knew they should have listened to me. I wasn't sure I was happy about having to breathe the NAK. I am in hospice now. My doctor asked me once if I knew what caused my emphysema or COPD. I smoked for 35 or 40 years. I don't know if the NAK could have made things worse. I was exposed to other things. I worked for a while plating parts. That was a really dangerous place to work.

I retired from Rocketdyne. They were good to me. They took care of me. It was a good company. I enjoyed working there.

UNITED STATES DEPARTMENT OF ENERGY

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 7/12/2010

Interviewee(s): 78

I worked full time on the hill from 1976 to 1982 or 1983 for both Rocketdyne and Atomics International. There just was not that much difference between the two parts of the company, we just went back and forth. After I left SSFL, I went to Canoga Park as a purchasing representative and my duties took me back up on the hill occasionally in the 1990s and 2000s. I had an office in Canoga Park and then later on in West Hills. Later on, I was also involved in a laser and electro-optical program.

I was there during the years that DEF was the general manager, after GHI was in that capacity.

I left under my own gumption when I finally decided, "I need to get out of this mess." I knew that if I had to suit up and wear a respirator to work with radioactive materials, it was not going to be good for me in the long run. I wanted a safer job with less health risk, so I found myself a job in production controls and moved on.

I worked with radioactive materials, handling "a little bit of everything." I worked in decontamination, including the Sodium Reactor Experiment, the Sodium Burn Pit, and Buildings 5, 6, and 59. All the buildings had a yellow stack – which meant that radiological materials were handled there.

When I worked at the SRE, we took the facility apart. I was there for 1½ or 2 years, working 30 feet below ground surface and using a jackhammer. We would take a radiation reading and when we found contamination, we would dig it up, box it up in special lined boxed, and they would ship it away. I do not know where it was shipped to, but everything went off-site. I think it went to Beatty, Nevada. I do not know where it was stored on-site before it was shipped away.

We wore film badges. No one seemed to think it was that all that hot. We also used dosimeters and collected urine samples in a bottle every 30 days. This was all pretty standard health monitoring, and no one seemed to be too concerned.

A lot of things did not go as planned.

Building 5 had a coal gasification system that we ran around the clock. Coal was converted to a low butane gas by putting the coal in a vessel of molten salt. One day the molten salt vessel blew up. The vessel was under pressure and a 36-inch blind flange malfunctioned. Molten salt was spewing all over the place and going into the drainage system. Building 5 and Building 59 had both been contaminated from previous experiments. I asked, "how come we are not wearing film badges?" I was told that the buildings did not have that much radiation left in it and we would all be adequately protected as long as they were monitoring the building. So I asked for the radiation records, specifically for Building 59, and I was told they could not find them. When I pushed hard, they came up with some kind of calculation of their best guess as to what I had been exposed to.

A lot of stuff seemed to disappear like that.

I was working in Building 59 -- which had the yellow and black stacks. I asked why we were not wearing film badges. I was told that they were not necessary because they were monitoring the building. The SNAP reactor was still in the vault in that building. JKL, the project manager, is dead. The shift manager, MNO, is dead. Another guy I worked with, PQR is dead. All cancer related deaths.

Going back to my story about Building 5, after the explosion following the flange blow out, nasty crap was coming out of there and running into the street in front of the building. We were putting sand bags out to keep it on the street. The stuff eventually froze up again. We got it shut down. I was one of the victims of that accident. I filed a workman's compensation case for hearing loss afterwards. I was wearing a respirator and a breathing apparatus -- but no hearing protection. I went to an audiologist and found out I had tinnitus, damage to my hearing.

Working all those years with a jackhammer inside an enclosed vessel, and around the rocket testing, took a toll on my hearing.

I almost got killed once in Building 59. I was working on a rotating shift and they were in testing mode. There was a big pressure vessel in the other vault (not the one that the SNAP reactor was in). They had a big mock-up of the Clinch River fast breeder reactor that was planned for Tennessee. It was never built due to politics after the Three Mile Island accident. A previous test had been run and the meters were reading like all the pressure had been bled off as required. I was removing a blind flange from the vessel with a crane and soon learned there was still pressure in the vessel. It blew and sodium oxide was all over the place. I couldn't breathe and I couldn't see. I do not know how, but I got out of there. STU was there too. He died eventually of leukemia. It sounded like a nuclear bomb going off in that vault. There was not any radioactivity in there. But I do not know how I got out!

When I was working in Building 5, we would cut out components, like some piping for example, and take it over to the Sodium Burn Pit to burn off the sodium with a hose. We would stand behind a blast shield at the Sodium Burn Pit because you know what happens when you add water to sodium. That is what we would do. I do not know what that pit was used for before then. I have seen photos of buried objects in the Burn Pit, and I know contaminated valves full of sodium have been buried out there for years.

I was licensed to drive a skip loader. One time, I was operating the skip loader in the Sodium Burn Pit digging up asbestos from old tanks. I had to be suited up in protective clothing for this work. I ran into something that was solid and shiny – it was not a rock. I got a pug and got a reading on it; it was radioactive. It pegged the dosimeter. I reported into my supervisor and he told me to cover it back up and go away. We boxed up the asbestos I had already removed and I did what my supervisor told me and covered whatever it was back up and left.

Later, when I was a program representative for purchasing, I remember seeing a purchase order for some big tarps they would use to cover the place up before it rained. I have heard that a lot of things were buried out there and that everything went there back in the old days. The thinking was, out of sight, out of mind. I ran into one thing with that skip loader. I know from that experience at least one thing was in there that was not supposed to be. How many more things are in there?

We used trichloroethylene when I worked for Rocketdyne. We used that stuff all over the site, at CTL5, CTL6, and on the test stands, including Coca, Alfa, and Bravo.

One thing I found somewhat strange is that they do not have good records of who worked where. We were all part of this general pool with a common job classification. I was low man on the totem pole when I hired out there. Everyone else had 30 years of seniority – they could have all been my dad, I was all over the place, working here and there, wherever they told me to go. Then things got slow and I went over to Atomics International. That is when I started working in Building 59.

We used cleaning solvents for everything. Trichloroethylene was the most common, but we used other things, like Freon. We would flush things out in the open, and it would run down the asphalt, eating away at the asphalt as it drained. There were no catch basins. We used a line to flush with the solvents and the grease and oil would wash off. We did this outside of buildings. The tanks were already outside. We also used Dilenol (alcohol and water combination) in a closed, pressurized system.

Where did the solvents go after we used them? I do not know. Hopefully into a 55-gallon drum with some other miscellaneous solvents, but I do not really know. They were all stored in large vessels or tanks with pumps. Every building on site had trichloroethylene available. I have no idea where it was disposed.

Part of the problem was that no one knew how to properly dispose of solvents like we know today.

Did we have policies and procedures? Well yes – we pretty much did what we were told.

Rocketdyne was a lot more safety-conscious than Atomics International. They had a higher standard. The rocket side had a book of procedures on safety and everything else. The AI side was looser, it was more experimental. We did what our bosses told us to. Everyone at Rocketdyne followed the procedures. No one wanted to get hurt. One time I got a metal chip in my eye. They got me in to see an eye doctor right away and took care of it. They were always after us to wear safety glasses, hard hats, etc. The NASA folks, a lot of them had Air Force experience, and they were strict.

AI was completely different. They were looser and using different kinds of standards. DOE was not nearly as visible as NASA was.

The training we got up at SSFL was mostly on-the-job training. We did get some training in how to work with liquid oxygen and liquid nitrogen. I had been trained in how to handle those while I was in the Air Force. I was smart enough to know what not to do.

I do not know of anything buried at SSFL except for perhaps in the Sodium Burn Pit. I am not aware of any liquids being dumped on the ground.

As for record keeping, I have my own radiation records around here somewhere. I do have some questions about what I may have been exposed to while I was working in those buildings without a film badge. They claimed they monitored the buildings, not the people. They told me not to worry – they could come up with an estimate of what I had been exposed to. However, they do not know where I worked or at what time. They cannot seem to find any of their records. Maybe they do not want to find them.

That whole attitude did not set well with me, so I left and went on. Now I am starting to worry about it, especially when I started realizing how many of the people I worked with have already died. I wonder if anyone has ever done any analysis on mortality rates by buildings.

Could there have been any hot spots in Building 59? The SNAP reactor was in there until very recently. They kept it behind a locked door, but it was still in there. Building 59 is now gone. The same is true for Building 5.

On a daily basis, the shift leader filled out a log. The logbook kept records round the clock, each shift filling in what had happened in the building during their shift. Where are those logbooks now? I do not know. Maybe in the same place as the radiation records for the buildings that they cannot find.

My concerns at the Santa Susana Field Lab are with the Burn Pit, Building 59, and Building 5. Who knows what went into the Sodium Burn Pit over the years. The nuclear experiments that they ran up there ended long before I started working up there. It is possible that all kinds of things are buried there. It could have all been taken to the Burn Pit. No one seemed to think that was a problem, it's just the way things were done. Building 59 still had the reactor in it when I worked there. They buried it in place, but this still concerned me. Building 5 had previous radioactive experiments before I worked there and it too concerned me.

Would I want to build a house up? No.

If you buy a house anywhere near SSFL now, there are all kinds of disclaimers that you have to sign during your purchase of a property. Based on what I know, I would not even want to live in Simi Valley. I do not know what went on in the 1950s, 1960s, or early 1970s before I worked at the site, but I would be concerned living in the area. Many people have gotten sick around there since the 1950s. At one time, there were 8,000 people working on the hill between AI and Rocketdyne. There were only 500 people employed up there by the time I was hired on.

I retired from Boeing. I think they are a good company. They are very safety conscious. They bought a real mess when they bought SSFL. They are not doing much now beyond cleanup. They are a good company and I do not think they would do anything sleazy. I feel sorry for them, getting stuck with that mess.

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UNITED STATES DEPARTMENT OF ENERGY

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 7/16/2010

Interviewee(s): 80

When I first started working at SSFL, there was nothing at Canoga or DeSoto yet. There was a facility (called Slauson) on Slauson Street in Los Angeles. Once the Canoga facility and the DeSoto facilities were built, they closed down the Slauson facility. I reported to the Slauson facility for the first two days I worked for the company, and then I went to Beverly Hills for a physical. I didn't start working up on the hill until Friday. My hire date was Monday June 13, 1955. There were no administrative services up on the hill at the time. In 1956, the Rocketdyne Division opened its own administrative services on the hill (Santa Susana).

When I started in 1955 there were no separate divisions within North American Aviation. It was one big company and the test site at Santa Susana was called the Propulsion Field Laboratory. In November of 1955, they divided the company into five divisions: 1) Autonetics, 2) Space, 3) Aircraft, 4) Atomics International, and 5) Rocketdyne. We became North American Rockwell when we merged with Rockwell International and then ultimately became Rockwell International. Subsequently we were sold to Boeing.

I worked for Rocketdyne from 1955 to 1992 and from 1996 to about 2004. I was in the Turbomachinery Development group at Santa Susana from 1955 to 1960. After 1960, I was based at Canoga but had management responsibility for one unit at SSFL. I was not up there full time after 1960. From 1955 to about 1958, I was located in the Area 1 engineering building which was a one-story wood-frame building on the road west toward CTL1. It was painted North American green, just like all the buildings up there. In 1958, my unit was moved to the engineering building in Area 2.

There was a Sodium Pump Facility just inside the front gate. They were learning how to pump liquid sodium.

I had only brief involvement with the atomic side of SSFL. There was a launch failure involving a rocket launched from Johnson Island, near Kwajalein Atoll in the South Pacific. The launch involved atomic warheads. It failed shortly after liftoff and the atomic warhead

contaminated everything around it. They brought the engine back up to SSFL. Because the engine was one of my engines, I was asked to help see if we could figure out what went wrong.

My office was at the Canoga Park plant when the engine from the Johnson Island failure was brought up to the hill. I was managing turbomachinery engineering at the time and went to the hill specifically to look at the turbomachinery to see if I could detect any problems. I didn't find anything wrong with it. I think the Engine Systems people had already figured out what had gone wrong. We were just making certain that what they had not missed a problem in the turbomachinery. Based on what little experience I had up there when I was investigating the Johnson Island failure, I was under the impression that they were very cautious. I thought maybe they were being overly protective of me. I had to put on a white suit, booties, and gloves. I had a badge that you would pass in front of a Geiger counter to see if I had been exposed to radiation. You would check the badge going in and coming out to see if you had been exposed. It is my recollection that they had strict rules about how long you could be in the areas.

I have no knowledge of how radiological materials were handled, stored, or disposed. In fact, I never even heard about the accident involving the reactor until years later. Everything that happened up at Santa Susana was classified. If you didn't have a need to know something you didn't have access to the information. The rocket engine people didn't know what was happening on the nuclear side and the nuclear people didn't have access to the rocket engine information for that matter. I probably wouldn't have found out about a nuclear accident in real time unless a health emergency was declared. If there were any concerns about unsafe conditions, the area would have been cordoned off. In the late 1980s a computer tomography machine, which was an inspection tool, was installed in the area previously used by Atomics International. I made a few trips up there to observe the construction and installation. There was never any atomic testing going on during this period.

VWX was the Facilities person I dealt with on this project. She provided the Facilities support in setting up the computer tomography machine in the late 1980s. She did a great job.

I was involved in testing turbopumps at CTL1, CTL2, Bravo, and Delta test stands. I was so busy with turbopump stuff, I didn't even know about the other rocket engine testing. There was a lot going on. The military was pushing us. They needed the IBMs and the ICBMs. We were right in the middle of the Cold War.

Regarding chemical materials, I worked with a lot of trichloroethylene. It was a great cleaning solvent and a great degreaser. It didn't have an environmental stigma at the time. I wasn't afraid of it because I had a job in a machine shop during high school where I cleaned machine parts with trichloroethylene using my bare hands. I've always felt the furor over trichloroethylene was overblown. I know it did a good job at just about everything, including taking the skin off your hands. Parts used in LOX systems had to be cleaned thoroughly to remove any hydrocarbons left by the fabrication processes and 'triclor' was the best cleaning agent available.

I really don't remember where we stored the stuff. I think it was stored in metal cans. I don't think it was stored in plastic containers. It may have been delivered to us in 55-gallon drums. I wasn't involved in transporting or storing it.

There were two groups on the hill: the development people and the test people. I was in Turbomachinery Development. The development people directed the test people regarding which tests to run. The test people then supplied the materials, operated the test stands, and did maintenance on the facilities. I wasn't involved in the management of chemicals. I wouldn't be surprised if someone just poured trichlor on the dirt when they finished cleaning something back in those days. It wasn't considered hazardous. It didn't even occur to me back then that we shouldn't do something like that. Maybe I lead a sheltered life.
I was aware of some off-normal events. I remember an accident investigation involving CTL-4 in the mid-60s. They were using UDMH and NTO as a propellant and a test stand blew up one morning. It killed a couple of guys. YZA was the chief engineer at the time and asked me to be his representative on the hill during the investigation.

I remember another incident that occurred at Delta 3 one night. They were testing fluorine, which is a great oxidizer but a miserable chemical to handle. You got more for your buck with it than with liquid oxygen. A fluorine leak occurred somewhere in the piping system. I was testing turbopumps at Delta 2 on second shift. Fluorine has a strong odor (they put fluorine in public water systems to help your teeth, but its smells bad). At any rate, I remember the Test manager, BCD, came roaring over in a jeep and told everyone to get out. To my knowledge, no one ever had any ill effects from that event. I don't remember what they did with the fluorine. They probably drained the tanks. I don't know where they drained the fluorine to, to the ground maybe or they could have brought in hazardous handling rigs, but I don't think so. I don't think they existed at the time.

There is a difference between getting a strong smell and suffering ill effects from it. For example, when I was a kid, my father's machine shop was in an ice plant that used ammonia as the refrigerant. That building was built in 1900. It was an old place that had lots of leaks. We smelled ammonia all the time and had no ill effects.

Kerosene, oxygen, and nitrogen were the highest consumption liquid materials used that I worked with at Santa Susana. Nitrogen was an inert gas used to pressurize tanks, but is not hazardous.

I do remember we had these big water cooled flame buckets that deflected the rocket flames away from the ground. The engine exhaust produced a lot of soot which flowed downstream with the flame bucket water. The soot from the Alpha and Bravo areas flowed into ponds. There were fish in the ponds but they weren't very appealing because they were all black from the soot. We didn't consider the soot to be toxic.

I didn't need (or get) a lot of training. We were all learning as we went along. Most of the training we did get was safety training for the test stands. Each test area had a system of lights. Red meant a test was underway, yellow meant a test was about to begin. Green meant you could enter. I didn't have any materials handling training because I wasn't doing that type of work.

They had a liquid oxygen plant up there for several years. It was between Area I and Area II. So we had our own, local source of liquid oxygen. Kerosene came up in tank trucks. We handled similar to the way gasoline is handled at a gas station. It didn't require anything special.

There were very few liquid oxygen accidents. One happened at Bravo 2 on a day with very low humidity. A layer of the liquid oxygen was floating as vapor close to the ground. It wasn't visible – it looked just like air. A guy came out with a cigarette and threw his cigarette butt on the ground. When it hit the liquid oxygen layer, the asphalt flared up. When he stepped on it to put out the fire it flared around his shoe. I heard the story, I didn't see it. The mechanic lost a pair of shoes but wasn't hurt and but there was no environmental damage.

There were company policies. There were a hundred rules and regulations. These were more focused on airplane plants than on rocket plants testing. It was against the rules to sleep in the airplanes. This didn't have much bearing on us in the rocket side, but because we were part of North American Aviation, it was one of the rules. They could fire you if you racked up too many violations. A lot of the rules were more focused on what we weren't allowed to do. They didn't allow tardiness or insubordination. The rules were mostly related to personnel issues and didn't guide how we were supposed to do our work.

We documented a lot of our activities. We recorded what we did in logbooks. We generated a lot of reports. Later, briefing charts replaced reports. The briefing reports went to the government, our customer. The government was paying for everything we did and each program had its own special requirements for reporting. They reports and briefing charts were kept in files in the program office. We also had to do progress reports and monthly reports. A lot of the files got trashed after we moved them around too many times. I kept my own reports in my file cabinet through about 1965. Almost everything was classified up to about 1965. I had a secret clearance, but I still didn't see everything. Files were organized by department. We saw things on a need-to-know basis. When I was in the Army, I was in the security division.

I was involved in developing turbopumps for the rocket engines. I worked on the Navajo, Jupiter, Thor, Atlas, H1, and Shuttle rocket engines.

The impression I had was that they were very careful with the nuclear stuff. The nuclear stuff was not very forgiving. There was a heavy emphasis on safety. They were conscious that they could hurt people and they didn't want that to happen. On the rocket side, we needed hardhats to go to a test stand. They were not designed for people as tall as me; I am 6 foot 4 inches.

We always documented what we did. In all of my years, Rocketdyne was a very open technical organization. There was very little political maneuvering. We could argue on a technical level, but that didn't carry over to the personal level. We got along like a team.

One of the wonderful things about working at the place is that we were all looking for the truth. We didn't want to do something wrong; it didn't make any sense to proceed with a test if we were going to do something wrong. We were interested in learning together. It was a fun place to work.

Trichloroethylene was no big deal. It was like how cocaine used to be in Coca Cola and doctors used to prescribe it; they thought it was good for you. We didn't know what was bad for us. We weren't afraid of it.

They worked more with chemicals in the research area. They developed solid propellants for armament rockets like NASTY, NAKA, and NALAR. The NA part always stood for North American. I don't know what the rest of the letters stood for. The solid propellant rockets had fins on the back to spin-stabilize the rocket. They had an explosive war head on the end.

I have a book about Rocketdyne, written by Robert S. Kraemer in 2006. It's called Rocketdyne: Powering Humans into Space. It provides a lot of the history.

I am not familiar with the Area 4 Sodium Burn Pit. I do know that sodium burns when it comes into contact with oxygen. It would seem like that may have been a place to get rid of sodium. I don't know what the result of that would be. I don't recall hearing about a surface disposal area. I would have probably heard about that if it existed.

I was told there was an area west of the old Area 1 engineering building where old rocket engine parts were used as fill. (Some of the old engines had gold in them. We had a lot of failures over the years; we blew up a lot of hardware. The engine parts became junk once they failed. It wouldn't have paid to have them hauled off. There was a long old building that was used as an equipment lab on the left side of the road and the engineering building on the right side. Just past the engineering building, there used to be a canyon that isn't there anymore and I was told they used scrap rocket engine parts to fill it in.

Most of the test stands have been taken down. If we had a propellant tank, before we scrapped it out, I am sure we would have cleaned it out first.

Once we had a contract to build two tanks, one each for NTO and for UDMH for the upper stage engines on the USAF Manned Orbiting Laboratory (MOL) program. They were designed with bladders to be squeezed. The pressure outside the bladder pushed the propellants in the bladder into the engine. They were built at Canoga Park but I don't remember if they were ever tested at SSFL. If they were it was before I came on the program and the tests would have been conducted in Area 4. But nothing was ever thrown into the scrap heap until it was decontaminated first.

In my experience, Rocketdyne was always very careful. I have to believe that Atomics International was the same way. It was a culture that came down from North American Aviation.

I don't recall any problems with any tanks, where the tank itself was a problem... Most facility tanks had to be designed with a 10 to 1 safety factor. Flight weight tanks were lighter than what we had on the hill. They rely on the pressure provided by the propellants for structural integrity. They only had to last until they were emptied. We never tested any flight weight tanks up there. Our facility tanks were very beefy.

I loved working up there. I can't think of anything that would have been more interesting to me. The government wanted these ballistic missiles. The public wanted us to be successful. The engine testing would rattle the valley. They knew it would help keep the Russians from bombing us. Now, they are not doing any more rocket testing here.

During the Cold War, the government wanted missiles bad. The contracts were cost plus. We didn't worry too much about costs. There were incentives for us to build lots of test stands. In 1958 or 1959, there were 18 large engine test stands. They were firing all the time. It was a phenomenal time that will never be repeated.

I retired in 1992. I was out for about three years, and they asked me to come back. Boeing was developing a "flex force." There were not any benefits except you could add to your pension. I worked on the RX68 engine – a gas generator cycle engine they were planning to use on the next moon mission.

I was a nuts and bolts guy. The one thing I missed the most once I retired was the interface with the people. EFG was the president of the company when I hired in. He was much loved by everyone. Everyone felt he was looking out for them, personally.

I remember the DC electrical generator for CTL-1 came out of a Pacific Electric substation. The Pacific Electric streetcars were the early rapid transit system in Southern California. The valley line ended at Shoup and Victory. There were double tracks running down Sherman Way. It was a magnificent system at one time. I rode it to school during junior high and senior high school.

UNITED STATES DEPARTMENT OF ENERGY

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 7/6/2010

Interviewee(s): 107

I worked for Atomics International at Canoga Park, California from 1961 to 1973 as an engineer with the SNAP 2, SNAP 10/10A, S8ER, and STIR programs. Prior to my time at Canoga Park, I worked on the OMRE, SPERT, MTR, and SL-1 for Atomics International in Idaho Falls (1957-1961) and for General Electric in Hanford, Washington (1951-1957). I provided a brief chronology of my work history to the interview team. (I also showed the interview team a scram button that was removed during decommissioning of the STIR facility, a pneumatic tube for collecting samples, and my QA stamp, which was the first neutron radiography level 3 stamp ever produced.)

I worked on SNAP 2 and SNAP 10/10A in Building 24. The SNAP 10A program became SNAPSHOT, the first nuclear reactor in space. I was involved in calibrating the reactor instrumentation. The SNAPSHOT program ran for less than 30 days as the DOD collected all the information they wanted from the program and then shut it down. SNAPSHOT has a 300-year orbit and is still in space.

I worked on the S8ER in Building 10, which was much larger than the SNAP 10/10A reactors. But after 2 years, the S8ER was shut down. I was an alternate engineer in the Building 12 critical facility, where all of the free plutonium in the world was located at one point.

Most of my work at Canoga Park involved the Shield Test Facility and Shield Test and Irradiation Reactor (STIR) in Building 28. The Shield Test reactor was a 50 KW reactor. It was shut down and converted to a 1 MW reactor, which became the STIR. The STIR was used to conduct irradiation tests for the Jet Propulsion Laboratory. Samples for this testing were handled quickly as the half- life of isotopes involved was just minutes. Under the STIR program, I conducted studies on shielding, neutron activation, and neutron radiography. Neutron radiography was my primary research in the early 1970s. I worked on neutron radiography of electronic explosive devices for the Saturn and Apollo space programs, including Apollo 7 through Apollo 17. An issue of the North American Rockwell Corporation journal *Skyline* shows examples of how neutron radiography can be used in non-destructive

examination. The radiograph of a motorcycle was my son's motorcycle. The radiography left the motorcycle slightly irradiated and an AI health physicist noted I could not take the motorcycle home right away.

I was also involved in non-destructive ultrasonic and radiographic testing of reactor vessels. I was part of a team that built a skate to move around the pressure vessel of a reactor and electronically transmit information back to the engineers. This system was developed at Santa Susana and then applied to the testing of railroad cars in Louisiana.

In 1973, I was part of a team that went to Sandia National Laboratories in Albuquerque, New Mexico to conduct studies on weaponry, such as the thermonuclear B61 (Mk-61) Bomb. We were known as "black hatters" (bad guys that steal weapons) and our goal was to determine how dismantled weaponry could be reactivated. The lab had three dismantled nuclear devices that we worked on reactivating. We had some assistance in our efforts in the form of the operator's manual for the weaponry.

The only incident I am aware of during my time at Santa Susana is the use of approximately two parts per million of potassium dichromate in the STIR cooling tower. Potassium dichromate was used to minimize corrosion, but the state of California came in as the regulator and stated it could no longer be used. A phosphate compound was used to replace the dichromate compound.

In the late 1960s, AI underwent a big layoff period. When I was first at the site, there were approximately 300 employees, but by the time I left there were approximately 60 people. It seemed that every Friday we were having a going away party. A reduction in forces occurred at other labs as well, including Argonne National Laboratory and Oak Ridge National Laboratory.

I wrote the safety analysis report and worked on the engineering of fuel element removal and shipment from the STIR facility. When fuel elements had to be replaced, the used fuel elements were placed in a storage rack inside the reactor vessel. New, unused fuel elements were taken from the storage vault in the building and placed in the reactor.

STIR was owned by AEC (now DOE) and used for neutron radiography. When General Electric built its own neutron radiography facility, AI decided not to compete with them and abandon the STIR for the L-88 reactor. The L-88 reactor was also used for neutron radiography and was the first reactor of its kind.

Documentation from experiments and testing, including rolls from recorders, were packaged quarterly and sent to Rockwell International storage facilities that were originally in downtown Los Angeles, and moved later to Newport Beach. The Newport Beach facility also contained documents from the Nixon library. Nearly 10 years of records from the STIR facility would have been sent to one of these locations.

In the late 1960s, I recall one day at the STIR facility when we were told to "shut her down" because of what was interpreted as being air emissions from the building stack. We never asked questions when told to shut down a reactor, so we did what we were told to do. However, the instrumentation and records on the facility were all normal. The readings that had set off the alarms were consistent with a bomb, not with normal operations of the reactor. About a half hour later, it was discovered that the Chinese had detonated a nuclear weapon and fallout in the atmosphere had been mistakenly attributed to the STIR facility. Weapons testing fallout was not a big deal to us, but this instance got our attention because we had to shut down the STIR as a result.

We had a "safety first" attitude throughout AI and this dictated how operations were conducted.

I never went to the sodium pond, but I am aware of a pond in the western portion of Area IV used by AI and Rocketdyne to dump excess sodium or NaK used in the S8ER. It would snap, crackle, and pop like fireworks when exposed to water. When SNAP piping was steam cleaned, you could also hear the snap, crackle, and pop in the piping due to the sodium and water reaction.

Water from the STIR cooling tower would drain into a holding reservoir at the edge of the asphalt driveway leading into Building 28. The reservoir would accumulate cooling tower water as well as rainwater. A sump pump located at the northwest corner of the test vault accessway was used to pump the water over to Rocketdyne. After the water was pumped to Rocketdyne, AI had no control over it. Rocketdyne conducted regular sampling of the water and then released it to the Los Angeles River. AI was essentially a guest of Rocketdyne's at the site and Rocketdyne could tell AI what to do. Presumably, if there were any issues with the water from AI, Rocketdyne would have discussed it with AI.

During a shielding study test, the intensity of the radiation was so great that a temporary perimeter, similar to the caution tape used by police, had to be established outside the regular building perimeter.

My last chore at AI was packaging up and shipping lithium hydride and tungsten slabs to Oak Ridge National Laboratory as part of an AEC consolidation effort. The slabs were approximately 8 square feet in size and ranged from 1 inch to 10 inches thick. They were used in shielding studies related to a project that aimed to send a person and reactor into space together. The AEC began centralizing operations and eliminating duplication. This involved moving operations to Oak Ridge, which had a reactor the same size as STIR.

Radiological material was handled very carefully. I was trained in both neutron radiography and explosive devices for my work at AI. The NRC developed "tech specs" for handling radiological material. These specifications were very comprehensive and almost made it difficult to build a nuclear power plant as some of the specifications were difficult to achieve. Work became more laborious after the tech specs were developed. Prior to the NRC tech specs we had operating limits that we had to work under. The operating limits provided more room

to operate than the tech specs and allowed common sense to dictate how operations were conducted. (I provided the interview team with a document describing STIR operating limits.) But after Three Mile Island, the NRC developed the tech specs, which became the way of living for nuclear power plants.

There were no real reactor incidents during my work at AI. If reactor instrumentation showed unusual results we would scram the reactor and operate in safe mode. Procedures dictated that an incident report would have to be written up. The incident report would be distributed throughout the organization and used as a "lessons learned" tool. An outside team from DeSoto would come to critique operations and review the incident report to prevent similar incidents from occurring in the future and ensure issues are handled the same way across the site. The incident procedures demonstrate the attitude regarding safety at the site.

I received a lifetime exposure of 24 rems during my time at Hanford, WA, Idaho Nuclear Laboratory, and SSFL. Most of my SSFL exposure was from neutron radiography using indium plates that were 16 inches by 20 inches by 1/16 inch thick. The plates would become activated and because of how we held the plates, I received facial exposure. I wore safety glasses and a dosimeter that kept daily records of my exposure. During shielding studies, the reactor room would sometimes become so hot we had to wait a few months for the radiation to subside so that acceptable exposure limits were met. This happened several times, but as a result, we never had any abnormal exposures. Objects used for shielding studies were 5 feet square of various thicknesses. Materials studied included lithium hydride, depleted uranium, lead, and tungsten

Radiological waste, including contaminated clothing, was disposed at the RMDU in 55-gallon drums. Initially, these drums were taken out to sea and dumped, but that practice fell out of favor and after than all waste from the RMDU was sent to Idaho for disposal. I am not aware of any Area IV waste disposal on site. When projects were shut down, uranium and plutonium were transported to Idaho for disposal. Beatty, Nevada was also considered as a disposal location.

The only hazardous chemical I recall working with at AI is lithium hydride, but it was encapsulated in aluminum and was pretty safe unless the lithium hydride was penetrated.

The Organic Moderated Reactor Experiment (OMRE) in Idaho Falls was an organic reactor that was cooled with an organic terphenyl. A by-product of this was byphenyl to which we were all exposed. Additionally, when we had organic spills, such as a spill on the floor, we would clean it up using trichloroethylene. These organics exposures were considered normal before we knew the materials were hazardous. I do know that UCLA did a safety study as a result of our exposure, but I never heard the final results.

Also, regarding hazards, I recall when I worked at the 100KE reactor at Hanford, I was associated with a technical group that performed coolant studies in a facility called the 1706 KE. The tests included high temperature coolant operations, which called for use of asbestos as

an insulation material. We had a contractor that was good at his work, but sloppy in his cleanup, consequently we had lots of loose, airborne asbestos all over the place. This went on for two years at which time I left GE Hanford, and I went to work at Rockwell Idaho.

Lab activities at AI used radiological sources and chemicals handled under a hood. Radioisotopes for calibration units were stored in the floor vault and when the STIR facility was decommissioned the calibration sources were sent to DeSoto, but I am not sure how they were ultimately disposed.

I was trained by ordnance people at the Downey facility to conduct neutron radiography on ordnance devices. I received radiological training by peers at AI. I also received hoisting and rigging training from an outside contractor. The people in the AI training department were sticklers for training.
As I recall, everything I did at the SSFL was documented. We had sheets documenting start-up and shut-down procedures and kept log books documenting work. All documentation was retained at the storage facility in Los Angeles or Newport Beach.

I think the sodium burn pit is the same sodium pond I referred to earlier where excess sodium and NaK was sent for disposal. I am not familiar with the service disposal area or any leach field or septic systems. I am not aware of liquid material being disposed down floor drains. I don't recall any issues with drainage systems or tanks other than two Rocketdyne guys that were killed when they entered an underground vessel that contained nitrogen gas. The Old Conservation Yard was a junkyard where lumber was deposited. One employee took lumber from the yard to build a house on the Colorado River in Nevada. People could bid on items in the junkyard in an auction.

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UNITED STATES DEPARTMENT OF ENERGY

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 7/15/2010

Interviewee(s): 125

I worked for Atomics International from 1962 to 1965 in the Building 20 hot cell, and the DeSoto facility. I also did some hot cell work in the SRE cleanup, removing some fuel rods.

I handled radioactive material all the time in the hot cell.

I was young when I started and didn't know what I was doing on my first day. There was a pretty rapid learning curve, but I was impressed with the operations of Atomics International. I was impressed from one end of the facility to the other and thought operations were very well thought out and facilitated. The key was safety in handling radioactive material. I was quickly indoctrinated into the hazards of what I was working with. I had some basic knowledge, but I did not come to my job with all the necessary knowledge. I think we had a unique operation in the hot cell. There was the potential for bad exposures if something went wrong. But I thought the design of the building was well thought out and engineered with safety in mind. Safety was pretty much the number one concern and everyone I knew took safety very seriously.

Anything that occurred that was not planned was very minimal. From my experience any non-planned events were easily handled and rectified. There was constant monitoring, and the health physicists (HPs) in our building were constantly monitoring everything, including keeping track of our doses, and various areas of the buildings. The building contained separate areas that required different safety protocols and levels of personal protection. Areas were temporarily marked off with ribbons or tape occasionally so you knew not to go into a certain area unless you had the proper protection. Even if a temporary area had to be set up, it would have been well marked with tape or roped off. When you crossed into a certain area you had to abide by its dosage rates, cleaning standards, or protective clothing requirements. It might have seemed like they were going overboard now and then if you didn't know what they were dealing with. They took it seriously.

I am all for the company. I had a positive experience at Atomics International. My wife worked for Rocketdyne for 27 years and my daughter has about 27 years with Rocketdyne as well. My family has had a very positive experience with AI and Rocketdyne.

I know there may have been things that weren't done correctly, but part of that is probably a lack of knowledge at the time. As science progressed we were better able to predict outcomes and hazards. I feel Atomics International was very responsible and encouraging toward safety. I can't fault them for anything.

I did live in Simi Valley for a while and I do know what is going on in the community. I think some members of the community are what I call "Green Weenies." I thoroughly believe in environmental protection, but I also believe in common sense. There are people that go overboard and they go overboard without the proper knowledge of the situation.

I would definitely disclose any information I had on potential contamination if I had it, but I just don't have any knowledge of this.

I was interested in the SSFL community activities as a citizen of the area, and as an employee of the Ventura County Fire Department. I was even involved in some local politics and I know what the people have been saying for many years. Honestly, I am surprised this is still going on. The site was cleaned up and I thought that would be the end of the community frustrations, but even that did not satisfy everyone. I don't know what is still up on the hill today.

I took my work and the hazards associated with it very seriously. I knew the risks and we took the appropriate precautions. I don't see with the knowledge we had at the time, and probably even now, how they could have done a better job. We had certain jobs to do and there was a small percentage of risk associated with those jobs, but you assumed that risk with the job.

I was in the Air Force as a jet mechanic and I took my job very seriously because I knew that other people's lives depended on me doing my job properly. I had that same mentality working for Atomics International. Sometimes things didn't go exactly as planned, but if there was a potential exposure it would have been seconds, maybe minutes, but you knew what the exposure would be and you had a dosimeter, a film badge, and a hand meter. In some cases, a health physicist may be right there behind you with his own meter. I felt very well covered and secure with regard to health and safety monitoring.

We dissected the fuels that came out of the reactors in the hot cell and would run tests on them. We would take the fuel out of its casing, cut it apart, and take various measurements as our work dictated. I also worked in fabricating the fuel down at the DeSoto facility. I worked at two buildings in DeSoto. I am not completely sure of the numbers, but I think I worked in Building 1, the main building facing DeSoto Avenue, and another building behind Building 1.

I didn't machine any fuel at DeSoto, but we would pick up fuel from the machine shop. I think the machine shop handled beryllium. Safety rules dictated that we report any movement of fuel

from building to building. We had to have movement of fuel authorized and they had to keep track of how much fuel was in any one location to prevent potential danger. We knew we couldn't have more than a specified amount of fuel in any particular location at a time. We would have to make a phone call to get permission to move the fuel. I assume they checked the load in the area and then told us whether we could move the fuel.

Handling the fuel from the machine shop at that stage was not particularly hazardous. You had to wear gloves and prevent contact with the skin. Sometimes you would have the fuel installed in an air-controlled atmosphere. Although I didn't machine the fuel at DeSoto, I weighed and measured it. I can't remember for sure if we cleaned the fuel when we got it or when we finished working with it, probably when we finished working with it, but I am not positive. In retrospect, I think the cleaning process was the only part that could have been done better. We used trichloroethylene, a cleaning solvent used throughout industry. Current knowledge tells us that this wasn't the best chemical for the environment. But we were using the chemical in a little glove box, not in any huge machine. At DeSoto, we were just one line in the fuel machining and fabricating process. We ran tests and collected measurements on the fuel which had been cut into various lengths before we received it. This was done to collect baseline data for comparison with fuel that came out of a reactor after use. There were records associated with each fuel rod and they were numbered on the end. We would take measurements on each segment of the fuel that would later be assembled to form the fuel rods.

The only time I ever had a problem that scared me I was working at DeSoto. We were putting fuel into the cladding and then a welder was going to seal the fuel in the cladding. We had to load the fuel inside a controlled atmosphere. I think it was a nitrogen atmosphere. We had to purge the atmosphere, get it under a vacuum, purge again, and then fill it with nitrogen gas. Once the fuel was loaded into the cladding, we filled the cladding with NaK and/or sodium and then the cladding could be sealed by the welder. The glove box I worked in had an access port that was also atmospherically controlled. Under an inert atmosphere, we would clean the glove box out. I think we did a dry clean of the glove box first, and then used acetone and damp Kim wipes for the final clean I think. I was at the last step of the process and loaded the damp Kim wipes into the glove box. I went to stick my hands in the glove box when a big explosion occurred.

The explosion occurred because there was still a speck of sodium or NaK in the glove box and it reacted with the moisture from the Kim wipe. There was also acetone vapor in the atmosphere and once that flashed it caused a big explosion. I was very lucky in that I had not closed the access port so the explosive gases had a place to vent. It looked like a rocket engine with flames shooting out of the access port. That is the only major incident that happened to me, but I wasn't exposed to any radiation. The use of acetone may have been the biggest safety factor involved in that incident, but not being a chemist, I wouldn't know what other chemical was available to do the same type of job.

I cannot think of any similar large incident that occurred at SSFL. There were probably a lot of little things that occurred at SSFL that were unusual, but nothing that wasn't at least anticipated

at some point as being possible. For example, say you dropped a piece of fuel, you would have to stand back further maybe, reassess exposure issues, and clean it up. So if something that happened that was unplanned there were still procedures in place to deal with the situation. This was in the hot cell, so it was not in an open area. I did remote fabrication and machining of different parts at SSFL. So an unanticipated event in my work could have been dropping something from the remote manipulators onto the hot cell floor. The remedy for the situation may have involved something like moving things around and getting an overhead crane to pick up the dropped object. The remote handlers made things more complicated and clumsy, but we had procedures to deal with unplanned events.

You try your best to anticipate potential problems and avoid them, but things happen as they would at any job.

Worker health was protected differently depending on the area. You had cloth masks that went over the nose as one level of protection and then a more hazardous area may call for fully sealed air supply masks with face pieces. You may wear layered clothing depending on where you were working. You may wear a lot of layers in the most hazardous area and then shed layers as you moved through sealed entryways into less hazardous areas. The clothes, such as coveralls, gloves, or boot covers would be bagged in each area and go into separate contaminated collection bins. I don't know if they had a hot laundry facility or not.

I don't know of any disposal of radiological material on site. Disposal occurred either in a metal drum for regular trash or a lead, steel, or concrete container built specifically for the contaminated waste. Radiological material would come into the facility in a protective container and go out in the same manner. Sometime we shipped fuel rods back out to an off-site storage facility, but I don't know where that would have been. Most of our fuel came originally from Hanford, Washington or a site in Idaho.

I don't have any knowledge of radiological spills, leaks, or dumping, certainly nothing illegal.

The only thing I was aware of was the disposal pond for sodium. I never saw anything first hand, but I knew of the location of a pond, also known as the Sodium Burn Pit. I heard that they would throw the sodium out there and "let it do its thing," that is, explode when it hit the water. I assumed it was uncontaminated sodium, but I don't know that as fact. I never saw sodium put in the pond when I was at SSFL. Later in my life, when I was working with the Ventura County Fire Department, I saw training demonstrations of sodium reactions and we worked closely with Rocketdyne's Fire Department. They would often instruct us because they worked with much more hazardous fuels on a daily basis than we did at the Ventura Fire Department.

I know we used trichloroethylene and acetone and probably some other chemicals at the hot cell. Chemicals were stored in metal, fire resistant containers. As far as disposal, they were all shipped out in plastic, metal, or glass containers depending on the chemical. I don't remember exactly how we disposed of chemicals. We took out whatever we had to take out and followed

our established rules for that. You would monitor the waste for contamination levels and dispose as appropriate. In the hot cell, particulates would be swept up and put in the appropriate container. Damp wipes would be used as another level of cleaning, and finally you would go in with your cleaning chemicals. Contaminated solids would go into appropriate containers. Any contaminated liquid waste would go into the building's contaminated liquid waste collection system.

Building 20 had a liquid waste collection system and a gas filtration system. I don't think anything left the building immediately. Sanitary waste went to the sewer system, but everything else went into the building's own built-in disposal system. Everything was filtered. The basement of Building 20 contained the filtration system. The hot cell and the area outside the hot cell was kept at a negative atmosphere. Air would be sucked into the hot cell and then into the basement containment filtration system where eventually it was cleaned enough to be vented out.

I am not aware of any unusual occurrences relating to chemicals other than the incident at DeSoto I mentioned earlier. I am not aware of any on-site disposal of any hazardous chemicals.

As far as policies and procedures go, as a new employee I was told what my work would entail and the purpose of it. We had sessions with the HPs and they explained the types of radiation and effects of radiation. We watched training films. We learned how to avoid exposure, how to safeguard ourselves, and how to use and read the safety instruments properly. We also learned the limitations of the safety instruments. We had various training session on different things. I think the training may have changed over time to respond to issues that arose. I'm sure I read manuals as well. The company culture was such that we complied with the rules. We knew what we were dealing with. I was pretty low on the totem pole, but I worked with very intelligent people and had all the confidence in the world in them. I think safety was on the top of everyone's mind.

I also received on-the-job training. I had a good mechanical background before I came to AI, but working there around knowledgeable people and discovering how much I didn't know motivated me to go back to school. I took an algebra class through what is now Ventura College while I was still working at AI.

I never saw or heard of anything being buried on site as SSFL. Now, I have read some things on the site, but I don't know anything from personal experience.

We documented our work at SSFL through photographs and ledgers, maybe notebooks as well. Everything was documented. You pretty much did you job and wrote it down. I don't know what happened to these records after I turned them into the boss.

If there was any disposal down toilets or floor drains it went into the building's collection system.

I think a regular disposal team used the Sodium Burn Pit, but I was never there to see anything. I do not know anything about a surface disposal areas, leach fields, septic tanks, discharge locations, storage tanks, or gas holdup tanks. I vaguely recall the Old Conservation Yard as a disposal area. I can't really say anything for sure about it though. I remember a scrap yard on the west side of the road coming into the site.

I was not aware of any problems with underground pumps, sumps, storage tanks, piping, sewer, or drainage systems.

I was primarily up in Building 20 on the hill. As far as I know everything in this building went through air processing contained beneath the building. The building was self-contained, I can't remember but I think there may not have even been any windows in the building. If something needed processing it was processed internally before being discharged to the atmosphere or shipped off-site. There were a lot of below grade processing features at Building 20.

At one point I also got involved at SRE. As far as I remember we were down below in SRE's hot cell. I believe I was handling the fuel rods and getting them ready for off-site disposal. This was after the SRE was shut down. I also was probably involved in cleaning up the SRE hot cell afterward. I got sent over to SRE because of my skills and experience working with the remote manipulators.

I know I received some level of exposure while working at AI, but that was part of the small risk I assumed taking the job and I was not concerned about it. I remember having to scrub my head one time because some speck of radiation was found when they ran a meter over my head. You would have a final check before you could come out from a hazardous area to a nonhazardous area. You would have to run a meter all over your body to confirm you were not bringing any radiation into a nonhazardous area. They wouldn't let you out of a building until you had no detections on the meter. Otherwise, you would have to go back and shower to remove any radiation. There must have been hot and clean showers too now that I think about it.

Overall, I had a wonderful and interesting time working for AI. I really enjoyed my job.

UNITED STATES DEPARTMENT OF ENERGY

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 7/9/2010

Interviewee(s): 154

I worked at ETEC starting in about 1977. I had worked down at Canoga Park facility with a lead engineer that I was familiar with. He started up a new instrumentation group at SSFL and I requested a transfer to go up on the hill too. Later I transferred back to Rocketdyne. I think I worked at ETEC from 1977 to 1985 (about 7-8 years).

I was an instrumentation engineer. I tested the various sensors that were to be used in the sodium cooled reactors to evaluate their performance, dependability, and reliability. I tested level, temperature, and leak detection sensors, made mostly in the US, but some from Germany and possibly a few others countries as well. Before I went to work for Rocketdyne and Atomics International, I had worked for an electrical heating company in the Pittsburgh, PA area. Due to my electrical heater experience, I specified the types of heaters to be used, approved drawings, purchased heaters, and ensured the heaters were installed correctly on various tanks and lines. I was the resident expert on electrical, tubular heaters, but my primary responsibility was in testing sensors to evaluate how well they performed under different working conditions. I worked on small projects helping others with heaters or liquid level sensor devices. I also wrote reports on heaters and liquid level measuring systems and provided them to DOE.

I worked in an engineering building; really, it was a group of trailers across the street from the Instrumentation Lab. Later they built a more permanent engineering building adjacent to the trailers and I moved into that building. I also worked in Building 104, which is where I think most of my work was conducted; there were sodium tanks in that building for us to use for our testing.

I did not work with radiological materials, nor did I wear a film badge.

I did not handle any hazardous materials. I did not work around any hazardous materials unless you count sodium. I never handled sodium but I worked around it. I never had to wear any

protective clothing for my work. I did not knowingly work around anything that I considered hazardous to me personally.

I know of an area where they had a reactor that had some sort of meltdown and they closed it and put asphalt over top of it, but that was prior to my time on the hill and was all gone by the time I worked up there. I was not aware of any radiological spills or leaks while I worked up there. I do not know of any chemical leaks or spills up there that would be hazardous to people either.

There was a chemical laboratory – but I rarely went in that building. I believe it was the general practice to put hazardous materials into 55-gallon drums that were eventually shipped off site. Since I did not do that myself, I am just telling you what I was aware of. They were very careful up there. They had very strict procedures as to how things were done, such as with the handling of liquid sodium. It was pretty rare circumstance that anything went wrong.

I did not need much training for what I did at ETEC as I had a lot of experience from prior positions. My supervisor did make sure I understood the correct procedures for everything, but I did not need any special training. We got on the job training for how to follow the procedures.

A typical experiment would involve putting liquid level sensors in a proper position in a tank. In Building 104 for example, we would raise and lower the level of sodium in the tank and see if the sensor responded properly. We would test the sensors under different temperatures to see if that affected performance. We would test the performance and reliability of the various sensors and then write a report of the test results.

We obtained a lot of data, and gave that data to DOE in the form of reports. The original report went into the DOE library that was north of the administrative building for ETEC. Three women worked there. One copy was in the library, one copy we kept in our building, and one copy went to DOE. The results were not sensitive, we were just reporting on how the instruments performed, so we did not control the distribution of the reports. I do not know what DOE did with the copies of the reports once we gave them to them.

Once or twice a year, someone from DOE-HQ in Washington, D.C. would come up to check on what and how we were doing. I would demonstrate how I tested the various sensors and heaters.

Virtually everything we did at ETEC had a purpose.

We tested the sensors to see if they operated properly. We tested to make sure they detected leaks. We created leaks on purpose to see if the sensors would detect the leaks. We wanted to know if the sensors were working properly. We detected leaks because we caused leaks – it was purposeful to test the sensors.

I would recommend that you talk to others that worked at ETEC during this same time period. The others may not have responded to the opportunity to be interviewed since it came in the form of a letter. It might be better to give these other workers a telephone call; it may result in a more positive response! (Names of a few other engineers were provided.)

There was one building at ETEC that had a fence around it and barbed wire on top. They reprocessed fuel rods or something, but I never went near that building I just saw it as I went on my daily noon time walks to the water tower to get some exercise. It was the only building considered to be dangerous that I knew of. I did walk by the sodium burn pit now and then. Occasionally, there would be a dead animal in the pond. The sodium burn pit was a pond – sodium ignites when it comes into contact with water. They would put items that had been contaminated with sodium in there to burn the sodium off. It was a controlled situation when they did it. I did not observe it; in fact, I think it happened pretty rarely. It was not a pretty place.
I worked in Building 104, the instrumentation lab, where my primary work occurred. I went into most of the buildings at ETEC because I had associations of various kinds with different experiments going on, but I was never in a place where hazardous chemicals were being handled that I knew of.

There had to be some leach fields or septic tanks on site. I do not know where water went. The water on site was not potable. We drank bottled water in all of the buildings.

I know about the old conservation yard. It had mostly metallic junk, stuff that was no longer needed. I would go there to see if there was anything I could use – like tanks or piping – to save money. They encouraged us to check there before we ordered anything new. There were occasional items that could be reused for other experiments.

There was a large fuel tank, I think it has been removed, that was full of oil that they used for experiments. An oil line connected the tank to one of the buildings.

There were various types of sodium tanks at ETEC. They were aboveground, as they had to be heated and insulated. They had trays under them to capture any leaks. Of course, there were sensors to detect any leaks as well. They had trays under them just in case. There were a lot of safeguards to prevent sodium leaks in place by the time I worked up there.

Air contaminates sodium. They did not want to contaminate the sodium. Leaks were not good.

Of course, we caused leaks so we could observe the results. We wanted to see if we could cause a fire or an explosion. The leaks were purposeful. We made them for experimental purposes. They were purposeful leaks.

You may be aware that there is a corner of the San Fernando Valley where an unusually high number of people have been diagnosed with cancer. My ex-wife claimed that she had cancer caused by exposures she received as a result of working up at SSFL. I was tested annually

after I worked up there. Now that I am no longer working up there, I am not tested. I try to pay attention to what is going on at ETEC with the cancer cases so I can determine whether I should be concerned.

I am amazed at the reported costs of cleanup at SSFL. I am afraid it is a bit of over-kill. It is hard to believe there is sufficient contamination up there to require all the cleanup going on. I do not know how they can spend so much money to clean that place up.

I am concerned that they will never get it cleaned up to everyone's satisfaction. I pay taxes and the money being spent on this clean up does not seem justified.

To the best of my knowledge, no one purposefully caused any contamination. While I still worked up there, they would bring a trailer on site every so often and I participated in voluntary medical testing, with tests such as breathing into a tube to test our lung capacity or blood tests. We would only hear about results if the results were out of the normal range. I was told that I tested fine.

UNITED STATES DEPARTMENT OF ENERGY

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 7/20/2010

Interviewee(s): 254

I worked for Atomics International (AI), Rocketydyne, and Boeing at the SSFL from 1957 to 1989 for a total of 32 years. I had worked in almost every building on the hill by the time I retired. I was a mechanic, an MTS3, and then the Engineer in Charge (EIC) at the RMDF.

I first handled radioactive material in about 1965 when I worked in Building 5. We had been doing heat transfer studies with loops using non-radioactive materials. Then we received radiologically-contaminated organic material for use in our loops in Building 5. That was my first encounter with radioactive material.

I received schooling and training on how to handle radioactive materials and what we were expected to do before we did anything. By that time, the AEC was coming up with all sorts of rules so we could protect ourselves and the company. I was under the impression that before 1965 safety had been much more lax. But by the time I was involved in handling radiological materials, the AEC had established some guidelines for safety. For my entire time at the site, I was always under the eyes of an HP (health physicist).

I worked for Rocketdyne from 1957 to 1960. In 1960, they laid off 10,000 people and I was one of them. I had worked for one of the Von Braun engineers who had come over from Germany. He and I were friends and he helped me get a job at AI in 1960. My initial years at AI were spent working on heat transfer studies with loops. At first we worked with organics and not radioactive material. We would go into a room full of pipes and cover them with asbestos. The asbestos would be thicker than all get out. We didn't know at the time that asbestos would later turn out to be a hazard. That was one of the health and safety changes that occurred during my time at SSFL.

During my days at Rocketdyne, we used lots of trichloroethylene and acetone to clean engine parts and didn't worry about where it went. We used every kind of chemical known to man at Rocketdyne. I was a crew chief in gas generation at CTL-2. We would stand on a grated

platform about 10 feet from the ground and use chemicals to clean the rocket engines. All the chemicals would drain down from the test stand into a holding pool of water located below the grates we were working on. The pool would drain to holdup ponds outside the buildings. The fire department would then come along about once a month and set the ponds on fire to burn any chemicals off.

Over time the safety got more stringent and we had more training. We eventually started catching any chemical runoff and putting it in barrels. A group was created to handle waste at the site. There was an evolution of safety in my 30+ years at the site on both the Rocketdyne and AI side.

When I first started working with radiological material in Building 5 we had safety procedures to follow. We had to dress appropriately and we had to protect the area we were working in by controlling access. You had to clean the area when you were done and put radioactive waste in RA (radioactive) disposal containers. The door going into the lab had radioactive stickers to let everyone know that it was a radioactive lab.

Dressing appropriately for radioactive work in Building 5 included shoe covers, coveralls, a soft hat or head gear, and a couple of pairs of gloves. I didn't have to wear a respirator in Building 5. I always wore a film badge and dosimeter my entire time at AI. Those were standard issue at AI even before I worked with radiological material. I was told that I got the most radiation of anyone who worked at Rocketdyne. We were supposed to wear the film badges at work, but it was like our company badge and we got so used to it we put it on all the time. A few times I even wore it home.

The level of radiation was so low in Building 5 that time limits for exposure were not in place yet. Most of the contamination in Building 5 was alpha contamination so it wouldn't penetrate very far. I did have blood and urine samples collected at least once a year while working in Building 5. When I later moved to the Hot Lab, I was monitored monthly because I was working with more radioactive material. There was a monitor at the entrance of the radioactive lab room and you were expected to monitor yourself entering and leaving the lab. I don't remember if there was a building alarm for Building 5. The radiation levels were low in Building 5 and there were no reactors in the building. I never received any exposures in Building 5.

There were 13 reactors on the hill over the time I worked there. I didn't work in any of the reactors when they were operating, and I didn't handle radioactive material until the coolant went to Building 5.

I moved to Building 20, the Hot Lab, after my time in Building 5. That became my primary place of work. That was a high radiation lab and Building 20 did have a building alarm. You had to sign in and out of the building near the entrance. The health physics office was near the entrance as well and you would go there to get a film badge or dosimeter before leaving the lobby if you didn't already have one on. Building 20 had all kinds of barriers because there

were different levels of radiation in the building. If you were in the operating gallery you didn't have to wear any protective clothing, unless you were handling something that could penetrate the walls. If you were on what we called the backside of the building, or the service gallery on this floor plan I have, you had to be fully dressed with coveralls, gloves, and boot covers. If you were "in cell" you had to add another set of coveralls and a respirator. The hot cells had 4-foot thick walls and radiological glass to keep the radiation in the cell. You also had to wear a respirator if the hot cells were being opened or if you were transferring radioactive waste.

When you came out of the hot cells, the first thing you would do would be to take off one layer of clothing in the decontamination room right outside the hot cell. That top layer would go in a container for disposal as radioactive waste. Then you would step into the hot change room room and take off the second layer of clothing. The hot laundry was packaged and sent to the loading dock area and off to the hot laundry facility where the clothes would be cleaned and could then be reused. So when you had two layers of coveralls on to work "in cell" you would remove one layer in the decontamination room and then you would remove the second layer in the hot change room. Masks were also laundered and a "cold guy" would help you take off the mask and place it in a bag for laundry.

Once you were naked, you would go into the shower to rinse off. There was a monitoring device between the hot shower and the cold change area and you would have to check yourself. If anything was picked up on the monitor you had to go back to the hot shower for another rinse to get any remaining radioactivity off of you. You didn't leave the hot shower room until the monitor said you were clean.

The operators that had to set up equipment in the hot cells wore lots of protective equipment and multiple layers of clothing and gloves because the hot cells were really hot and dirty. You always wore a respirator with supplied air in the hot cells. Depending on what you were working with, you may even wear three layers of coveralls in the hot cell. Sometimes if you were going "in cell" to clean the cell you would even wear raingear.

Safety rules became more strict as time passed. I had the feeling that before I was there safety was less stringent. During my time there, we had monthly unit meetings to keep up to date on safety and training issues. We took it very seriously.

We were mostly company people and we were there to invent things. Two or three people were just there to get a paycheck, but the rest of us looked forward to going to work. We worked for engineers, inventing new things for the nuclear industry because it was a brand new field. The engineers often had an idea in their minds of what they wanted their experiment to do and we would talk to them to see how we could develop the tools and equipment they needed for their experiment. Many of the young engineers didn't know the difference between a wrench and a screwdriver. The engineers got the projects and the money, but we were the ones that had the practical experience to help them develop their experiments. We looked forward to accomplishing things at work.

The Hot Lab had a hot storage room behind the hot cell. The guy who ran the place, BDE, was a strange duck. He used to be a piano player from Las Vegas, but he made sure the backside of the Hot Lab was run properly. Before he got to the Hot Lab, there wasn't a "dedicated backside man" at the Hot Lab. This was a problem because we found things that were too hot in the backside of the Hot Lab and they shouldn't have been there. He fixed that situation though. I don't think enough money was spent on waste management in the early days. We didn't have dedicated waste handling like we had later. This was another example of the evolution of safety. In hindsight, things should have been cleaner and we should have gotten rid of waste faster.

We had a hot storage and equipment room in the Hot Lab that would store things like a milling machine, drill press, or tools that we needed for operations in the hot cell. The work would change so we would need different tools, but they were all stored in the hot storage. Casks would come in through a door at the north side of the building, through the mock-up and assembly areas. In the case of fuel elements, it was because they were too long to enter the building any other way. The size of the material dictated where it went in the Hot Lab. Metallurgical work was done in Cell 1 because this involved the smallest pieces of fuel. I had to modify and build a machine that would cut out small pieces of fuel and cladding from a fuel element so we could actually work with it. Cell 4 held the largest pieces of hot material, often a section of the fuel rod. As fuel rods were dissected and smaller pieces were removed for examination they were moved into different cells. I remember cutting out small sections of the fuel elements from the SNAP 10 reactor for study in Cell 2. We looked at very small pieces of fuel; it was too hot to work in large quantities. It could make the lens of a microscope go black from high levels of radiation. So we had to invent a system that allowed us to look at very small portions of the fuel. You didn't need a big piece of something to examine it in the metallurgical room.

Waste from the Hot Lab went into casks, which were essentially lead-lined barrels that were sized based on the quantity of waste and the radiation level. Casks were sent to the RMDF, now called the RMHF. We held the casks there until we could complete all the paperwork necessary to ship the waste off-site for burial.

I worked at the Hot Lab for many years on and off. Every time we had a slow period I got farmed out because I was an instrumentation guy. I could work with anyone on the hill.

When the SRE was finally shut down, they ripped all the instrumentation out and got rid of a lot of stuff. In 1975, they found some residual sodium in the reactor vessel. They asked me to go over to the SRE and figure out where and how to hook up the existing thermocouples and heaters. That was a really fun time. I became the lead man on that project and worked on dismantlement of the SRE. We needed to heat up the reactor vessel to melt the sodium to a liquid so it could be removed. Because they had ripped the old instrumentation out of the control room, I had to go find and install the instruments and figure out the electrical wiring for heating elements located on the outside of the reactor vessel. I had to find the correct heating

elements on the vessel and their corresponding switches on the electric box with thousands of wires and make sure everything was connected properly. Once this was done we could heat the vessel to 230°F to melt the sodium. Just to be clear, we did not run the reactor. We just reconnected the heating elements on the outside of the reactor vessel to heat the sodium to its melting point so we could remove it.

Before we could even get to the reactor vessel though, we had to dig out the dirt around it because the reactor was buried in the ground. We removed the 4-foot thick magnetite concrete, which was a concrete with steel shavings in it that surrounded the reactor vessel. When I was working on SRE dismantlement I also had to deal with the "dip-leg tube." The "dip-leg tube" was a tube that went down 20 or 30 feet into the ground. It was located in a separate pipe gallery beside the reactor vessel. We found radiation at the bottom of that hole and it "gave me terrible fits getting that cleaned up." In fact, a piece of concrete fell on my head when I was working in that area. It is a good thing I had a hard hat on.
I worked on the dismantling the SRE from 1975 to 1980. Then in 1980, I was sent to the RMDF as the EIC. We started getting rid of a lot of things at that point because there was stuff stored everywhere. I worked at the RMDF from 1980 to my retirement.

As far as spills go, I only have first-hand knowledge of one spill at the Hot Lab, but I have heard of others. A holdup tank was located in the basement of the Hot Lab (Building 20), under the operating gallery, and it had a line that came out at the north end of the building to a transfer tank. A tanker from the RMDF would pump the radioactive water from the holdup tank and take it to the RMDF where it would be put in an evaporator and reduced to sludge before being disposed. One day either the hose broke or the tank outside the Hot Lab overflowed, I can't remember which exactly, during the transfer process and contaminated water spilled onto the asphalt. The asphalt on the north end of the building became contaminated with the radioactive water. We spent quite a bit of time cleaning that up. We had to invent a super vacuum that used HEPA filters to clean up the contamination. We also used foam to help clean up. We kept cleaning until we brought the radiation down to acceptable levels. That is another safety issue that has changed over time – the acceptable level of contamination. What was acceptable then may not be acceptable now. I'm sure that incident was written up in an incident report.

I also heard that the asphalt behind the loading dock on the west side of Hot Lab was a spill. I heard later that they dug down about 10 feet to make sure they removed all the contaminated dirt. That was after I had left though.

Additionally, there was a driveway along the east side of the Hot Lab. At the northeast corner there was a 10-foot high bank. Before the days of chemical containment, chemicals from the shop area of the Hot Lab, such as trichlor, acetone, or paint thinner, were dumped on the ground down this bank.

When I worked at the RMDF, everything that came in there was already packaged. Depending on exactly how it was packaged and what level of radiological contamination it had, we either

had to repackage it, clean it further, or just complete the final necessary paperwork. Some waste at the RMDF came from DeSoto, but most of it was from SSFL. The level of radioactivity also dictated where the material was stored at the facility. There were different areas specified for each level of radioactivity. Highly radioactive fuel that came to the RMDF was stored in the RMDF Vault. The vault contained cells designed to hold fuel elements. A 50-ton crane would lower a cask that contained four or five fuel elements onto the vault floor. Another manipulator would then transfer one fuel rod and place it in one vault cell that was then topped with a plug. The cask would move to the next vault cell and lower the next fuel element in so that each fuel element was stored in its own cell. The RMDF stored waste, but it also stored items that were waiting examination in the Hot Cell. So some material was stored at RMDF until it could be examined at the Hot Lab, and then when it was done at the Hot Lab it would come back to the RMDF and await final off-site disposal.

We stored all kinds of chemicals at the RMDF and I don't think we did a good job managing the chemicals in the beginning. Eventually as safety regulations changed, they decided it wasn't a good idea to have all those chemicals sitting around so we started getting rid of the chemicals. We also started using chemicals much more sparingly. We also stored a lot of radioactive tools and equipment at the RMDF that had been used at other facilities.

At one time they washed towels at the RMDF. This was not hot laundry. The washing facility wasn't that good and by the time I got to the RMDF, they had gotten rid of it. But we still had 10-20 barrels of soap left over from the laundry facility. Eventually they asked us why we were keeping them around and we got rid of them.

The RMDF had some spills over the years. There was a spill into the leach field that happened before my time. I only learned about it because we had a big program, with a big budget, to clean up the leach field. It was going on while I was at the RMDF, but I wasn't directly involved in the cleanup at the leach field itself. The people working on the cleanup had to be fully dressed in protective clothing that was supplied by the RMDF.

If something occurred that was unplanned we would call RST first. He was the manager at Building 20 and then became the manager at SRE and RMDF. Everything went through RST no matter what it was. We would also call CEF or an HP if they hadn't been called first. After making the phone calls to the appropriate people, you would all work together to determine how to deal with the unplanned event.

The film badges measured your accumulated daily exposures and they had to be processed. Our film badges were given to HP once a month so they could be sent to Chicago for processing. HP would keep track of your lifetime exposure. A dosimeter measured your minute by minute exposure and could give you immediate feedback. We were only allowed to be exposed to 120 mR a week and 5 R a year when I was there. If one of your two dosimeters pegged for any reason (even if you suspected it was inaccurate) you had to leave the area immediately. The 5 R a year exposure limit was a North American limit. I think the

government limit was 20 R, but North American set higher safety standards than the government.

Going back to the Hot Lab, anytime you worked in a hot cell you had to wear two new film badges. You would take off your monthly film badge and put it in your locker and then sign out two new film badges from HP. Then when you got to the backside of the Hot Lab you would put on your two new film badges and a dosimeter before going into the hot cell. The reason for this was that you knew you were going into a very hot area and they wanted to separate out that daily exposure in a hot area from the monthly exposure where you may be working in a variety of different areas. HP would add the hot cell exposures to the monthly exposures so they still kept track of lifetime exposures; they just kept the records separately. There was absolutely no on-site disposal of radiological waste to my knowledge. I mentioned the spill at Building 20 from the transfer tank overflowing, the leach field spill at RMDF, and the "dip-leg tube" at SRE.

Originally we were supposed to save the SRE building. It was going to be used as a building for the Saturn rocket. We did a lot of work to clean up the SRE building over the years and it was really disappointing to me when the decision was made that the building would never used again. It was sad to see it demolished. That happened to a number of buildings. We cleaned them up for reuse, but they were not used and eventually demolished.

As far as chemical handling went, we didn't contain anything when I worked at Rocketdyne in the late 1950s. It wasn't until the 1960s when I was at AI that I think we started looking at containment of chemical waste. I don't remember exactly when we initiated chemical containment at Building 20, but it came through training sessions from the Health and Safety Department.

I had a couple of jobs that involved searching through junk that was deposited in canyons. Debris, deemed to be clean at the time, had been disposed in the canyons and when we learned about the hazards of asbestos I had the job of searching through the debris piles to get the asbestos out. This occurred when I worked at RMDF when I was heading up D&D teams.

At some point, Rocketdyne outlawed the use of Trichlor. I don't remember exactly when. When that happened, our chemical standards at AI changed as well. Where we used to have Trichlor delivered to us in 50 gallon drums, our delivery dropped down to 2-liter jugs. We still used it, but much more sparingly. The safety rules evolved, but so did the chemicals. New cleaning chemicals were being invented. The chemicals were just getting more volatile and more dangerous. At AI, we wanted anything associated with the reactors to be clean and dry. We didn't want there to be any oil that would hold contamination. But at Rocketdyne, cleaning involved making sure there was nothing left on equipment that would react to oxygen. So while cleaning was important to both sides, there were different purposes for cleaning.

After about 1980, I know that TCE was found in the groundwater under the reactor in Building 59. One of my jobs was to set up the sump pumps to capture the groundwater. Normally, there

was an automatic pump that continuously pumped the groundwater from the reactor building. The water would go to a holdup pond where it would be monitored for radiation and if there was no radiation it would go to another pond before being released. Once TCE was found to be dangerous, we had a program to catch it. Early on, we pumped TCE-contaminated water into a tank and hooked an air compressor to the tank to help evaporate the TCE. After a week or two, chemists would test the water to see if it was safe to release. That doesn't seem like such a good idea, looking back on it now. Now, they filter the TCE-contaminated water instead of evaporating it. We didn't get rid of the TCE – we just released it into the air instead of onto the ground.

Every building had chemical storage lockers located outside of the building. They were fire safe lockers and were marked for the specific type of chemical that could be stored in them. There were special cabinets for each type of chemical. We also had catch barrels that stored the used chemical material. Rocketdyne eventually created a waste management unit that was responsible for picking up the used chemicals and take care of them properly. Since they were the bigger organization they had more capacity and they could pick up chemical waste throughout the entire site.

I don't recall any unplanned events or on-site disposal that dealt with chemicals. Chemicals weren't my focus though. I am not sure when the fire department stopped burning chemicals off the ponds.

We had a lot of company policies and procedures, including large books of information. We had monthly meetings were pertinent information to our operation was passed on. In Building 20, RST had a young engineer who was in charge of policies and procedures for his facilities. RST would make sure we were doing things properly. The policies changed continuously. Rockwell/Rocketdyne was adamant about keeping current because they had to bid on government contracts and the contacts had a lot of procedural requirements. People were generally good about following the rules. Some of us may have been reluctant to implement new rules, but generally, everyone followed the procedures. I'm sure CEF, our head HP, would cringe if he heard my name. He didn't always think I was doing everything I could. One of the toughest things for me was to quit smoking. I finally was able to do it when they told me our health insurance premium would double if I kept smoking. That gave me the motivation I needed; it was hard though.

Training depended on the job. There were certain health and safety courses that everyone had to take, such as how to dress and wear masks properly, how to read and understand signs and sirens, or how to properly climb ladders with a SCUBA tank on. Everyone was indoctrinated. Then specific jobs may require specific additional training. Due to safety rules becoming more stringent, we had to be trained in the use of SCUBA gear. We had to demonstrate that we knew how to operate the gear properly and we even had to be able to climb a ladder wearing it. We had to be recertified every year in some of the required skills. We would also have health and safety meetings to be advised of new or changing rules or procedures. There were also some specific rules for radiation workers, such as men couldn't wear beards.

I don't recall any contamination being buried on the site. The debris disposed of in the canyons was deemed clean at the time. I think it was buried as landfill material. Once we learned about asbestos, we went back to dig any of the asbestos out of the debris. This was in the early to mid-1980s. I think the debris may have been disposed in the canyon near the Burn Pit.

We would document what we did in weekly highlight reports that we had to give to RST, our unit manager. It was a written report of what we did in the week. It would be published and he would send it to his manager, DFG. I didn't have to keep any log books for my work, but EGH kept the best log books. He kept them because he had a higher classification than I did and that was part of his job. In all my time at AI, everything was documented! It was part of the culture to document everything. It is possible that some people didn't document things before my time, but I don't know for sure.

I don't know of any liquids being disposed of in toilets. The drains in Building 20 all went to a holdup tank in the basement. The holdup tank drain was kept full of water to prevent backflow. The only things that weren't connected to the holdup tank were the bathroom drains and they were connected to the sewer system, but I don't recall any liquids being disposed in the toilets.

The Sodium Burn Pit was not the best place, in fact, it was a bad place. It was not supervised as it should have been. Everybody at AI used it for cleaning chemicals. It was a big pool and you would take sodium contaminated things to the pit. Generally people dropped stuff in the pond to clean the sodium out, then fished the items back out of the pond, and finally left the items outside the pond area on the ground. Eventually they authorized a salvage operator to come up and haul the material away. The Sodium Burn Pit was out in "left overshoe." The HPs monitored it constantly. There was a lot of stuff that was taken there. There was one strange incident I remember about the Sodium Burn Pit. One day there were a bunch of generals in the area and a guy had a bunch of glass balls full of sodium. He was standing on a rock and throwing the balls into the Burn Pit and letting them explode. He was suggesting to the generals they could be hand grenades for use at the rice paddies in Vietnam.

In 1984 or 1985, the Sodium Burn Pit was drained and radiation was found. They had to let the pond dry out for a while. FHI was working on cleaning and digging out the Burn Pit. He would know about cleanup there. We had worked together at the "fart factory." That's what we called Building 5 because there was sulfur dioxide (SO_2) involved in the coal gasification process. One interesting thing that was also done in Building 5 was the grinding up of old x-rays from World War II. The x-rays were ground up and reacted with salt to extract silver from the x-ray. They could get about 99.9% pure silver back from the x-rays.

I am not sure about a surface disposal area. This might have been an area where contractors took construction materials and debris from building demolition or it could be an area where asphalt and soil were piled up for monitoring. I don't have any other information about leach fields, septic tanks, or drainages other than what I have already told you. Everything went to holding ponds and the HPs would monitor the ponds.

In 1977 or 1978 we had a lot of rain and the holdup ponds were overflowing. I would get a phone call in the middle of the night that a pond alarm was going off. This meant the water level of the pond was getting too high. I would have to go up to the hill in the middle of the night and we had to catch any excess water from the holding pond. We would use whatever we had to catch and manage the excess water, including those plastic swimming pools for kids, 55-gallon drums, and pumps. We had to catch everything because the HPs had to monitor it to see if it was clean. Even though it was presumably clean, it was rain from the sky, the fact that it fell in areas where radiological or chemical material was used meant we had to monitor the water. If it was clean it could go to the Rocketdyne holdup pond.

A picture I have shows how careful we had to be at SRE when we were dismantling it. We had to set up tents in the building to seal off areas we were working in and contain any air contamination. The men working to jackhammer concrete or other material worked under the tents to keep any contamination from becoming airborne and they had to wear full respirators. We did not "jack the building up" and lay it back down. We dug under the building and systematically dismantled it.

There were three areas where water would pool at the bottom of the SRE when we were dismantling it and we had to put pumps in those pools to take the water to the SRE pond. We had alarms go off there when the pond got too full.

The RMDF had a 10,000 to 20,000 gallon holdup pond down to the west, past Building 75. That pond had alarms and radiation monitors on it. During the rains, we had to store all the excess water in 55-gallon drums so the HPs could monitor it. We had a lot of drums that had to be stored in an outdoor storage area at the RMDF complex so they could be verified as clean before being released. One whole parking lot was full of drums of rainwater.

The Old Conservation Yard was a favorite place to get recycled equipment. We would go there to get equipment or materials for building things. We could reuse parts left there and we were encouraged to do so.

I don't recall any gas holdup tanks. All radioactive facilities had HEPA filters that filtered the air and gases.

I can't think of any other issues with pumps, sumps, tanks, piping, or drainages other than what I have already told you. There was a sewer pump located north of the Box Shop that went bad one night and all the buildings on that line got backed up. Maintenance crews fixed it in the middle of the night.

I was told I received the most radiation of anyone working up there. In those days, we were allowed a lifetime exposure of 100 R and one HP told me I had been exposed to 85 R, the highest of any employee. The company doctor would always monitor us and document everything. When I left the company I had to get a family doctor and I made sure to tell the

family doctor about my work history. I have never had any health problems that I attribute to my work on the hill. I did receive an extra large dose one time "in cell" at the Hot Lab and I couldn't go back in there for a while. I was in a lot of radiation fields with the kind of work I did and I would get high doses of radiation. Another thing that changed over time was they changed the dose rate to sieves or sieverts. When I retired, I got a document that told me I received a lifetime radiation dose of 38 sieves.

I had a wonderful time working at SSFL. Every day was new and exciting. I worked in every building up there. We had a lunchroom in the middle of the shop in Building 20 and we would play cards and ping pong during our lunch hour. There was a lunchroom in the RMDF as well. The lunchrooms were always isolated from any radioactivity. We would also see a lot of wildlife up on the hill, including mountain lions and bobcats. Mornings I was at the SRE we would see mountain lions on the rock outcropping above the building. I really had a fun time working there.

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UNITED STATES DEPARTMENT OF ENERGY

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 7/9/2010

Interviewee(s): 255

I worked for Atomics International from 1967 to 1985 as an atomic reactor inspector and certified x-ray technician. I also conducted helium leak tests and magniflux non-destructive tests. I worked in a number of buildings, but never went into a building unless I had a reason to be there. I have a few concerns about the Santa Susana Field Laboratory.

One of my concerns is with Building 4059, which was a reactor building. I know they took sand that was discovered to be contaminated out of the pit. I don't know what else they have done since then. I heard the building was torn down. Building 4059 was the last reactor that went in and the reason I know that is because I was the inspector when the fuel rods were placed in the vessel. That reactor ran about a year and then they took everything out.

I am also concerned about the large pit that had been dug out for another reactor or test site that was located between Building 4059 and Building 4626. The pit was out in the field a little ways from the road that comes down past Building 4059 and 4626. I have seen the overhead pictures of it. I think it has been filled. They were filling it when I left with miscellaneous dirt and concrete, but the fill material was not radioactive or anything like that.

I worked in Building 4005 and we made fuel rods for a reactor. That building has been cleaned up and used for other purposes since then. I don't think there were any problems in Building 4005. We didn't manufacture a lot of fuel up there.

Building 4022 was used to store radioactive material. It had a storage facility in the floor and you would take the cap off and put a fuel rod down there. They monitored that pretty close. I don't know how much fuel was stored in the building, because I only went to the building to magniflux the hooks on the cranes. I don't know anything about 4022 other than it had a fuel rod storage area. I don't know exactly what Building 4021 contained, but I suspect it had some radioactive material also.

Building 4012 was a reactor building that had some radiation in it at one time. It was cleaned up and we used it for an x-ray lab in later years when I was an x-ray technician. The walls in Building 4012 were 3 feet thick. If I was going to be x-raying in Building 4012 with cobalt or a 350 KV x-ray machine, I had to call security first so they would adjust the radiation monitors that were across the road and down the hill. Even with 3-foot thick walls, without that adjustment, alarms would go off in nearby facilities when I was x-raying. They could adjust the monitors so that they were not as sensitive as they normally were for the duration of my x-ray work.

Building 4021 and 4022 had outside drainage systems, most likely for handling rainwater. They did not expect the water to have radioactivity, but they monitored those systems just in case.

I know that everything was removed from SRE, the building was jacked up and everything below ground level was removed. I never saw anything in the sublevel basement until they started tearing it out. Everything was removed, including surrounding dirt. The dirt was packaged in boxes and shipped to a radioactive disposal site in Idaho or Nevada. I used to sign the shipping forms when they shipped that stuff out in the mid-1980s. I remember signing the form, but not where it was being shipped to.

The only time I handled any amount of radiological material was when I worked in Building 4005. Not a lot of us actually handled radiological materials. I didn't handle radiological fuel rods that went into reactor in Building 4059, but I was there and they were taking numbers off them and I was recording them.

There wasn't a lot of handling of radioactive materials as far as our group was concerned. I was in Building 4005 and working out of Building 4011 at that time for Atomics International, but there wasn't a lot of radioactive materials handling in those buildings. In ETEC, we didn't handle radioactive material other than a cobalt source and iridium source in the x-ray lab.

There was another building up there that I was in one time that had a reactor in a vat of water. The building was used for neutron radiography, but I went in the building to magniflux the hooks. I assume that building is long gone.

As I mentioned earlier, they took the reactor out of Building 4059 years ago and then they set that building up for other tests at that time. Even though Health & Safety said Building 4059 was a safe building to be in, I went in with my own equipment, including a Geiger counter, and walked that whole building to make sure it was safe. I did my own checking to verify that Health & Safety was right. When we were working in Building 4059, we wore rubber gloves, and in some cases booties and coveralls. When you come out of the work area you removed clothing or anything else that had become contaminated and put it into a separate container for disposal as radioactive material. So they took pretty good care up there.

Anything radiological was shipped off the site to a burial ground in either Idaho or Nevada. I am not aware of anything being buried on site.

I heard of something not going as planned at the SRE, but this was before I went to work on the hill. I heard that they had a holding tank for lightly radioactive liquids and it overflowed, drained into a gully, and Health & Safety was out there picking up radioactive material with table spoons. That's how little radioactivity was spilled; they could clean it up with spoons. It was a small spill that was removed with very small equipment. I was told that it was completely cleaned up.

I have had people in Simi Valley tell me that there has been radioactive material that has come down a wash from the hill and drained all the way to Royal Avenue, but I find that hard to believe. We were pretty safety conscious up there. By the time I started working on the hill in 1967 people were a lot more conscious of contamination than they had been years before. I can't vouch for anything that happened up there prior to the time I got up there, but I would not be afraid to go up there and set my motor home up and camp out.

The only incident I can tell you from SRE other than the minor spill from the overflowing holdup tank was when they cut the vessel out and removed it. They put it on a flatbed truck and were taking it off site, possibly to Idaho. They got down off the hill and before they got to Topanga Boulevard, the flat bed collapsed. I was not at the scene, but I was working on the hill at the time. They had a crane in there within minutes, loaded the material on another flatbed, and took it back up on the hill. They strapped it down securely and left it in Building 4022 overnight, and then hauled the vessel off site again the following day. There was no radioactive spill from it, but in the vessel was radioactive material. There was no contamination down there that I am aware of because they had Health & Safety down there real quick.

I am familiar with the Burn Pit near the Building 4886 area and don't think this area was used as it should have been. It has been cleaned up. I was never out there, but I know they took piping out there with sodium in it. They had a pit of water and to clean the piping out they would dump the pipe into the water and of course water and sodium don't mix.

As far as monitoring worker exposure to radiological material, I understand from others that in areas like the SRE people could suit up and go into the heavily radioactive areas and work for about 20 minutes and then they had to come out and another crew would go in. This was the case when the SRE building was being modified after the reactor had run for a while. And that was the way it was handled when there were any highly radioactive areas. That was before I got up on the hill though. At this point it is all hearsay, but I feel there was some other place where cleanup of radiation occurred and people could only go in for a short time. They also wore badges, film badges and dosimeters.

When I went out in certain areas I wore a film badge, a dosimeter, and in some cases two dosimeters because occasionally one would go off scale. If one went off scale it was not always clear if it was accurate because badges could be defective or it was possible to bump one and

set it off. If you wore two badges and one picked up something, but the other didn't you knew you were probably okay. The only time I went into areas where I had to wear the badges was when I was x-raying.

We had a couple of mishaps up there with an x-ray technician that wasn't paying attention. An example occurred in Building 4032. I was in Buildings 4036 and 4037, which served as office areas near Building 4032. A guy was x-raying in Building 4032 with a cobalt source and I was up there to make sure the people in the office were in a safe area because cobalt splatters all over and can go through 7 inches of steel and 1 inch of lead. I noticed the radioactivity went up as the x-ray technician was running the pill back into the "pig," as we called it. The pill went up and never came down. The technician tried to lock the source up in the pig, but it was still hanging out of the pig a little bit. So the technician got exposed to a little bit of radiation. That was what I called clean radiation. It didn't emit anything that would be harmful for you to breathe, but it sure could kill you if you got too close to it.

I am not really aware of any other spills or disposal, other than the SRE holdup tank overflowing.

The only other building I was in on occasion was Building 4020. That was the Hot Lab. I never heard of any spills in there, but when I was in there you had to wear a film badge and a dosimeter. They remotely handled radioactive equipment in the Hot Lab. The operators looked through windows that were essentially two panes of thick glass, separated 30 inches apart, filled with clear oil between the glass panes. I understand that they would pull some fuel rods in there and use remote handlers to put them in a lathe, remove the cladding from the fuel rods, and reclaim the fuel. I wasn't in there for that purpose. I went in there to helium leak test some things they were making up, little radioactive materials they were making up for the space program. I remember running some helium leak tests on little bolts about 1/4 to 1/8 inch in diameter and 1.5 inches long that they had drilled holes in the end of and put a piece of radioactive wire into it before welding it closed. Those bolts went into something destined for outer space.

Building 4010 was a reactor building. The reactor was removed and everything was cleaned up before I left in 1986. We used the control room of Building 10 as an office for our department.

At one time in Building 10 there were caskets of fuel rods that were already made up to go into either the SRE or the Hallum, Nebraska reactor. We used to go check the inert gas in the caskets to make sure it was acceptable. I remember the fuel was removed, but I don't know where it disposed.

I am still concerned about Building 4059. It might be a good idea to put in some wells around it and close to it and make sure there is no contaminated groundwater around that building because the reactor was in the basement and they had a 5-foot diameter tube that went from the reactor vessel to a huge diffusion pump packed in dry sand. The pump was used to prevent water from filling the cavity. The pump went bad and the cavity filled up with water. The

water may have become radioactive at that time. It wasn't what I called dirty radiation, but the water and/or cavity probably became radioactive. That's the place I'm concerned with. If it's been cleaned up and a report has been written on it then fine. You would have to go down at least 40 feet to see if there was any groundwater contamination because the basement was 32 foot deep and this was below that. The Building 4059 radioactive water could have possibly drained down into Simi Valley and could be the reason people are saying there is some contamination down as far as Royal Street in Simi Valley. It might be worth looking into.

As far as hazardous chemicals, I handled acetone and some alcohol, but I don't know how they were disposed. It wasn't dumped on the ground, I know that, but I think there was some kind of container that they were put into and then disposed of properly. When I worked with hazardous chemicals they were handled reasonably well. I don't remember anything with hazardous chemicals occurring in a way that it wasn't supposed to. I am not aware of any spills of hazardous chemicals. Going back to Building 59, anything we used with radioactive materials, like contaminated gloves, booties, or coveralls, was disposed of in separate containers, other than a wastepaper basket. It was handled differently. I am not aware of where it was ultimately taken or disposed.

When we were manufacturing fuel in Building 4005, there were two or three times we had to evacuate the building because some of the monitor alarms went off. In Building 4059 when we were getting that reactor core ready to go into the vessel we had to scram the building two or three times because alarms went off, but there was no contamination. Once we put the fuel in the container, one person could get within 2 feet of container, but if more than one person got in and around there, they say that the reactor would flash and it would set off the monitors. I don't know whether it ever did. I was in the building when we had to leave, but Health & Safety came in to check it out and clear the building. We were back in the building in 3 or 4 minutes. So, the radiation alarm went off, but I am not exactly sure why. There are a two ways the radiation alarm would have gone off. It could have been defective or it could have picked up radiation from a reactor flash. I know my film badges didn't pick up anything so it wasn't a flash on the reactor.

I'm sure there were company policies that dictated how we worked. The policy that irritated me the most was that they wouldn't let me drive my motorcycle between buildings with equipment strapped on the back. I used to ride a motorcycle to work and a lot of time we had transport equipment between buildings. People who drove their own cars to work were allowed to use their cars to transport equipment, but if I wanted to carry something on my motorcycle and drive between buildings, but they would stop me and make me walk. It was strictly a health and safety issue, you were not going to go up there and do anything that was going to put your life or limbs in jeopardy.

I'm sure that at one time there were rules or regulations that we had to read. I don't really remember that much about it. I think for the most part everyone did what they were supposed to and looked out for their safety and the safety of everybody else. We were pretty cautious up there. We all wanted to get off that hill alive and in good health. We had lead men and

supervisors who oversaw our work and provided training. We had procedures that told us how we were expected to conduct our work. There were instructions and we pretty much followed them to the letter.

We kept quite a few log books and I also documented a lot of stuff with a camera. I took a lot of pictures for use in reports. Many of my pictures went back to Washington, D.C. for reports by other people. I had a color darkroom and had the capability of making a 16" x 20" color print. So I put out a lot of information that way. I believe my negatives all went down to the Atomics International DeSoto facility. There was a photo lab down there and I think all my negatives went there. I didn't ask to keep any of my photos. One print I wished I had that I was called in to take a photo of was a result of a test article in a sodium tank. We put a test article in a tank of sodium, pulled it out, cleaned it and wrapped it in plastic in the evening, unwrapped it the next morning, and immediately placed it back in the tank. We didn't check it again until it was pulled out four or five months later. A spider had gotten in there and created a web on the baffles at the top of the unit. The sodium vapors created droplets on the spider web and I photographed it. That was a neat photo that I wish I still had. I had been called to take photos because a heater used to keep the sodium piping hot burned out. I went in and photographed that to show the extent of the damage. This all occurred in Building 4032.

There probably were things that went on that were not documented, but I can't think of anything. I am not personally aware of anything that was not documented. If there was something that happened at ETEC (also known as LMEC) I was out there with a camera to document it. We built big sodium pumps in Building 4463 and then transferred them into a pump case in Building 4462. I was out there shooting as many as 70 pictures while they were lifting that pump and transferring it over. I was continually shooting pictures.

The only liquids that I am aware of being disposed down a toilet were photochemicals from my darkroom. They were really not hazardous. I had my hands in those chemicals all the time.

Some tanks were removed from the outside of the Building 4024 years ago and I understand that the tanks were potentially holding radioactive gases at one time. The tanks were pulled out and everything around the tanks was removed. If it was contaminated it was hauled off. The tanks were located between Building 4024 and 4027, just outside and to the east of the Building 4024. The only reason I am aware of the Building 4024 tank is that at that time our department was headquartered at Building 4027 and they came in and took out the 4024 tank while we were nearby in 4027. I didn't know what Building 4024 was used for originally, although I think it was for a reactor that went out into space. It's still up there. They may have built that reactor in Building 4024 or there was also another reactor that was built up, but never had fuel placed in it, so that reactor could have been in Building 4024 as well, I'm not sure. So, there was the possibility of radioactive material in the basement pit of Building 4024, but I was never down there. Building 4019 also had a pit in it, but I don't know what was there. The pits were lined with reinforced cement.

The only disposal area I am aware of is the Sodium Burn Pit. I am not aware of any surface disposal areas at the western edge of Area IV or of any leach fields, septic tanks, or drainage discharge locations. I am familiar with the Old Conservation Yard. We got surrounded by wildfire in Simi Valley at one time and I came up to work after the fire had gone through the valley. I saw that the fire had come up the hill. It didn't do any damage at the edge of the hill, but it jumped to the salvage yard as the Old Conservation Yard was also known, and it got hot enough that it fused stainless steel piping together. It takes over 2,000 degrees Fahrenheit to fuse stainless steel together. There were also some lead acid batteries in there, glass cases that were melted down, and some puddles of aluminum.

I am aware of the following tanks at the Santa Susana Field Laboratory: Building 4059 had a liquid nitrogen tank. There was a big day use tank for diesel fuel between Building 4011 and SCTI (Buildings 4355 and 4356). There was a big tank farm in either area E, F, or G on the map. It contained a 1.5 million gallon tank for diesel fuel.

I remember one time we went down to Building 4356, where the steam generator was located in SCTI, and I was going down in the pit to do some inspection. I got down to the bottom grating and the whole bottom floor, about 10 feet down, was full of water. The sump pump had quit working. There was a steam generator down there. The other sump pump break down was in Building 4059. Those are the only issues I am aware of relating to sump pumps.

I feel as though everything was cleaned up at SRE. SRE as it was originally built is not there anymore. As I noted before, everything below the main building at SRE was removed. The building was jacked up, and everything was taken out and cleaned. Fill dirt was brought in and they put down a new foundation, filled it with cement and the building was used as a storage facility when I was there. I don't know where the fill dirt came from. I don't know if they had an area that they dug out up on the hill or if it was hauled on from some other location. I know it was clean fill dirt.

As far as specific radionuclide sources, we built uranium fuel rods in Building 4005 for an off-site reactor. The building was cleaned up completely and used for other tests afterward, but I wasn't involved then because I had moved to ETEC/LMEC. I had a cobalt source and an iridium source for x-raying only. The cobalt source was 100 curies of cobalt and the depleted pig that the cobalt was in weighed 500 pounds. It was transported on a unit with two large rubber tires and a dolly wheel. It would read about 20 mr (milliroentgens) at the outside of the case, but it was not contaminating anything. It could kill you if you received a big enough exposure.

I can't say that the Santa Susana Field Lab was a bad place to work. If it had been, I wouldn't have stayed that long. I enjoyed what I was doing. I was privileged in some ways because I did a lot of photography for reports and spent a lot of time in the large darkroom I had in Building 4027. Even though I was self-trained in color printing I managed to get it done. I think my specialty was helium leak testing for various areas. I was also an x-ray technician and we x-rayed welds of various things. I think the worst job I had was x-raying inside a gas-fired

heater at SCTI. That was hard work. You had to go in and set up your equipment and your film, crawl out through a burner opening, run the iridium pill out, x-ray it, crawl back into the heater and make another set up to do it all over again. The worst of it was when I had to go underneath the heater and I'm a little claustrophobic. There was just room enough to squeeze through. It was a bit scary when thinking about what could happen if we had an earthquake and the unit collapsed.

I don't think it is necessary to re-evaluate SRE and spend a lot of time and money on it. The only thing I think might need to be done, and might already have been done, is put a test well down around Building 4059 and other than that I don't know of any problems up there. I don't have an ax to grind and am not trying to make trouble for anyone. I don't think it is necessary to go back and duplicate past clean-up efforts.

UNITED STATES DEPARTMENT OF ENERGY

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 7/15/2010

Interviewee(s): 287

I started at SSFL on January 23, 1962 as a senior engineer at the Shield Test Reactor. Later I worked at the SNAP Critical Facility. I travelled to other locations as part of my job, including the Idaho National Laboratory. There I worked on a reactor test in Test Area North called the SNAPTRAN-3 – we blew that reactor up on purpose. For AI, I managed work at several places in addition to SSFL. That was the only reactor we blew up on purpose.

I handled radioactive materials as part of my job. Mostly I handled fuel rods when we were putting them into reactors. They were clean and there was no concern about handling them. Generally, the reactors were supporting research. The experiments produced gamma rays and neutrons. We were testing how the reactor handled various situations and various shielding designs.

The fuel was generally stored at the facility where the reactor was located. If it was stored the way it was supposed to be, it posed no risks. We did things the way we were supposed to. Critical facility fuel was not radioactive, so we could handle it without any risk before, during, or after the testing. When fuel was removed from a reactor, it was stored temporarily in the same building, and then it was shipped out. Some went to Oak Ridge and some went to Idaho. Some of the SNAP cores are still at Oak Ridge. I know one guy did some work on some fuel that came from here; I saw that he used some of the calculations from my report in his work. He confirmed my calculations. They used some of our fuel in the Tower Shield Test Facility at Oak Ridge. Much of the fuel removed from the reactors here was not that radioactive. We would store the fuel in the water pools for a while, and then ship it somewhere else for reprocessing. We used fuel that was composed of a standard uranium-aluminum alloy.

In some cases, we decided what to do. No one had done it before, so we made up the rules and documented what we did. If there were paper pushers they could not tell us what to do because they did not know anything more than we did, probably much less. Today, it is more paper than work. But back then, we could figure out what was best without interference.

I think we had logbooks. I do not know what we did with them. You got me. There were retention rules. Five years or ten years. We kept them as long as we were supposed to.

I did not handle many chemical materials. We did have some hot gases, some transient fuel tests. We handled all sorts of stuff. Mostly when we were working with something that was potentially dangerous, we worked with it under a hood. We were not crazy. We did not do anything stupid. We didn't put ourselves in any kind of danger. We had plain water drains and we had contaminated liquid drains. We did not put anything but water down the water drains.

Some of this is hard to remember. That was a lot of years ago. Aside from the reactor tests, I cannot really distinguish between some things I did up on the hill and what I did down in Canoga Park. But we did not pour anything in the toilet in my day.

Nothing unusual or out of the ordinary happened on my watch.

We always wore film badges and sometimes we had pencil dosimeters. The film badges recorded what we were exposed to, but they did not tell us anything. They were checked later by the health physicists. The pencil dosimeters would show the level of radiation. All the buildings were alarmed. If we didn't hear the alarm, we knew that we did not have anything to worry about. The film badge just tells you what you were exposed to. The dose that you got was the dose that you got. You could not undo that.

Later, when I worked for General Electric up in Vallecitos, a guy dropped a bit of plutonium on the floor. He bent down and picked it up. He nearly turned purple he held his breath so long. We used to joke about how he turned purple from holding his breath. Nothing like that ever happened near me at SSFL.

We wanted to do things safely. We were about safety, in spades.

I went to school for nine years before I went to work up at SSFL. I did summer jobs under people who were outstanding in the field at Oak Ridge and at Brookhaven. I was well trained by good people. I learned good habits before I got here.

It has been said, if you can do something, you do it. If you cannot do it, you teach. If you cannot teach, you do quality assurance. There was not anything of consequence that wasn't documented. We might occasionally have something happen that had no health and safety consequence that we would not bother to record. The reactors were designed to shut down (or scram) if something went wrong. Sometimes they were over-sensitive, and shut down too easily. It was a hassle to start them back up again. There were safety interlocks designed into the facility – that's the purpose of the instrumentation,

Occasionally we would have power hiccups. Everything was designed to fail-safe. It was a pain in the neck, but it was designed to be that way.

At the MIT reactor, the controls on our subcritical facility attached to the reactor were on a relay such that if a shutter was opened too fast the relay would trip and shut us down. There was no safety risk, just unneeded instrumentation. In this case, the instrumentation was overly sensitive and hindered our ability to get our work done. In those circumstances, we would purposely put a matchbook cover between the contacts of the relay to prevent the automatic shutdown. This would allow us to operate and not shut down most of the time. This type of thing was probably not documented, but it was done. Back then, I would have no problem with this sort of thing because it helped me get my job done. There is no way you could do something like that today. You would have to go through a lot of paperwork to get rid of the useless relay.

I do not know anything about the sodium burn pit. I have heard that they shot barrels there. That was the way things were done. Sometimes it was important to let the pressure out of a barrel, to expose the contents to air. It would have been dangerous for a worker to open a barrel. The safest and easiest way to puncture a barrel was to shoot it. That was done all over the country in those days.

I have heard there were places to dispose of things on site. I wasn't a cleanup guy. I was a reactor guy. I do not know where those disposal sites were. I know we ran a clean facility.
I do not have any information on leach fields, septic tanks, drainage locations, sewer lines, storage tanks, and gas holdup tanks.

Most of what the community is worried about here is over-blown. I have no doubts that EPA will do a good job on the survey and that DOE will clean up whatever is found. I am confident of that. There have already been clean ups and my guess is that 90% of the contamination has already been cleaned up. The surveys will not find any smoking guns.

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UNITED STATES DEPARTMENT OF ENERGY

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 7/20/2010

Interviewee(s): 296

I think most every site that I was involved with at Santa Susana Field Laboratory (SSFL) has probably already been cleaned up.

The first time I was on the hill was probably about 1956 on a visit. I started with Atomics International in 1954 at the Downey plant – actually it was called North American Aviation at the time.

I transferred up to the Liquid Metals Engineering Center in 1959. I was an engineer and I worked on the Kinetic Experiments for Water Boilers (KEWB). I designed a water boiler reactor. I had worked on a very similar reactor on a project in the 200 Area at Hanford before moving to California. The KEWB was underground. They eventually filled it in and put a cover on it. I assume it was cleaned up before it was filled in, although I have no knowledge that this was done.

I didn't have to wear a film badge in the beginning because we were just designing the facility. Film badges weren't necessary until the reactor went critical. The KEWB was the first reactor to go critical at SSFL, even before the Sodium Reactor Experiment. That was in about 1957. The SRE furnished power to the city of Moorpark for a little while. SRE was a lot bigger than the KEWB. I did not work on the SRE design.

I never handled any radioactive materials at SSFL. I handled radioactive materials at Hanford before I moved here, but I never handled any at SSFL.

KEWB was an experimental reactor. Once I had finished my job, contributing to the design of the reactor, I worked on other projects. My involvement was really only during design and construction. I wasn't involved once the reactors were operational.

I did work on other reactor designs, including two for Japan and one for Germany. I also worked on a small reactor for Denmark. I didn't go to any of those places. They shipped the

reactor to Denmark after it had been constructed. Another engineer went to Denmark and supervised it until it went critical. I got my picture in Newsweek along with a Dane while I was working on the Danish facility. This was a similar reactor to the KEWB. They were built of metal parts, mostly steel parts.

They did have a lot of radioactive materials in the Hot Cell at LMEC – but I was not involved in that operation. I would visit once in a while, but I wasn't assigned there. The research done there was part of the Advanced Sodium Program, which was funded and monitored by Argonne National Laboratory.

I left the company in 1963. I went to work for AeroJet in Azusa, California. I supervised the radiation effects program. They had two reactors in Fort Worth, Texas. AeroJet eventually moved everyone to Sacramento. I still lived in Northridge, but I flew up to Sacramento on a daily basis. The program manager was out of Cleveland. The company had four private jets. They were large and could carry 40 passengers.

In 1965, I went back to Rockwell and worked at Downey and Compton on the Apollo program. I was recruited by Rockwell to work on ground support equipment (GSE) for the Apollo program.

In about 1970, I went back to Hanford to work on the Fast Flux Test Facility. That was a $3 billion program. I was the systems manager, in charge of all of the sodium systems. Bechtel in S.F. designed that facility. We were the program managers. I was in charge of waste disposal, also. They built this facility out in the desert. The foundation was poured while we were still working on the design.

My first wife hated it there. We didn't want to live there. So, I went back to work for Atomics International at SSFL in 1972 and became involved in the sodium program. I worked directly for ILM. I was the program manager for the Advanced Sodium Components Test Program. A lot of my job was concerned with fiscal budgets. I was to make sure we spent money wisely.
I took courses in nuclear technology on my own, not through the company. I was a degreed engineer at 20. My degree was from the University of Washington.

At ETEC, I was not involved in handling radioactive materials or chemical materials. I had an office at ETEC formerly LMEC, not far from where the SNAP work was being done. That was JMN's program. Eventually he left the company and started his own company.

Every job up there was different. One time I was working at the Small Components Test Laboratory and I was supposed to document all the piping in that building. It was three or four stories high. We needed to have a full inventory of all the piping so we could have accurate drawings. Things were getting changed all the time. One time I stopped at the end of a day and I marked the pipe that I was at with a piece of black ribbon. When I got there the next day, the entire pipe had been re-routed.

I was involved in responding to a letter from DOE or AEC, whatever it was called at the time. CF Braun had been doing a design construct for the Large Component Test Facility. They had been working on it for seven years. They claimed they were 85% done. DOE got fed up with them. They asked if we could help get the building finished. I ended up writing a 13-page letter for ILM that described how we could get that facility finished. They liked the letter. They fired CF Braun and put me in charge. I used about 12 engineers to help me. We got in there and realized they were only 30% complete. We ended up completing the project in only a few months.

Any way, we finished it up. I had to supervise the electrical work in addition, even though I am not an electrical engineer. I finished the electrical design in about a month, and then we built it. The LCTF was built to test large pumps that were to be used in the future fast breeder reactors.
I don't know anything about any liquids being disposed down drains or in toilets. The company was pretty careful. Things were pretty lax at Hanford, but not at SSFL. LMEC was pretty good. Everyone wanted to do a professional job.

We used bottled water the whole time I worked up there. The tap water was never drinkable. It wasn't contaminated, but it didn't taste good. It was hard water.
I never went to the Sodium Burn Pit. I saw a movie of them throwing sodium in it, but I never witnessed that myself. It was just a big hole in the ground that contained water. In the movie it sounded pretty loud. Pure sodium is an excellent heat transfer medium. It is non-corrosive in pure form, but very corrosive as sodium oxide.

I don't know anything about any leach fields. I don't really know anything about on-site drainage. I think we outsourced a lot of design for the waste management work.

I don't know much about the old conservation yard. I knew about it, but I didn't know where it was and I never went there. We may have gotten some materials from there for the KEWB, because we didn't have a lot of money when we were building that facility.

For the KEWB reactor, we had to order special state-of-the-art valves. They took 20 weeks before they were delivered. They came, and I told the contractor to take the internal seals out of the valves before welding them into place. He forgot to do that. The valves were ruined when he welded them into place. The valves leaked live a sieve. We would have to order them all over again. This incident would have set the project back 20 weeks. However, the contractor was able to get replacement valves in one week because he didn't have to go through the company process, which was inefficient.

The SSFL was one of the cleaner places I worked. It was above average.

I never knew very much about the SNAP program. That was JMN's area. I used to hear stories about some problems with that program. But in general, I think the SSFL was run pretty well.
By contrast, I remember they used to say at Hanford, if you needed to dispose of radioactive material, just take it out and bury it. That was not how things were done at SSFL.

It's too bad there is so much fear about SSFL. The residential community grew up around the place. They didn't make the same kind of mistakes that were made at other sites. I remember one time at Hanford they wanted to build another chemical reprocessing facility. Everything would be done in it by remote controlled robots. There was one in 200 East and one in 200 West, and they wanted to build another. They pulled out the old drawings; they were in a big hurry. They poured a foundation, a 5-foot thick concrete foundation, and then decided they didn't want it after all. Then they just covered it up and cancelled it. I am not aware if the project was ever re-started.

Atomics International was run originally by the physicists, not by engineers. Physicists figure out the science, and engineers figure out how to get it done. It is great to work around the physicists.

I also worked for Lawrence Laboratory for about four years. I worked at both locations; in Livermore for one year and at Berkeley for three years. I worked there after I worked at Hanford and before I went back to SSFL. I helped set up Livermore Lab. I worked for Dr. Teller. It was exciting. One time I was in a meeting room with three Nobel Prize winners. I felt privileged.

I was working for IJL prior to the SRE core meltdown. He wanted to increase the power of the reactor. I told him I thought it was a bad idea. He wanted me to take over the project even though I did not want the job. They announced that I was taking over that program, and then the accident happened before I started. They took a lot of pictures of the damage down in the tank of the SRE. They gave the slides to me. IJL told them to give the pictures to me, so they did.

I don't think there was a cover-up at SRE because after the accident I was asked to give a talk at the last minute. I asked IJL if I could talk about the accident and use the slides I had been given and he said I could. I thought I was going to talk to 20 people for about 30 minutes. They gave me the address and I had just enough time to get there. I arranged the slides on the way and drove to the place where I was to give the talk. Three guys came out and met me. They said we've been waiting for you; you should start in about two or three minutes.

I went inside. It was an annual meeting the East Coast Utilities. There were 1,500-2,000 people in the audience! I talked for over four hours! I talked for two hours, then we took a break, and then I answered questions for two more hours. I showed all the slides. That's not what I would call a cover-up. No one was trying to hide anything, especially not Atomics International or DOE.

I told the audience what I thought. Everyone was interested; they stayed the whole time. I didn't hang onto those slides. I gave them back to the library which contained thousands of reports. Atomics International had a weekly newspaper and they had stories of what was being

done all over the site. Atomics International and Rocketdyne had very little to with each other back then.

I left the company in 1981 and took an early retirement. Right after I left, Atomics International and Rocketdyne merged one company and Atomics International was a part of Rocketdyne.

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UNITED STATES DEPARTMENT OF ENERGY

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 7/16/2010

Interviewee(s): 300

On July 16, 2010, I was interviewed in my home about my experience between 1958 and 1968 at the Sodium Reactor Experiment (SRE). This statement is based on my recollections.

From mid-1958 until mid-1968, I worked for Atomics International (AI) at SRE. SRE was located at AI's Nuclear Field Laboratory in the Santa Susana Mountains. During that time, I was employed successively as Senior Reactor Engineer, Senior Physicist, Experimental Supervisor, and Operations Supervisor. As an engineer, physicist, and the Experimental Supervisor, I planned, performed, and led the reactor physics work necessary to understand the performance of the SRE. As Operations Supervisor, I was responsible for operation of the reactor plant 24 hours per day, seven days per week. While I was a nonsupervisory employee, my immediate superior was LNO. As operations supervisor I reported first to GHJ, later to OQR, and finally to MOP. While I was Operations Supervisor, the Shift Supervisors and the maintenance foreman, NPQ, reported to me. Prior to joining AI, LNO had worked at the Hanford Engineer Works (HEW). After leaving SRE as Assistant Group Leader, OQR was promoted to Superintendent of the Hallam Nuclear Power Facility (HNPF) and later returned as Group Leader of SRE.

Prior to working at SRE, I was among 200 technical graduates hired by General Electric Company (GE) to work as Engineering Assistants at HEW. HEW produced weapons grade plutonium. During the 1940s and 50s, information related to the production of fissionable material was very highly classified, and no nuclear energy curriculum existed at any university. To prepare us to work in the nuclear field, GE trained us formally in their own Nuclear Training Program. While working at H Reactor, I received a 0.5 roentgen equivalent mammal (rem) dose of radiation during a refueling incident. Because of the training program, I understood the risk involved. The acute lethal dose is 500 rem (5 sieverts or 5 sv). After my exposure, I was required to submit collected urine for 24 hours and to stay out of radiation work zones for two weeks. Analysis of my urine indicated no ingestion radioactive material. My career dose is approximately 3 rem. Safety was paramount at HEW and at AI. Later, I would find safety paramount at Atomic Energy Commission (AEC) and Nuclear Energy Commission (NRC).

After leaving GE and before joining AI, I was commissioned in the United States Navy and served as an engineering duty officer. Most of my experience was in new ship construction in two commercial shipyards. All the work was nonnuclear. During the two years that I was stationed at Avondale Marine Ways, four workers died in the yard.

At the time I was hired by AI, I was qualified for the job based on my experience at HEW. I did however receive additional training at AI in supervision and management.

I left AI after AEC decided in September 1967 to retire SRE. By mid-1968, SRE staff had dwindled from 70 people to a chief operator, a reactor mechanic, and myself. Although AI offered employment to me in the Space Nuclear Auxiliary Program (SNAP), I elected instead to join the staff of AEC's regulatory arm that later became the Nuclear Regulatory Commission (NRC). During my time at AEC/NRC, I visited many licensed commercial power plants but rarely entered a radiation field. However, on one occasion, at the Robinson 2 nuclear power plant, during a plant outage, I did enter a 5 rem per hour field in the end bell of one of the steam generators. The purpose of my entry was to increase my awareness of the work in progress and working conditions.

I am a Registered Nuclear Engineer in the State of California.

The SRE reactor was located beneath the floor of the high bay in Building 4143. All of the primary reactor cooling systems and part of the secondary cooling systems were also located beneath the floor. The reactor and cooling systems were in heavily shielded concrete vaults. The reactor vault was designed to be physically inaccessible to personnel entry. After decay of sodium-24 during plant outages, entry to the cooling vaults was safe and necessary for system maintenance.

Natural sodium is comprised of one isotope, sodium-23. In a reactor, sodium-23 absorbs neutrons to become sodium-24. This isotope is strongly radioactive, is a beta (electron) emitter and a gamma emitter, and has a15-hour half-life.

Storage cells for fuel and moderator elements and wash cells for fuel elements were also located below the high bay floor.

The high bay accommodated two overhead bridge cranes, one of large capacity and the other of lesser capacity for auxiliary work. The heavy-duty crane was capable of lifting the concrete shield blocks covering the cooling vaults and the reactor loading face shield. It was also used to position the heavy lead-shielded fuel and moderator handling machines. These were necessary to transport irradiated fuel and moderator elements from the reactor to storage.

In addition to the high bay, Building 4143 contained the reactor control room, electrical equipment rooms, a hot cell, health physics laboratory, and most of the SRE staff offices.

Power was piped via the main primary and secondary cooling systems to the steam generator. The steam generator was the interface between the secondary cooling system and the feedwater/steam system that served the electrical turbine generator. Southern California Edison (SCE) owned and operated the water system, the turbine generator, and power lines connecting the generator to SCE's electrical distribution grid.

The main and auxiliary primary and secondary cooling systems each had a motor driven, vertically oriented, centrifugal pump. Each pump had a shaft seal to prevent liquid sodium at temperatures up to 500° F from leaking out of the pump. Instead of using conventional seals, freeze seals were developed for this purpose. Tetralin cooling systems were designed and installed for the the freeze seals. They reduced the sodium temperature in the seal to less than 208° F, the melting point of sodium. Tetralin was selected because it is chemically similar to kerosene and compatible with sodium. However, tetralin is an organic and decomposes pyrolytically at liquid sodium temperatures. Carbon is a decomposition product of that process.

Radioactive liquid and gaseous effluents were piped to storage tanks buried on the hill behind Building 4143. The tanks were covered with backfill.

Nearby were Buildings 4003, 4043, 4153, and 4163. The remaining SRE staff offices were in 4003. That building also provided space for nonradioactive test work. Building 4043 was used exclusively for warehousing nonradioactive spare parts for SRE. Building 4153, the Sodium Service Building, contained the secondary sodium storage tank and the sodium melt station. One end of Building 4163 was used for disassembly and maintenance of radioactive and non-radioactive SRE components and equipment. The remainder of the building was a machine shop that served the Nuclear Field Laboratory (NFL).

The fuel and moderator handling machines, when not in service, were parked in a bay off one end of the high bay. A carriage on the bridge crane was used to pick up the moderator-handling machine from its parking bay and move it onto the crane. A second carriage was needed to expedite movement of core moderator elements. An engineer on the SRE staff, OQR, discovered parts in the NFL Conservation Yard that could be used to inexpensively build a second carriage for the moderator-handling machine. I had informally approved OQR's request to proceed, but before we could do so, it was necessary for me to get approval from the Division Director.

The reactor core was an array of hexagonal logs of graphite moderator 11 inches across flats and 10 feet long arranged on end in the reactor vessel. Fuel elements were positioned in cooling channels on the axes of the moderator logs The fueled portion of rods was six feet long. All fuel rods and graphite logs were metal clad – the former to prevent fission products from entering the sodium coolant and the latter to prevent sodium from entering the graphite.

The SRE Group Leader was the senior manager at SRE. The supervisors of the operations, experimental, analytical, and modifications units reported to him. However, there were two small groups at SRE that were independent of the Group Leader. They were health physicists

and hot cell operators. Health physicists were always at the reactor when it was operating or being maintained, and they reported to AI's health physics management. Their independence assured that operating objectives would not obscure safety considerations. Hot cell operators were there when they had work to do for SRE or other NFL clients.

Fuel elements for Core 1 each contained seven rods of uranium enriched to 2.778 atom percent uranium-235. Six of the rods were in a hexagonal array around the center rod.

There were 14 power runs with Core 1 separated by outages for maintenance and modifications and for operation at criticality (zero power) for testing. Power Run 1 started in July 1957 and design full power, 20 megawatts thermal (Mwt), was reached in June 1958. Power Run 14 ended in July 1959 after the fuel melting accident and subsequent diagnostic testing at criticality and low power.

During the last few power runs with Core 1, tetralin leaked into the primary coolant through the freeze seal on the main cooling pump. When SRE was taken to criticality for Power Run 14 enough carbon had deposited in the lower part of fuel cooling channels to seriously degrade fuel cooling. While attempting to take the reactor from criticality to full power, the operator lost control of the reactor. Power increased by approximately 50% in perhaps 100 seconds. The operator reacted by inserting the control rod to regain control. He recovered control at low power where the reactor performed normally. He then attempted to increase power again and again lost control. This time power increased more rapidly to about 14 Mwt. The operator pressed the scram button which dropped the safety rods into the core and simultaneously drove in all control rods.

The reactor became unstable because of voids in the sodium coolant caused by boiling of sodium in the fuel elements, which was caused in turn by carbon blockages in the fuel cooling channels, which was caused in turn by pyrolytic decomposition of tetralin during preceding power runs. Thirteen fuel elements were partially melted, and the cladding on several moderator elements failed. Fission products were released to the primary coolant and to the helium cover gas above sodium pool in the reactor vessel.

All Core 1 fuel and all damaged moderator elements were removed from the reactor. New replacement moderator elements were loaded in the reactor. New freeze seal cooling systems were installed on all the sodium cooling pumps. The coolant for the seals was sodium potassium eutectic alloy. The eutectic alloy is molten at room temperature and is compatible with sodium. SRE personnel were not evacuated from Building 4143 during the melting accident or at any other time except for one practice drill. The cost of recovery was 1.25 million 1959 dollars and required 15 months for repairs and modifications. New fuel would be loaded for Core 2 operation. PRS was operations supervisor during the Core 1 power runs.

At one point during cleanup after the accident, the Group Leader required all SRE personnel including supervisors and himself to participate for one shift in the physical decontamination of the high bay. Most horizontal surfaces were cleaned by mopping. Most vertical surfaces were

cleaned by swabbing with Kotex® because of its absorbency. Operating and maintenance personnel continued the cleanup effort until Health Physics could release the high bay for unrestricted access by plant personnel. Health physicists used survey patches similar to gun cleaning patches to collect 100 square centimeter swipes of surfaces. Radiation counters were used to determine the amount of radioactive contamination collected on each swipe.

The fuel for Core 2 was thorium uranium alloy enriched to 7.1 weight percent uranium-235. The fuel elements were five-rod bundles surrounding a center unfueled support rod. Initial criticality with Core 2 was achieved in September 1960. Low-power physics tests were performed, and in January 1961 while increasing power for Power Run 15, the reactor performance was unstable. QST, Director of AI's Sodium Reactor Department, ordered shut down of the reactor pending review by AI's Sodium Reactor Review Committee. The committee provided an advisory function while necessary testing was performed to identify the cause of the problem.

RTU and SUV used an analog computer obtained from Systron-Donner Corporation to model the performance of the reactor. In this way, they demonstrated that the power coefficient of reactivity was positive, in other words that reactor had fast positive feedback. This led to the theory that fuel rods were bowing away from the axis of the bundles and into higher neutron flux. Testing verified the theory. Each fuel bundle was restrained with a spiral wire wrap and positive feedback was eliminated. The spiral wrap was installed in the SRE hot cell.

Reactor operation was resumed, and in October 1963 during Power Run 41A, the SRE returned to full power for the first time since Power Run 13. During that interval, various other problems were addressed including core temperature oscillations, several ruptured moderator elements, and gas inleakage in the main primary cooling pump. These problems were corrected.

In February 1964, the reactor was shut down for the Power Expansion Program (PEP). PEP increased the power output capability from 20 Mwt to 30 Mwt. New moderator elements, control and safety rods, and sodium pumps were designed, fabricated, and installed in SRE. Core 3 fuel elements were received and stored in the high bay. PEP modifications were completed. The fuel was uranium carbide, a ceramic capable of operating at considerably higher temperature making possible the production of high quality steam for more efficient production of electrical power. The fuel was enriched to 6.5 weight percent uranium-235. However, the fuel was not loaded in the reactor. AEC refused to continue funding operation of SRE. Shift operations ceased in September 1967. AI-AEC-12572 (see Bibliography) presented seven plans considered by AEC for the future of SRE. It was initially retired, and sometime after mid-1958, it was demolished.

Sodium is a soft metal at room temperature. It melts at 210°F and boils at 1620°F. Its thermal capacity is one-third and its thermal conductivity is 10 times that of water. Because of its high boiling point and high thermal conductivity, it is an attractive heat transfer medium for nuclear power plants. However, sodium reacts violently in water, can ignite spontaneously in moist air,

and, if ignited, burns in dry air. In high school and college chemistry laboratories, it is stored in kerosene.

Sodium was received at SRE in sealed 55-gallon drums and taken to the Sodium Service Building. Individual drums were connected to appropriate sodium piping. The drum was wrapped with electrical strip heaters and thermal insulation. Temperature was increased above the sodium melting point, and the sodium was transferred to the appropriate reactor cooling system.

Residual sodium from fuel elements was washed away by steam or water in the wash cells. The cells were needed to remove residual sodium from irradiated fuel elements prior to shipment for reprocessing. TVW continued to do developmental work on the wash cell process after the reactor went on line.

Sodium pumps, valves, and intermediate heat exchangers were examined and repaired as necessary in Building 4163. The work there involved components from both radioactive and nonradioactive systems. The building was decontaminated as necessary so that personnel access was generally unrestricted.

On one occasion, a reactor mechanic, in violation administrative and maintenance procedures tried to clean a sodium valve with toilet bowl cleaner. Toilet bowl cleaner is acidic; sodium is an alkali metal. He immersed the valve in a bucket of the cleaner. The chemical reaction was immediate and violent. Fortunately, the mechanic was not injured, but did receive a three-day suspension without pay for his violations. A liquid stain on the ceiling of the building remained as a reminder of what had happened.

On another occasion, a sodium leak developed at the steam generator with the reactor at zero power and the cooling systems hot. The leakage was collected in a pan that, to the best of my recollection, contained calcium carbonate. Atmospheric humidity was very low, and a fire watch was maintained until the secondary cooling system could be drained to the sodium storage tank. Had a fire developed, AI's Fire Department would have responded.

Large canisters of Ansul®, a powder for fighting fires including sodium fires, were available in the high bay and elsewhere.

SRE used copious amounts of nitrogen in the vaults for the primary cooling systems and in the sodium service vault. This provided protection against combustion of high-temperature, radioactive, liquid sodium leakage. The gas was stored in liquid form in an outdoor storage tank adjacent to the high bay. Helium gas was stored in 2200 psig bottles manifolded together. Helium was used as the cover gas in the reactor vessel and the fuel and moderator handling machines.

The sodium burn pit was an outdoor facility located on Jackass Flat. It consisted of a small, relatively deep pool of water constructed of concrete surrounded by a concrete deck. The deck

was at grade. At one end of the deck, was a single strong bulkhead with a few portholes in it. The portholes were glazed with high-strength glass. The bulkhead also had a hand hole to accommodate a hose nozzle. Debris, including scrap sodium system piping, bearing residual sodium-23 was washed with water from a fire hose. The reaction was violent, and the bulkhead provided protection for the operators. The reaction product was sodium hydroxide. When cleaned of residual sodium, the sodium hydroxide and debris were washed or pushed into the pool for later disposal.

After the AEC decided to decommission SRE, the primary sodium was shipped in drums to Hanford where the Fast Flux Test Facility, a sodium-cooled fast reactor would be built. The secondary sodium was shipped by rail in its storage tank to HNPF in eastern Nebraska. The speed of the train was limited to 35 mph, and an experienced sodium systems engineer from AI's NFL accompanied the shipment.

Personnel at SRE were required to wear carry pocket dosimeters and wear film badges. The dosimeters were collected daily and reissued the next. The allowable daily dose and the range of the dosimeters was 50 mrem. The wearer could read the accumulated dose as necessary during the day. Film badges, as I recall, were collected weekly and were capable of recording a considerably higher dose. Health physicists were responsible for issuing, collecting, and processing dosimeters and film badges. In addition to these measures all persons exiting the site used the hand and foot counter in the lobby of Building 4143.

Health physicists were responsible for surveying the SRE and environs for radioactive contamination, roping off contaminated areas, and establishing portals with stepoff pads to prevent tracking of contamination into clean areas. Health physicists issued Special

Work Permits (SWPs) to operators, mechanics, and others to enter contaminated areas and/or radiation fields. The SWP specified the protective clothing required, breathing apparatus, and the time permitted in the protected area. In high radiation areas, a health physicist carrying a radiation meter capable of measuring low, intermediate, and high level fields always accompanied the work party. The health physicists reported to separate management and their orders were absolute. In addition to these duties, health physicists monitored effluents from SRE.

On one occasion, and only one occasion, was I aware of health physicists not neglecting their duties, but rather establishing the wrong priority. There had been an inadvertent spill of radioactive liquid on the asphalt surface outside Building 4143. The two health physicists on duty were decontaminating shoe soles of two truck drivers from offsite instead of determining the extent of radioactive contamination and roping off the area. This problem was promptly corrected.

On another occasion, an operator's dosimeter was reading higher than expected based on the fact that no high radiation fields or contaminated areas were known to exist in the high bay at the time. Surveying disclosed a fine collimated beam of radiation exiting from a slight gap

between the concrete shield blocks above the vault for the primary cooling system. Packing the gap with lead sheet corrected the problem.

The SRE had two large liquid waste tanks buried in the earth a few hundred feet from Building 4143. The bottom surfaces of the tanks had severely corroded. The tanks were entered, decontaminated to the extent necessary, repaired and returned to service. To the best of my knowledge, this was done during the Power Expansion Program.

Solid and liquid waste from SRE was taken to the radioactive waste handling facility at NFL. It was managed by UWX.

I have no knowledge of toilets being used for disposal of chemicals or radioactive materials. I believe that the culture at AI in general and SRE in particular would not have tolerated such behavior.

AI had a training department that was responsible for the training and certification of Sodium Graphite Reactor (SGR), Organic Moderated Reactor (OMR), and SNAP reactor operators. SRE had an engineer, VXY, whose principal activity was assisting and cooperating with the training department in their work with SRE operators. VXY did much of the work in writing the SRE training manual and presented many of the classroom lectures. The classroom was located in Building 4143. Lectures covered layout, design, and operation of the various systems and the physical principles underlying their operation. On satisfactory completion of the training program, operators were granted certificates documenting their competence. All operators, chief operators, and shift supervisors held valid certificates.

The SRE training and operating manuals were, in my view, the two most important documents at SRE. The SRE Operations Manual was edited and maintained by WYZ of the SRE staff. It was an evolutionary document that depended on input from shift supervisors and other staff members for it technical content. The manual contained detailed procedures that identified valves, pipes, and other components by specific name or identification number.

During shift operations, a log was always maintained by shift supervisors to facilitate transfer of responsibility for the plant to the relieving crew. Management used the log books to stay abreast of plant operation and maintenance. The Group Leader, Supervisors, and Maintenance Foreman initialed the log after reading it. The Shift Supervisor on day shift prepared the Night Orders for the Operations Supervisor's approval. The Friday day shift supervisor prepared orders for the weekend. Holidays were covered in like manner. Each of the Unit Supervisors and the Maintenance Foreman prepared a weekly report of their unit's activities, and the reports were combined for documentation of the Group's activities. They also met as a group with Group Leader to discuss the week's activities.

For a time, we experienced thefts from SRE. Vacuum tube voltmeters, gloves, and gasoline were disappearing. To the best of my knowledge no radioactively contaminated tools or

materials were removed from the site. We asked security to inspect cars leaving the site. Security did this on a random basis at the NFL gate. We believe that this stopped the thefts.

During my time at SRE there was no sodium fire at the facility. Furthermore, I am not aware of any sodium fire at SRE before or after my tenure. However, near the end of my tenure, a brush fire burned through the Rocketdyne Test Facility and AI's NFL. This occurred on a weekend. The AI and Rocketdyne Fire Departments fought the fire as did departments from local jurisdictions. To the best of my knowledge, the fire started in Box Canyon and off property controlled by Rocketdyne and AI.

SCE owned the redwood cooling tower which was necessary for operation of their turbine generator and hence was essential for distribution to SCE's grid of the power produced by SRE. Although we believe that the automatic sprinklers designed to maintain the moisture content of the redwood functioned sometime in the preceding 24 hours, the cooling tower burned and was totally destroyed.

I spent some 19,000 hours of my life at SRE. I am now 82 years old, have four children, and six grandchildren. Neither I, nor my family, have suffered any ill effects from my employment.

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RESPONSE TO COMMENTS

Response to Comments on Draft Final Historical Site Assessment Issued on February 1, 2012
Historical Site Assessment, Santa Susana Field Laboratory Site
Area IV Radiological Study, Ventura County, California

Item	Comment	Response
1	Reference is made to the "Important Notice on the DVD box-set." However, this notice does not appear on the box or on the labels of any of the CDs. It does appear on the cover page of each of the Tech. Memo. text files with the exception of Tech. Memo. HSA-5B.	On February 8, 2012, a sticker containing this notice was sent to each recipient of the draft final HSA along with directions for affixing the notice to the CD box. Several parts of the HSA, including the interview summary report and the aerial photographic interpretation are not subject to this restriction. The notice was inadvertently switched between the HSA-5B TM and the HSA-5C TM. The HSA-5C TM does not contain any export control information.
2	The title of Plate 1 is "Area IV Buildings of Interest." However only nuclear reactor and critical assembly facilities are highlighted and captioned. To be complete, other important non-reactor buildings, such as the Hot Laboratory (building 4020), the Radioactive Materials Handling Facility (RMHF), the Nuclear Materials Development Laboratory (building 4055), the Sodium Disposal Facility (site 4866), etc., should also be included.	Agreed. Plate 1 was revised to show the areas/buildings listed on pages 4 and 5 of the HSA in Volume I, and identified by this comment.
3	Building 4020 is not identified on Plate 1.	Agreed. Building 4020 is now identified on Plate 1.
4	Site 4886 is not identified on Plate 1. Reference is made to Figure 2.2, but no TM is mentioned.	Agreed. Plate 1 was revised to show Site 4886. The site falls under the Section 1.2.7 heading entitled HSA-8.

Item	Comment	Response
5	These Volumes contain files for "incidents with no environmental release" for subareas 5B, 5D and 7/3/NBZ. These compilations are not referred to in the Volume I text file. If no environmental release occurred, then what is their relevance? Are there similar compilations for subareas 5A, 5C, 6 and 8? Their absence would lead the reader to believe that all incidents in these subareas resulted in an environmental release? This would seem unlikely. For instance, slide 12 of the June 15, 2011 presentation on the subarea 6 HSA, reported 20 incidents as not resulting in an environmental release.	Noted. For completeness, all documented incidents were included in the respective HSA TM for each subarea. In an effort to summarize incidents in subareas where many occurred such as SRE (subarea 6), Hot Lab (subarea 5D), and FSDF (subarea 8), the incidents were categorized to facilitate their presentation in both the HSA TM and on the slides used in the Stakeholder Meeting. Slide 12 listed 20 incidents out of 42 incidents at the reactor facility as "Personnel Exposure - no evidence of release to environment".

Item	Comment	Response
6	As requested here are my comments on the Draft Final HSA. I find it to be a mixed bag. The documentation of historical activities represents a prodigious amount of work. However, the translation of that documentation into the Tables 1.3, "Potential Radioactive Contaminants of Concern" appears to be a superficial exercise devoid of any technical evaluation of quantities of radionuclides that might have been used or produced, and released into the environment so as to be of potential concern. This is typified by the following entry for Building 4027 on page 25. "Radionuclides of concern include all radionuclides that are included in the background study plus any additional radionuclides identified during the HSA." The Tables seem to have been created by maximum use of the cut/paste options, without technical basis. If you consider the frequent use of the logic that adjacent buildings were the justification or that drainage was the justification, it would have been much simpler to state that "all radionuclides could be present everywhere" and all of the effort to produce the Tables could have been avoided. The Tables are useless as a guide to focus attention on likely concentrations of radionuclides of significance. There is no consideration of the effects of prior remediation or the ubiquitous NORM. There are also numerous silly entries in the Tables that are meaningless or baseless. The Tables only serve to reinforce the radioactive paranoia of the most phobic members of the community, and does not serve the best interests of anyone.	Noted. To customize a list of ROCs and associated quantities by facility/subarea is beyond the scope of the HSA not to mention that it requires detail about process history that we do not have. For instance, at SRE we could estimate radionuclide inventory and content using a code like ORIGEN if we had fuel composition, reactor time, reactor flux as function of time, down times, etc., etc. At hot lab, this kind of analysis would be very difficult simply because fuel was processed here from many on-site and off-site reactors. This is one of the reasons why the list is all inclusive in the HSA however, effort was directed during the design of analytical lists for the Soil FSP so that a balance was struck between what could be there and what can be analyzed reliably as well as adding "caveats" about expanding analysis such as C14, Ni63, etc., at locations where facility history is well documented. Stakeholders are reminded that these ROC lists were the product of document reviews (of many documents). This means that if a particular radionuclide was in or could have been in a facility, it was included in the HSA report. The function of the HSA was to collect historical information. The initial extensive list of radionuclides from the background study was critically evaluated and reduced. The radionuclide suites were developed and applied to address this type of issue.

Item	Comment	Response
7	I understand. However, the tables of radionuclides of concern lack any real relation to what may be there or what might be found. They imply far more than is really justified by the operational history. It is not really evidence. Also, it does not matter because you are essentially sampling everywhere for everything.	Noted. See response to previous comment, above.
8	...looking back on the...comments on each HSA subarea, now looking at the bigger picture, aside from investigating offsite wells, "Spray Fields" should be considered a potential source of contamination. The spray field on the road to the Simi Valley overlook next to Building 133, was contaminated with Cesium 137, yet, they could not explain a source, nor could they explain what the industrial sprinklers were doing there. This needs to be investigated further, the below Historical Document shows the Upper and Lower Spray Fields in AREA II as this was common practice, the AREA IV lines should be followed to find a source and research spray fields and not just brush off as fire suppression.	Noted. The source document for the sketch provided in the comment cannot be confirmed nor does it connect the "sprays" to any source of radiological or chemical contamination. If these sprays were used to release radiologically contaminated effluent in Area IV then surface radiation would have been measured thru the gamma survey effort in these areas. The "sprays" located along the subarea 6/7 edge with the NBZ were surveyed with the most sensitive gamma surveying instruments, the ERGS II, and the results do not support the suggestion of the "sprays" for other than fire prevention/suppression.

Item	Comment	Response
9	There are a few documents regarding the Sodium Reactor Experiment (SRE) that I feel were not referenced properly in the Draft, please consider the "Minutes of Meeting, August 5, 1959 – Ad Hoc SRE Review Committee", the "SRE Radioactive Vent System of December 18, 1957 by R.P. Nebiker" and the Re-examination of Radioactivity Implications of Dissolved Uranium in SRE Primary Sodium Coolant, February 20, 1960 by R.S. Hart"	Noted. EPA does not possess these documents nor were they provided during the comment period for the TM containing the SRE.
10	There were Energy Technology and Engineering Center (ETEC) and Atomics International (AI) operations outside of AREA IV that should be referenced, made part of the HSA and included in any future sampling efforts, including but not limited to The Bowl in AREA I (owned by The Boeing Co.) and Building 203 in AREA II (Owned by the Federal Government administered by the National Aeronautics and Space Administration (NASA).	Noted. The scope of EPA's radiological study includes only Area IV of the Santa Susana Field Laboratory.
11	OS-21, located in Runkle Canyon is the Closest offsite well to the west of AREA IV should be sampled for health and safety reasons as the property was recently purchased for the development of homes within the City of Simi Valley.	Noted. OS-21 was included in EPA's groundwater program but the legal counsel for the owners of the property would not grant the EPA access to the well unless it could prove there was a specific scientific reason to sample it. The property owner legal counsel would not allow EPA sample the well just because it was close to Area IV. OS-21 has been sampled numerous times before and DTSC has issued a "No Further Action" letter for the well. There are no data that would lead EPA to believe contamination has migrated to the well since the letter was issued.

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VOLUME II

FINAL
TECHNICAL MEMORANDUM
SUBAREA HSA-5A
HISTORICAL SITE ASSESSMENT
SANTA SUSANA FIELD LABORATORY SITE
AREA IV RADIOLOGICAL STUDY
VENTURA COUNTY, CALIFORNIA

Prepared for:

EPA Contract Number: EP-S7-05-05
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October 2012

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LIST OF ACRONYMS AND ABBREVIATIONS

ACA	articulated control assembly
ACP	activated corrosion product
AEC	U.S. Atomic Energy Commission
AETR	Advanced Epithermal Thorium Reactor
ARRA	American Recovery and Reinvestment Act
Atomics International	Atomics International Division of North American Aviation, Inc.
CDPHE	California Department of Public Health and Environment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
Ci	Curie
COC	Contaminants of Concern
CRIEPI	Central Research Institute of the Electrical Power Industry
CT	computed axial tomography
D&D	decontamination and decommissioning
DCGL	derived concentration guide limit
$DCGL_W$	derived concentration guide limit, wide area
DHS	Department of Health Services
DOE	Department of Energy
dpm/100 cm^2	disintegrations per minute per 100 square centimeters
DTSC	Department of Toxic Substances Control
EPA	U.S. Environmental Protection Agency
EPIC	Environmental Photographic Interpretation Center
ESSAP	Environmental Survey and Site Assessment Program
ETEC	Energy Technology Engineering Center
FCEL	Fast Critical Experiment Laboratory
FOIA	Freedom of Information Request
HEPA	high-efficiency particulate air
HGL	HydroGeoLogic, Inc.
HR	House Resolution
HSA	Historical Site Assessment
ICP	inductively-coupled plasma
KEWB	Kinetic Experiment Water Boiler
KHI	Kawasaki Heavy Industries
kW	kilowatt
kWt	thermal kilowatt
LLTR	Large Leak Test Rig
LMEC	Liquid Metal Engineering Center
LMFBR	Liquid Metal Fast Breeder Reactor
μR/hr	micro roentgen per hour
mR/hr	milli roentgen per hour

MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MCP	maximum permissible concentration
MDA	minimum detectable activity
MWd	megawatt days
NBZ	Northern Buffer Zone
NRC	Nuclear Regulatory Commission
NSA	nuclear safety analysis
ORISE	Oak Ridge Institute for Science and Education
pCi/g	picocuries per gram
PRG	preliminary remediation goal
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
RHB	Radiological Health Branch
RMHF	Radioactive Material Handling Facility
S2DR	SNAP 2 Demonstration Reactor
S8DR	SNAP 8 Development Reactor
SBZ	Southern Buffer Zone
SETF	SNAP Environmental Test Facility
SGR	sodium graphite reactors
SHEA	Safety Health and Environmental Affairs
SNAP	Systems for Nuclear Auxiliary Power
SPTF	Sodium Pump Test Facility
SSFL	Santa Susana Field Laboratory
TM	technical memorandum
TO	task order
TRU	Transuranic
TRUMP-S	TRU Management by Pyropartitioning – Separation

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TEXT

FINAL
TECHNICAL MEMORANDUM
SUBAREA HSA-5A
HISTORICAL SITE ASSESSMENT
SANTA SUSANA FIELD LABORATORY SITE
AREA IV RADIOLOGICAL STUDY
VENTURA COUNTY, CALIFORNIA

1.0 INTRODUCTION

This technical memorandum (TM) presents a summary of the identified environmental concerns associated with past radiological operations within a portion of Area IV at the Santa Susana Field Laboratory (SSFL) site located in eastern Ventura County, California (Figure 1.1). The SSFL site consists of four areas: Areas I, II, III, and IV; and two buffer zones: the Northern Buffer Zone (NBZ) and the Southern Buffer Zone (SBZ). The U.S. Environmental Protection Agency (EPA) is conducting a radiological characterization study of SSFL Area IV and the NBZ pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). EPA's study consists of a Radiological Historical Site Assessment (HSA), gamma scanning of accessible areas, geophysical surveys, soil and water testing. EPA's gamma scanning, geophysical, soil and water testing investigations are being developed and presented in separate work plans and data reports.

HydroGeoLogic, Inc. (HGL) has been tasked by EPA to conduct the radiological characterization study within SSFL Area IV/NBZ (hereafter called the "Area IV Study"). Figure 1.2 illustrates the location of Area IV and the NBZ. EPA has elected to subdivide the Area IV Study Area into subareas. Subarea boundaries are based on existing Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) areas for the SSFL site. EPA has further subdivided some RFI areas based on features such as roads, drainage pathways, building use, and number of buildings.

Table 1.1
Area IV Study Area
Subarea Designations

Area Designation	Number of Sites
HSA-3	1
HSA-5A	26
HSA-5B	46
HSA-5C	23
HSA-5D	21
HSA-6	38
HSA-7	18
HSA-8	8
BZ-NE	2
BZ-NW	2

The objective of the HSA component of the radiological study is to provide a comprehensive investigation that identifies, collects, organizes, and evaluates historical information relevant to nuclear research operations as it pertains to radiological contamination in the Area IV Study Area. Once these areas have been identified, potential areas where radiological contamination may exist at the site will be identified for sampling.

This work is being executed by HGL under EPA Contract EP-S7-05-05, Task Order (TO) 0038 under the technical direction and oversight of EPA Region 9. In accordance House Resolution (HR) 2764, the Department of Energy (DOE) is funding EPA's Area IV Study. DOE elected to fund EPA's study with funding allocated under the American Recovery and Reinvestment Act (ARRA) of 2009. On December 6, 2010, the DOE and the State of California Department of Toxic Substances Control (DTSC) signed an Administrative Order on Consent (AOC) for cleanup of the Area IV and the NBZ. Under this AOC, radiological contaminants will be cleaned up to background concentrations as defined by EPA's July 2011 radiological background study.

1.1 TECHNICAL MEMORANDA AND THE RADIOLOGICAL HISTORICAL SITE ASSESSMENT

This TM presents information relating solely to sites and buildings located within Subarea HSA-5A. This TM, along with the other TMs prepared for the subareas identified in Table 1.1. Each TM has been made available in draft for review and informal comment by SSFL stakeholders and the general public. EPA responded to each comment via draft "Response to Comment" tables, which were also made available to SSFL Stakeholders. Each draft was edited as described in the Response to Comment tables, and these edits along with any new information made available to EPA have been compiled into EPA's official Radiological HSA for the Area IV Study Area.

The content of each TM is based on guidance provided in the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM, Revision 1, August 2000). MARSSIM is used as an investigative tool to gain an understanding of the nature and extent of radiological contamination left at a site. The TMs provide preliminary recommendations for MARSSIM classifications based solely on historical information, which may be incomplete. The preliminary classifications identified in the TMs will be used to guide the subsequent gamma scanning and multimedia sampling effort. Once more complete historical environmental data have been obtained, and the results of geophysical surveys, gamma radiation scanning surveys, field observations, and the results of soil sampling and laboratory analyses are available, the preliminary classifications presented in the TMs will be revised.

1.2 GOALS AND METHODOLOGY OF THIS TM

This TM is focused on radiological information within subarea HSA-5A and the drainage channels that lead to and from this area. The location of subarea HSA-5A is shown on Figure 1.3. Plate 1 presents a summary of the features related to potential radiological sources identified within the HSA-5A subarea. Detailed information pertaining to the use of radioactive materials and the potential release of radionuclides at sites and buildings within HSA-5A are provided in Sections 2 and 3 of this TM. Preliminary findings specific to HSA-5A are presented as follows:

- Descriptions and locations of potential, likely, or known activities that involved radioactive material, radioactive waste, or mixed waste;
- Initial MARSSIM classifications (e.g., Class 1, 2, 3) of potentially impacted areas;
- A site-by-site assessment of the likelihood or "weight of evidence" of radiologically contaminated media;
- An assessment of the likelihood of potential migration pathways; and,
- Identification of, confirmation of, and, if appropriate, addition or subtraction to, the list of the potential radiological contaminants of concern.

As specified in MARSSIM, a "site" is defined as any installation, facility, or discrete, physically separate parcel of land, or any building or structure or portion thereof, that is being considered for survey and investigation (MARSSIM, Revision 1, August, 2000). MARSSIM guidance defines all sites as either "non-impacted," or "impacted" by radiological operations. All of the sites at the Area IV Study Area are considered to have a reasonable potential for residual contamination, so none is classified as "non-impacted." Impacted areas of the Area IV Study Area are divided into one of three classifications.[1]

- *Class 1 Areas:* Areas that have, or had prior to remediation, a potential for radioactive contamination (based on site operating history) or known contamination (based on previous radiation investigations).
- *Class 2 Areas:* Areas that have, or had prior to remediation, a potential for radioactive contamination or known contamination.
- *Class 3 Areas:* Areas that have a low potential for radioactive contamination.

The information provided in this TM together with comments and recommendations provided by SSFL stakeholders and the general public will be used in the EPA's investigation strategy for sampling and analysis for residual radiological contamination in surface and subsurface soil within HSA-5A. In addition to the HSA, information gathered by EPA's Area IV and NBZ gamma scanning program and targeted geophysical investigation will assist EPA in fine-tuning the overall investigation strategy for the Area IV Study Area, and in making the final determination of the appropriate MARSSIM classifications.

1.3 BRIEF DESCRIPTION AND HISTORY OF SSFL AREA IV AND THE NBZ

The SSFL site occupies 2,850 acres of rocky terrain with approximately 700 feet of topographic relief near the crest of the Simi Hills. The Area IV Study Area comprises approximately 465 acres. Though some of the study area is relatively flat, some portions of the area exhibit steep relief and rugged terrain. The site elevation is between 1,880 feet and 2,150 feet above sea level. The overlying soils of the Area IV Study Area consist of weathered bedrock and alluvium that have been eroded primarily from the surrounding Chatsworth and Santa Susana formations. Several geological faults cross this area.

[1] *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), Revision 1*, NUREG-1575, Rev. 1, EPA 402-R-97-016, Rev. 1, DOE/EH-0624, Rev. 1, August 2000, pp. 2-5.

The climate in the vicinity of the SSFL site is classified as Mediterranean Subtropical, corresponding to an average temperature of 50 degrees Fahrenheit in the winter and 70 degrees Fahrenheit in the summer. Rainfall averages approximately 18 inches per year.

A shallow groundwater system exists in the surface soils at small isolated locations. A regional groundwater system exists in the deeper fractured Chatsworth Formation. In some areas, groundwater from the Chatsworth Formation flows through fractures in the rock and emerges at the ground surface as seeps or springs. Groundwater underlying the SSFL site is not currently used, or anticipated to be used, as a source of drinking water for the nearby communities or at SSFL, but nearby residents may in the future consume groundwater emanating from this site

In addition to rocket and small engine testing facilities in other portions of the SSFL, North American Aviation, Inc., had facilities at Area IV for researching, developing, and constructing equipment to use nuclear energy through its Atomics International (AI) Division.[2] According to a 1959 company brochure, AI maintained a nuclear field test area covering approximately 300 acres at the SSFL site.[3] Under contract to DOE and private customers, AI supported the development of civilian nuclear power, as well as the testing of non-nuclear components related to liquid metals within 90 acres of Area IV of the SSFL site. The facilities within these 90 acres would later be referred as the Energy Technology Engineering Center (ETEC).[4]

Nuclear facilities at ETEC included 10 nuclear research reactors over the period July 1956 through February 1980. These research reactors are listed in Table 1.2.

Table 1.2
Research Reactors Located at the Santa Susana Field Laboratory[5]

Reactor Acronym	Building No.	Facility Name	Power Level (kW)	Period of Operation	Power Generated (MWd)	Radioactivity at End of Operation (10^3 Ci)
KEWB	4073	Kinetics Experiment Water Boiler	1	7/1956 to 11/1966	1	6
L-85/AE-6	4093	L-85 Nuclear Experimentation Reactor	3	11/1956 to 2/1980	2	18
SRE	4143	Sodium Reactor Experiment	20,000	4/1957 to 2/1964	6,700	120,000
SER	4010	Systems for Nuclear Auxiliary Power (SNAP) Experimental Reactor Facility	50	9/1959 to 12/1960	13	300

[2] North American Aviation, Inc., *The North American Story*, December 1960, p. 7
[3] Atomics International, A Division of North American Aviation, Inc., *Atomics International*, December 1959, p. 5.
[4] http://www.etec.energy.gov/History/Area-IV-History.html
[5] Oldenkamp, R.D. and Mills, J. C., *Nuclear Operations at Rockwell's Santa Susana Field Laboratory – A Factual Perspective*, Rockwell International; Report No. N001ER000017, September 6, 1991, p. 23.

Table 1.2 (continued)
Research Reactors Located at the Santa Susana Field Laboratory[6]

Reactor Acronym	Building No.	Facility Name	Power Level (kW)	Period of Operation	Power Generated (MWd)	Radioactivity at End of Operation (10^3 Ci)
S2DR	4024	SNAP Environmental Test Facility	65	4/1961 to 12/1962	13	390
STR	4028	Shield Test Irradiation Facility	50	12/1961 to 7/1964	1	300
S8ER	4010	S8ER Test Facility	600	5/1963 to 4/1965	215	3,600
STIR	4028	Shield Test Irradiation Facility	1,000	8/1964 to /1974	28	3,714
S10FS3	4024	SNAP Environmental Test Facility	37	1/1965 to 3/1966	16	6,000
S8DR	4059	SNAP Development Reactor Facility	619	5/1968 to 12/1969	182	220

Seven criticality test facilities (i.e., facilities housing operations involving masses of fissionable material capable of sustaining a nuclear chain reaction) were also located on Area IV.[7] These are listed in Table 1.3. Other nuclear facilities within Area IV included the Radioactive Materials Disposal Facility and the Hot Laboratory, as well as the Sodium Disposal Facility, or Area IV burn pit. Each of these facilities will be addressed as a site within the appropriate TM along with supporting buildings and open areas.

According to the DOE ETEC web site, most nuclear research related programs and operations ceased in 1988 and were replaced with decontamination and decommissioning operations.[8]

Table 1.3
Criticality Test Facilities at the Santa Susana Field Laboratory[9]

Facility Name	Building No.	Period of Operation	Notes
SNAP Critical Test	4373	1957 to 1963	First SNAP-2 criticality tests
Organic Moderated Reactor	4009	1958 to 1967	Basic tests of reactor concept
Sodium Graphite Reactor	4009	1958 to 1967	Basic tests of reactor concept
SNAP Critical Equipment	4012	1961 to 1971	Later SNAP criticality tests
Fast Critical Experiment	4100	1961 to 1972	Started as Advanced Epithermal Thorium Reactor (AETR)
SNAP Flight Systems	4019	1962	SNAP flight system criticality
SNAP Transient Test	4024	1967 to 1969	SNAP transient response tests

[6] Oldenkamp, R.D. and Mills, J. C., *Nuclear Operations at Rockwell's Santa Susana Field Laboratory – A Factual Perspective*, Rockwell International; Report No. N001ER000017, September 6, 1991, p. 23.
[7] Atomics International, A Division of North American Aviation, Inc., *Atomics International*, December 1959
[8] http://www.etec.energy.gov/History/Area-IV-History.html
[9] Oldenkamp, R.D. and Mills, J. C., *Nuclear Operations at Rockwell's Santa Susana Field Laboratory – A Factual Perspective*, Rockwell International; Report No. N001ER000017, September 6, 1991, p. 25.

The NBZ is a 175-acre parcel of land that abuts the SSFL property (Figure 1.2). The NBZ is a naturally vegetated area containing drainage channels that transport surface water from the SSFL downslope to surrounding populated areas.[10] The NBZ was purchased by the Rocketdyne Division of Rockwell International (Rockwell) in 1998 from the adjoining Brandeis-Bardin Institute (now known as the American Jewish University) because an environmental contractor found that the NBZ contains radioactive and chemical contamination that had migrated from the SSFL.

With the exception of 452 acres owned by the U.S. Government in Area I and Area II, which is outside of the Area IV Study Area, the entire SSFL site, including the NBZ, is owned and operated by The Boeing Company.

1.4 BRIEF DESCRIPTION AND HISTORY OF HSA-5A

Subarea HSA-5A is approximately 38.4 acres of flat land that contained 37 buildings over the years. It includes B, G, and 11th through 17th Streets. Drainage is generally to the southeast. There are no ponds in this subarea. Radiological operations in the HSA-5A area related to the SNAP and SNAP 8 programs as well as to the Advanced Epithermal Thorium Reactor and the Fast Critical Experiment Laboratory.

1.5 SITES IN HSA-5A

During the peak of operations, Subarea RFI-5A comprised 27 sites, most of which were buildings. This technical memorandum addresses each of these 27 sites within Subarea HSA-5A. Of the 27 sites, 3 were reactor buildings and 14 housed operations possibly involving radioactive materials. Of the 27 sites in Subarea HSA-5A, only 2 buildings and a parking lot remain today.

1.6 SITE SUMMARY METHODOLOGY

In preparing this TM, the following types of documents were reviewed:

- radiological characterization reports;
- previous radiological surveys;
- decontamination and decommissioning (D&D) reports;
- environmental monitoring reports;
- license termination reports;
- aerial photographs dating back 50 years;
- building floor plans;
- piping diagrams and construction drawings;
- RFI reports;
- unusual occurrence reports;
- incident reports;

[10] Agency for Toxic Substances and Disease Registry, *Draft Preliminary Site Evaluation, Santa Susana Field Laboratory*, Atlanta, GA, December 3, 1999, pp. 2-5.

- plant operating reports and logs;
- safety analyses reports;
- facility surveillance and maintenance reports; and
- information obtained from interviews with former workers or other persons.

Numerous documents were obtained through information requests sent to Boeing, DOE, and other parties. EPA sent formal information requests to Boeing, DOE, the Nuclear Regulatory Commission (NRC) and the California Department of Public Health and Environment (CDPHE) under § 104(e) of the CERCLA. In addition, EPA directed Boeing to identify and provide pertinent documents within a number of document databases comprising approximately 1.4 million documents relating to all areas of the SSFL site, including Area IV, as well as some offsite facilities. The information acquisition process is complete.

EPA sent Boeing its original information request letter on June 24, 2009. Boeing provided an initial response to this request on August 20, 2009, and a supplemental response on December 10, 2009. On June 8, 2010, Boeing provided relevant site drawings and maps as identified by EPA during a review of flat files at Boeing's Safety, Health, and Environmental Affairs (SHEA) building on site. Subsequently, on June 17, 2010, EPA sent Boeing a supplemental information request letter specifically requesting all maps, diagrams, and as-built drawings for past and current buildings in Area IV. On July 15, 2010, Boeing responded and provided additional documents, including maps and drawings. On November 15, 2010, Boeing provided a third supplementary group of documents. On December 23, 2010, and January 11, 2010, Boeing provided numerous additional documents in response to both EPA original information requests and EPA queries of Boeing's document database for the SSFL.

In October 2010, EPA also sent the National Aeronautics and Space Administration (NASA) a formal information request letter. On November 22 and December 2, 2010, EPA received information responsive to this request.

EPA sent DOE its original information request letter on June 24, 2009. DOE provided an initial response to this information request on August 31, 2009. Subsequently, DOE provided supplemental responses to this initial information request on a monthly basis. Additional information responsive to the EPA's information request was received in September, October, November, and December 2009, as well as January through December 2010 and January through July 2010. On June 17, 2010, EPA sent DOE a supplemental request for information, specifically requesting maps, diagrams, and as-built drawings for past and current buildings in Area IV. Starting in its July 2010 supplemental response to EPA, DOE provided information that was responsive to both the EPA information requests letters.

Other requests for information pertaining to the site have included § 104(e) information request letter sent to the NRC and CDPHE. The purpose of the inquiries to both the NRC and the CDPHE was to identify and obtain any nuclear materials licenses pertaining to the site that may not have been captured via the information requests sent to other parties.

In preparing the HSA-5A TM, 849 individual documents and photographs were reviewed. The review process was conducted by first screening over 80,000 documents amassed for the project. These screening efforts produced 692 documents relevant to past operations at facilities within

HSA-5A and were therefore determined to warrant in-depth evaluation. Each of these 692 relevant documents was thoroughly evaluated for information considered useful for assigning MARSSIM classifications. In addition to screening and evaluating reports and other documents, a comprehensive aerial photograph analysis of Area IV was prepared. This analysis is provided in Appendix A of the HSA.

1.6.1 Contents of EPA's Site-by-Site Analyses

The subject areas considered and addressed for each site discussed in Section 2 of this TM are presented below. For each subject area, the list of criteria evaluated and the associated parameters for the evaluation are described. The most complete available information was used to evaluate the site; no known information was omitted from the description. In the event that known information did not conform to one of the listed subject areas, it was included in the most logical place.

Site Description
A physical description of the site including, at a minimum, the following data elements: building numbers of all buildings within the site; date of construction of building(s); buildings in the vicinity not associated with the site; location of site relative to street(s); site plan(s); and floor plan(s) from as-built or plan drawings, if available.

Building Features
Information related to dimensions or size of building(s), below-ground structures, vaults, pipelines, sumps, condensation lines, sewers, drains, swales, and leach fields. If none of these features were identified, the text "no information was located" was inserted.

Former Use(s)
Details of past use(s) of the site, including dates of activities.

Information from Interviewee(s)
This category includes information about the site provided by interviewee(s). If no information has been obtained for a particular site, the text "none to date" was inserted. Individuals who have been interviewed include:

- Former SSFL Employees (e.g., health physicists, electricians, mechanics, construction inspectors, nuclear technicians, etc.)
- Survivors of Former Employees;
- Former Contractors (and one survivor of a former Contractor);
- Community Stakeholders;
- Residents in surrounding areas.

At the discretion of the Interviewee, each interview was conducted either by representatives of the EPA only, representatives of the DOE only or jointly by EPA and DOE representatives. EPA's primary objective of the interview program was to help direct the soil sampling crews to potential source areas of radiological contamination identified during the course of each interview. All information on potential source areas, corroborated or not, was recorded in EPA's HSA process.

At the time of writing this TM, the EPA had completed forty-nine (49) interviews. Under the DOE/EPA joint interview program, eighteen (18) interviews have been conducted. Approximately 107 former employees have requested to be interviewed by DOE only and those interviews are complete. An additional eighty five (85) people were referred to EPA and DOE by interviewees during the course of the interviews, and of these, only twenty (20) could be located, which resulted in four (4) additional interviews. DOE has provided all of their interview transcripts to EPA for use in EPA TMs.

The interview information obtained to date relevant to this TM is depicted on the relevant Plate 1 figure. Appendix B of the HSA provides a summary of the interview process and completed interview summaries of each interview.

Radiological Incident Reports
Reports on any documented incidents at the site with the potential for release of radioactivity into the environment. If no incident reports were found, the text "none found" was inserted.

Current Use
Current use of the site, or date of demolition of building/structure.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s)
Previous radiological investigations such as surveys, decontamination activities, and cleanup activities were evaluated. The evaluation of previous investigations and cleanups addressed, at a minimum, the following elements:

- agency conducting the investigation;
- purpose of the investigation;
- dates of the investigation;
- details of releases inside building, to air, to soil, and to surface water, as applicable;
- decontamination/cleanup activities; and
- final survey results.

Radiological Use Authorizations
Use authorizations have been defined as issuance of a license for radioactive material(s) from an appropriate regulatory agency. All known licenses issued for the site were included; if none were found, the text "none found" was inserted.

Former Radiological Burial or Disposal Locations
A description of known burials and/or disposals of radiological materials on the site, including applicable dates, if known. If no documented burials and/or disposals were identified, the text "none found" was inserted.

Aerial Photographs
The applicable photographic analyses from the report prepared by the EPA's Environmental Photographic Interpretation Center (EPIC) in March 2010 were included for each site. These analyses include photographs from the following dates:

- December 22, 1952;

- August 19, 1957;
- August 21, 1959;
- 1962/1963;
- March 1, 1965;
- August 13, 1967;
- April 20, 1972;
- May 16, 1978;
- October 21, 1980;
- August 21, 1983;
- October 10, 1988;
- June 19, 1995; and
- June 8, 2005.

Aerial photograph anomalies were interpreted as a trigger for assigning a higher scrutiny to a particular site than other information (such as historical documents) would indicate.

Radionuclides of Concern
Radionuclides used/generated at the site. This description includes, at a minimum, the types of radiological material(s) managed at the site; radionuclides known or suspected to have been handled or generated on the site; and how the identified radionuclides impact the list of radionuclides of concern in the background study. If no information was available, the text "none found" was inserted. It is important to note that not every radionuclide listed in this historical site assessment will have a sample analysis. The radionuclides are listed for completeness, indicating that they have been mentioned or discussed in a cited document or report. However, many of the facility and site reports reflect the conditions at the time, thus every mention of a specific radionuclide does not mean it would be present now, due to decay. For this reason, the Radionuclides of Concern sections described for each facility or site list those found in historical records. The Radionuclides of Concern (Table 3.3) lists radionuclides that will be analyzed and does not include those that would have decayed in the years since operations ceased.

Drainage Pathways
This category includes information on the direction of surface water flow on the site and the presence of sanitary drains, storm drains, septic systems, or leach fields on or near the site.

Radiological Contamination Potential
The potential for radiological contamination was evaluated for each site. Evaluations included consideration of the completeness of past cleanup and remedial operations. Many past clean-up efforts likely did not achieve the requirements of the DTSC/DOE AOC dated December 2010 that generally requires a cleanup to background levels for both radiological and chemical contaminants.[1] Background studies for the site are nearing completion with EPA leading the radiological background study and the DTSC leading the chemical background study. The potential for radiological contamination is quantified in this TM by assigning a preliminary MARSSIM class describing the possibility for residual radiological contamination at the site based on all information collected to date. The basis for assigning the preliminary MARSSIM classification includes an examination of the following data elements:

- historical site operations;

- previous radiological investigations;
- reported incidents of releases;
- decontamination and remediation operations at the site;
- interviews with former workers;
- drainage pathways on or near the site;
- aerial photograph interpretation; and
- site reconnaissance.

Recommended Locations for Soil/Sediment Sampling

For each site, recommendations were made for possible targeted soil/sediment sampling locations. The selection of potential sampling locations was based on locations with the highest potential for radiological contamination as well as at the particular site based on all known information collected to date. The criteria evaluated for developing recommended soil/sediment sampling locations include the following:

- topography of the site;
- historical site operations;
- radiological investigations;
- reported incidents of releases;
- decontamination/cleanup operations at the site;
- interviews with former workers;
- storm drains on or near the site;
- sewer lines on or near the site;
- aerial photograph interpretation; and
- site reconnaissance.

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2.0 FINDINGS

This section organizes the building areas within HSA-5A according to five logical "clusters" (a.k.a. groups) based on operational characteristics and geographic locations. Plate 1 depicts the entire HSA-5A subarea and should be referenced while reading Section 2. Each HSA-5A group (discussed in Sections 2.1 through 2.5, below) is depicted in an accompanying group map, which serves as a guide for the text describing the building areas in that group and also as an index for the group's site photograph and building layout drawings.

2.1 GROUP 1

The Group 1 index map is presented in Figure 2.1. Following Figure 2.1, the site photograph and layout drawings for each building area within HSA-5A Group 1 are presented. HSA-5A Group 1 includes six buildings including Building 4024, the Systems for Auxiliary Nuclear Power (SNAP) Environmental Test Facility (SETF), Building 4023, the Liquid Metals Component Test Building, and Building 4027, the SNAP Engineering Development Laboratory.

2.1.1 Building 4023 Area

Site Description: The Building 4023 area comprises Building 4023 and the land surrounding the building located on 12th Street. The "old" portion of Building 4023 was constructed in 1962, and the "new" building section was constructed in 1976.[11] The facility was approximately 20 feet below the general grade of the adjacent 12th Street and was surrounded by an "A.C. Ditch" to the north and east of the building.[12,13] Figures 2.1.1a through 2.1.1d provide a current photograph and the best available building-specific drawing(s) that the research team could find. The 1969 site layout does not show a radioactive waste holdup tank; however, a plan view of the building from a 1993 final survey report shows a waste holdup tank to be located directly east of the building between the building exterior and the "A/C Ditch" (Figure 2.1.1c). Building 4023 was serviced by substation Building 4742; however, that building was located southwest of Building 4042, which was located on the other side of B Street. Plate 1 presents a summary of all identified features for this site.

Building Features: Building 4023 was a DOE-owned single story structure with galvanized steel walls and roof and a concrete slab floor. The sodium test loop was located in a small partitioned area in the western, or "old," portion of the building, constructed in 1962. This portion of the building has also been used for storage. The "new" building section, constructed in 1976, held an analytical chemistry laboratory and a storage set-up room.[14] A 250-gallon stainless steel waste holdup tank was installed at the facility in 1976 and was located in an exterior sub-grade open-top concrete vault (7.5 feet x 10 feet x 6 feet) at the east end of Building

[11] ORISE, *Verification Survey of Buildings 005, 023, and 064, Santa Susana Field Laboratory, Rockwell International, Ventura County, California*, 94/K-14, October 1994.
[12] Drawings appear to indicate that A.C. refers to "asphaltic concrete." The ditches surrounding this building were paved and likely served as a pipe trench for the cooling system return and supply lines between the building and the evaporator (Atomics International Drawing 303-027-C2, Topographic Plan, March 4, 1963).
[13] DOE, *Certification Docket for the Release of Building 023 at ETEC*, Docket No. DOE/CD-ETEC-023, February 1997.
[14] ORISE, *Verification Survey of Buildings 005, 023, and 064, Santa Susana Field Laboratory, Rockwell International, Ventura County, California*, 94/K-14, October 1994.

4023.[15] Approximately 80 feet of 3-inch cast iron drain line and 40 feet of 2.5-inch galvanized pipe vent lines were included in the waste holdup system. The drain lines ran along the outside of the building to a double fixture fitting near the holdup tank vault. The drain line then ran underground approximately 6 feet. through the vault wall and into the tank. Portions of the drain line were covered by a concrete pad that was used to accommodate an air conditioning unit.[16,17]

Former Use(s): Building 4023 served as the Liquid Metals Component Test Building and the Corrosion Test Loop.[18] The first section of Building 4023, constructed in 1962 and known as 023, housed a small sodium loop to conduct studies of radioactive contamination transport. The second section, constructed in 1976 and known as 23A, served as a storage and setup room as well as an analytical chemistry laboratory.[19]

In 1976, a use authorization allowed the use of a small section of activated stainless steel Experimental Boilers Reactor fuel cladding in a small sodium test loop, located in the northwest corner of Building 4023, to gather data on transport characteristics of radiological contamination in sodium loops.[20,21,22] The sodium loop tests were halted in 1983 and the loop was dismantled in 1986.[23] At this point the connections to the tank were sealed and sinks were removed.[24]

In 1982, an Alnor Dew-Point Meter containing a 6.25 µCi Ra-226 source was brought to the facility to be disassembled, but the disassembly was never authorized or attempted and the instrument was removed intact in 1986. A 10 µCi Mn-54-sealed source, which was checked annually to ensure that no leaks had occurred, was stored in the building from 1983 to 1986.[25]

According to a 1987 Site Consolidation Assessment, Building 4023 served as a development and demonstration test facility in support of the Rocky Flats Plutonium Recovery Project in 1987. These operations were located in the east bay and chemistry laboratory. The west bay of the building was being used for the storage of powerjet hardware. Additional information regarding these operations in Building 4023 could not be located; however, available information indicates the project included the mechanical and structural design of 24 glove boxes, special manipulators and conveyor systems. This project also included the development of design criteria, definition

[15] Information could not be located to identify the waste disposal practices prior to the installation of the waste holdup tank in 1976. Additionally, a February 17, 1981, Rockwell International internal letter indicates the tank to have been 500 gallons.
[16] Rocketdyne, *Building 023 D&D Operations Final Report*, 023-AR-0002 Rev. A., March 7, 1996.
[17] Rockwell International, *Rocketdyne Division Environmental Monitoring and Facility Effluent Annual Report, De Soto and Santa Susana Field Laboratories Sites 1989*, RI/RD90-132, May 1990. p. II-14
[18] Little information has been located describing the liquid metals component test operations in Building 4023 or when these operations occurred.
[19] DOE, *Certification Docket for the Release of Building 023 at ETEC*, Docket No. DOE/CD-ETEC-023, February 1997.
[20] Information contained in historical documents obtained by HGL to date have not provided information regarding specific building operations that occurred from 1962 through 1976. Additional information regarding the operations during this time period are needed.
[21] DOE, *Certification Docket for the Release of Building 023 at ETEC*, Docket No. DOE/CD-ETEC-023, February 1997.
[22] *Liquid Metals Test Building – 023, Santa Susana Facility, Ventura County, California, Building Piping Plan, 303-023-M5*, January 1, 1963.
[23] Rocketdyne, *Building 023 D&D Operations Final Report*, 023-AR-0002, September 21, 1993.
[24] DOE, *Certification Docket for the Release of Building 023 at ETEC*, Docket No. DOE/CD-ETEC-023, February 1997.
[25] Rocketdyne Report, *Building 023 D&D Operations Final Report*, 023-AR-0002 Rev. A., March 7, 1996.

of process equipment and glove boxes to manage plutonium, development of flow diagrams, design and specification of equipment and glove boxes, safeguard evaluations, experimental verification designs, reliability, availability and maintainability evaluations, and preparation of conceptual design reports.[26][27]

In 1989, reports appear to indicate that Building 4023 served as a support facility for the Transuranic (TRU) Management by Pyropartitioning – Separation (TRUMP-S) operations in Building 4020, located in Subarea HSA-5D. Atomics International requested DOE's approval to utilize the facilities for a 2-year period beginning July 1988 for the Kawasaki Heavy Industries (KHI) and the Central Research Institute of the Electrical Power Industry (CRIEPI) of Japan-sponsored "pyrochemical partitioning of actinides from PUREX waste" program. According to the reports, inductively-coupled plasma (ICP) analysis at Building 4023 was not higher than 10 µCi of activity. The ICP analyzer was located in Room 102A. The material used in this experiment was listed as including uranium, neptunium (Np-237), plutonium (Pu-239), and americium (Am-241). The process of transporting the material from Building 4020 to 4023 was identified as follows:[28,29]

> When aqueous samples are transferred from Building T020 to Building T023 for analysis and back to T020 for solidification and disposal, no more than 10 µCi are contained in the 20-milliliter aliquot needed for rare earth analysis in Building T023. The aliquot will be placed in a 25-mL glass vial and sealed with a screw-top cap. The glass vial will be placed in a plastic bottle with a screw-top cap. R&NS will smear the bottle to make sure it is uncontaminated, and the plastic bottle will be sealed in a plastic bag. The bag will be placed in a carrier which will be transported to Building T023. At Building T023, a sphincter port will be used to introduce the sample and its plastic bottle into the nebulizer glove box. Excess sample and waste will be bagged out of the nebulizer glove box and taken back to T020 in a similar manner to that described above.

While Building 4023 was owned by DOE, DOE agreed to use the building for this program. The program was listed as being part of "DOE's Private Sectors Initiative," and DOE agreed to provide the experimental materials and dispose of the waste. At the conclusion of the work, the facilities were to be decontaminated to a "level that they may be released for unrestricted use." The confirmatory survey was to have been funded by the project.[30,31,32] The duration of these activities in Building 4023 could not be located.

A March 1991 environmental, health, and safety self-assessment of ETEC provided a five-year plan that included activities for the decommissioning of Building 4023. According to this document, activities planned for Building 4023 included the surveillance and maintenance of

[26] ETEC, *Site Consolidation Assessment*, April 16, 1987. p. 13.
[27] Litwin, R.Z., *Rockwell International Background and Capability to Develop a Weapons-Grade Plutonium Fuel Cycle and Disposal Evaluation for the PDR*, October 5, 1992.
[28] Rockwell International, *Safety Analysis for Building T020, Operations, TRUMP-S*, 190ER000011, December 4, 1989.
[29] Rockwell International, *Revised TRUMP-S Project Radioactive Materials Usage Application*, 190TI000001, October 31, 1989.
[30] Rockwell International, *Safety Analysis for Building T020, Operations, TRUMP-S*, 190ER000011, December 4, 1989.
[31] Rockwell International, *Revised TRUMP-S Project Radioactive Materials Usage Application*, 190TI000001, October 31, 1989.
[32] Rockwell International, *TRUMP-S Test Program – Nuclear Materials Management Plan*, 190NMP000001, October 17, 1989.

"remaining radioactively contaminated systems in and around" Building 4023. These included a disconnected radioactively contaminated hood inside the building and the associated piping and radioactive liquid holdup tank. These surveillance and maintenance activities were to be continued until the facility was to be decommissioned in the Fiscal Year 1993. Activities planned for Fiscal Year 1993 included the decontamination and removal of the radioactive liquid hold-up tank and the associated piping located outside of Building 4023, as well as the removal and packaging of the radioactive fume hood that was reported to contain a contaminated sink. Activities were to include the packaging and disposal of the tank, piping, and sink as radioactive waste.[33] According to the certification docket for Building 4023, the radioactive liquid waste holdup system was removed in 1993.[34]

In 1992 and 1993, an analytical and ICP instrument was used to analyze small amounts of radioactively-contaminated solution from the Molten Salt Oxidation project for trace metals. According to a final radiological study completed in 1994, the work was reportedly completed without incident and the remainder of the radioactive solutions and containers were transferred to the Radioactive Material Handling Facility (RMHF). The study did not indicate the quantity or nature of the radioactive solutions and containers that were transferred to the RMHF.[35] DOE formally released Building 4023 on April 21, 1997.[36] The State of California Department of Health Services (DHS) concurred with the release of Building 4023 on February 19, 1998.[37]

Information from Interviewees: A summary of the information provided from interviewees is presented below.

Interviewee 101 worked at the SSFL in the Atomics International Engineering Department as a manager of System and Test from 1986 through 1997. The following excerpts were pulled from the interview:

"I managed buildings 133, 005, 006 and 023, as well as some inactive buildings, and a total of perhaps 15 people. . .

Building 023 was used for research in a joint DOE / Japan project, lasting 8 years, dealing with chemical separation for fuel recovery."

Radiological Incident Reports: There have been two incidents associated with Building 4023 that could have resulted in a release to the environment. The following table provides information presented in an incidents database provided by Boeing. Summaries of the incident reports are provided following the table, when available.

[33] Rockwell International, Document No. GEN-AR-0023, *An Environmental, Health, and Safety Self-Assessment of the Energy Technology Engineering Center, Volume 2*, March 18, 1991.
[34] Flore, J.J., Department of Energy, Docket No. ETEC-023, *Certification of the Radiological Condition of Building 023 at the Energy Technology Engineering Center Near Chatsworth, CA*, March 12, 1997.
[35] Rocketdyne Report, *Final Radiological Survey Report of Building 023*, 023-ZR-0001, March 1, 1994.
[36] Liddle, Roger, DOE/OAK, Letter, "Release of Facilities for Unrestricted Non-Radiological Use," April 21, 1997.
[37] Wong, Gerald, DHS/RHB, Letter, "Boeing's Request for Concurrence in Release for Use Without Radiological Restriction, Rocketdyne Santa Susana Field Laboratory Building T023," February 19, 1998.

Building 4023 Incident Report Summary

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A0084	12/18/1980	R/A Sodium Loop	Activation Corrosion Products*	Rinse water surged out of deconned loop leg, contaminating the area.
A0257	4/22/1981	Sodium Loop	Co-60/Mn-54	Five grams of hot radioactive contaminated sodium leaked from loop and burned.

* Activation corrosion products have been defined as typically comprising Co-60, Mn-54, Ni-59, Ni-63, and Fe-55).

- On December 3, 1980, after modifications to the Sodium Loop, personnel poured alcohol into the cold leg of the loop to neutralize the residual sodium in the leg. Personnel drained the alcohol and poured new alcohol in, let it set for six hours, and drained the alcohol. Approximately one quart of water was poured into the cold leg of the loop, and reacted with the sodium in the sample line that had not been neutralized by the alcohol. The water and a small amount of sodium surged out of the cold leg of the loop contaminating the ceiling, walls and floor with maximum contamination levels of 1,000 dpm/100 cm^2 of Mn-54 (A0084). The incident report does not provide information to indicate whether and how the contaminated areas were cleaned following the incident.[38]

- On April 22, 1981, there was a minor sodium (approximately 5 grams) leak and fire, with Cs-137, Mn-54, and Co-60 as the principal radioactive isotopes contained in the loop at the time. Compression clamps holding "Conoseal" on the top portions of the loop broke allowing approximately 5 grams of sodium to leak out. The loop was approximately 1,200 degrees Farenheit (^{o}F), resulting in a sodium fire. The fire was extinguished with calcium carbonate. Smears (also known as wipe samples) of the loop and the floor showed no radioactive contamination. The incident report did not provide any results of the wipe samples but indicated the lack of significant activity would likely have been the result of the source having been recently inserted in the loop (A0257).[39,40]

Current Use: Building 4023 was demolished in 1999.[41] The previous building site has been restored to a natural state, including reseeding with native grasses.[42] Based on available information, the dimensions of the excavation made during building demolition are unknown.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): A chronology of radiological investigations at this building is as follows:

- According to the final radiological survey completed in 1994, a comprehensive radiological survey of Building 4023 and its surrounding area was performed in 1988. The 1988 survey recommended remedial efforts be undertaken to remove residual

[38] Bradbury, S.M.,, Internal Letter Re: Radiological Safety Incident Report, Building 023, December 18, 1980.
[39] Bradbury, S.M., Internal Letter Re: Radiological Safety Incident Report, Building 023, April 28, 1981.
[40] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries,* May 2005
[41] DOE, NNSA Service Center, *Environmental Assessment for Cleanup and Closure of the Energy Technology and Engineering Center, Final*, March 2003.
[42] Cabrera Services, Inc., *Final Status Survey Report: Final Status Survey Post Historical Site Assessment Sites, Block 1*, March 2007.

radioactively-contaminated compounds from the building structure and grounds.[43]

- In September 1993, Rocketdyne completed a final report on the decontamination and decommissioning (D&D) operations at Building 4023. According to the report, D&D of the building occurred in three phases, starting in 1986 with the removal of the sodium loop and ending in 1993 following the removal of the radioactive liquid waste holdup system. The 1993 report provided a summary of the D&D activities in 1986 and 1990.[44]

    - In 1986, the sodium test loop was removed and two sinks were disconnected. The sink connections to the liquid waste holdup system were sealed and the sinks removed and dispositioned.

    - In 1990, the high-efficiency particulate air (HEPA) filtered gas exhaust system was removed. The fume hood was disconnected from the liquid waste holdup system and the HEPA exhaust system, and was relocated for storage within the facility. The ducting from the fume hood to the filter plenum was removed and disposed of as low level radioactive waste. The remaining components of the HEPA filtered gas exhaust system, filter plenum, blower and exhaust stack were removed and shipped to the University of Missouri for use on the TRUMP-S project.

  The 1993 D&D activities included the decontamination of the fume hood, removal and disposal of the liquid waste holdup system, including the drain and vent lines, the liquid waste storage tank, and the floor area where the sodium loop had been located. The removal of the liquid waste holdup system included the removal of a portion of the concrete pad of the air conditioning unit to gain access to the drain lines. Following removal of the drain and vent lines, which were cut into waste box lengths, the tank was removed and transported to the RMHF for size reduction.[45]

  During the final survey, fixed contamination of Cs-137 was found on the concrete floor in the old control room where the sodium loop had been installed at levels ranging from 1,289.63 disintegrations per minute per 100 square centimeters (dpm/100 cm^2) to 20,551.21 dpm/100 cm^2 maximum beta. The area was decontaminated by "scabbling" of the concrete surface and vacuuming until no surface contamination above 1993 release limits were located. The 1993 surface contamination limits for beta and gamma emitters was <5,000 dpm/100 cm^2 average, <15,000 dpm/100 cm^2 maximum, and <1,000 dpm/100 cm^2 removable.[46,47,48,49]

[43] Rocketdyne Report, *Final Radiological Survey Report of Building 023*, 023-ZR-0001, March 1, 1994.
[44] Rocketdyne, *Building 023 D&D Operations Final Report*, 023-AR-0002 Rev. A., March 7, 1996. p. 3-4
[45] Rocketdyne, *Building 023 D&D Operations Final Report*, 023-AR-0002 Rev. A., March 7, 1996. p. 4-5
[46] Rocketydyne, *Final Radiological Survey Report of Building 023*, 023-ZR001, March 1, 1994, p. 65
[47] Rocketdyne, *Building 023 D&D Operations Final Report*, 023-AR-0002 Rev. A., March 7, 1996. p. 5
[48] Rocketdyne, *Building 023 Final Survey Procedure*, 023-SP-0001, August 3, 1993, p.8
[49] According to various documents available on the Department of Energy website, scabbling is the process of removing nuclear surface contamination from concrete surfaces. Industrial methods used for removing contamination by this process include, but are not limited to, high pressure water jets, grit blasting, lasers, and explosives. The document referenced here does not provide detailed information of the process used during the final survey.

- According to an internal letter dated October 13, 1993, two soil samples were collected from soil beneath an underground pipe servicing the underground storage tank, both of which had been previously removed. The purpose of the sampling was to determine if the soil in the area had been impacted from materials transported through the pipe. According to the letter, the soils sample results were "non-detect for all of the constituents analyzed" without specifying what the detection levels were. Constituents analyzed included K-40, Tl-208, Pb-212, Pb-214, Bi-214, Ra-224, Ra-226, Ac-228, Th-227, Th-234, and U-235; however, the letter did not state the detection levels or why the above radiological constituents were analyzed for and did not include Cs-137.[50]

- In 1993, Rocketdyne conducted a final radiological survey to ensure compliance with 1993 acceptable contamination limits for activation products and mixed fission products and for ambient exposure rate. The survey, conducted only within the interior rooms of the building, had the following contamination limit criteria for alpha and beta contamination: average contamination of 5,000 dpm/100 cm^2; maximum contamination of 15,000 dpm/100 cm^2; and removable contamination of 1,000 dpm/100 cm^2. For gamma contamination, the contamination criteria limit was 4 milli roentgen per hour (mR/hr) above background at 1 meter interior and exterior.

  As indicated above in the summary of the September 1993 D&D operations final report, surface scans during final surveys of Building 4023 found elevated levels of Cs-137 on the concrete floor in the old control room requiring additional decontamination. This area was decontaminated and post-remedial action scans reported surface activity to be below the 1993 release limits. The observed detection limit ranges for removable alpha was 2 dpm/100 cm^2 to 9 dpm/100 cm^2. Total beta and removable beta were 252 to 373 dpm/100 cm^2 and 6 to 23 dpm/100 cm^2, respectively. The net ambient gamma exposure rate was measured at 0.49 mR/hr to 0.66 mR/hr.[51]

- In 1994, Oak Ridge Institute for Science and Education (ORISE) conducted a verification survey using surface scans to confirm that remedial actions had been effective in meeting 1994 guidelines. The survey teams, consisting of Environmental Survey and Site Assessment Program (ESSAP) personnel, performed visual inspections and independent measurements and sampling inside the building structure as well as exterior areas. Surface scans were performed using gas proportional, ZnS, GM, and/or NaI detectors coupled to ratemeters or ratemeter-scalers with audible indicators. No soil samples were taken because the entire area around Building 4023 was paved.[52] The report indicated that scans inside the Building 4023 Control Room identified elevated direct radiation with an activity level of 20,000 dpm/100 cm^2 in two areas within the Control Room that required additional investigation. Rocketdyne personnel decontaminated the two areas and ESSAP personnel performed additional scans following the decontamination, and the post-remedial activity was less than 1,400 dpm/100 cm^2. Additional scans of the building by ESSAP personnel showed the total surface activity was comparable to background levels. Final survey results for total surface activity levels inside Building 4023 were less than 66 to 400 dpm/100 cm^2 for alpha and less than 1,400 to 6,700 dpm/100 cm^2 for beta.

[50] Rockwell International, Internal Letter Re: Building 023 Soil Sample Results, October 13, 1993.
[51] Rocketdyne Report, *Final Radiological Survey Report of Building 023*, 023-ZR-0001, March 1, 1994.
[52] ORISE, *Verification Survey of Buildings 005, 023, and 064, Santa Susana Field Laboratory, Rockwell International, Ventura County, California*, 94/K-14, October 1994.

Final survey results for activity levels on exterior surfaces, including the holdup waste tank vault, were reported to have been less than 66 to 120 dpm/100 cm^2 for alpha and less than 1,500 to 1,600 dpm/100 cm^2 for beta.

As indicated above, the 1993 surface contamination limits for beta and gamma emitters was <5,000 dpm/100 cm^2 average, <15,000 dpm/100 cm^2 maximum, and <1,000 dpm/100 cm^2 removable.

- On February 19, 1998, the Radiological Health Branch (RHB) and DHS reported the results of a confirmatory survey of Building 4023 conducted on August 23, 1997. According to the report, a complete qualitative gamma scan of the facility and surrounding area was performed with selected measurements of total and removable beta surface activity and local gamma exposure rates also being conducted.[53] The survey began with background measurements in the north end of the building where no reported handling of radioactive materials occurred. The report provided three background measurements based on three different meter readings as depicted in the following table:

August 1997 RHB Building 4023 Background Measurements

Meter	Reading
Ludlum M-19 Rate meter (μR/hr)	8 μR/hr
Ludlum model 3 survey meter w/ 1x1 NaI probe	2,500 cpm
Ludlum model 3 survey meter w/ Ludlum 44-9 G-M pancake probe	40 cpm

The survey included a complete gamma scan of the floor inside the building and the lower two meters of the interior walls. The survey reported no indications of elevated gamma radiation fields within the building. Additional surveys included using a G-M pancake probe, sensitive to beta and gamma radiation and a NaI detector for gamma, to perform contact measurements at selected locations throughout the structure and the tank sump. The NaI detector for gamma showed a range of 1,600 cpm in the control room to 3,200 cpm at the tank sump. G-M pancake probe measurements ranged from 20 cpm on the west wall of the control room to 60 cpm in the center of the control room. The RHB also collected a soil sample from the bottom of the tank sump on the "south" side of the building. However, a graphic showing the sampling locations shows the sump to be located east of the building, outside of Room 106. This sample was sent to the Sanitation and Radiation Laboratory for analysis; however the results are not provided in the report. The possible contaminants identified in the report included Cs-137, Mn-54, and Co-60; however, a table included in the summary appears to show gamma readings in the tank sump to have included K-40 at 22.8 pCi/g, Cs-137 at 0.953 pCi-g, and Co-60 at 0.068 pCi/g. The summary indicated that the survey results were "all less than twice background for the structure and surrounding area." As a result, the report summarized that the survey results and laboratory analysis results confirmed the results of the final radiological survey in 1993 and the ORISE verification survey in 1994.[54]

[53] Wong, Gerard, DHS Radiologic Health Branch Letter Re: Boeing's Request for Concurrence in Release for Use Without Radiological Restriction, Rocketdyne Santa Susana Field Laboratory, Building T023, February 19, 1998.
[54] DHS/RHB, Letter, "Boeing's Request for Concurrence in Release for Use Without Radiological Restriction, Rocketdyne Santa Susana Field Laboratory Building T023," from Gerard Wong (DHS/RHB) to Phil Rutherford, February 19, 1998.

- According to the 1997 annual site environmental report, D&D activities in 1997 included the removal of asbestos-containing materials, which were disposed of as construction debris. The report did not indicate any radiological surveys during these D&D activities.[55,56]

- In March 2007, Cabrera Services, Inc., presented the findings of the Final Status Survey Report for Post-Historical Site Assessment (HSA) sites located within "Block 1," which included Building 4023. During this survey, samples were collected from 15 random-start systematic sample locations within each of two survey units at Building 4023, survey unit 10 and survey unit 11. Eighteen out of 5,562 gamma walkover survey measurements exceeded a z-score of 3 (<1%). The highest gamma walkover survey results in both survey units were investigated with biased surface soil samples. One subsurface sample was collected to investigate the former sump pit located east of the building. None of the samples reported radionuclide concentrations above their respective 2007 Derived Concentration Guideline Levels (DCGLs). The DCGLs established by Cabrera Services, Inc., were derived, radionuclide-specific activity concentrations within a survey unit corresponding to the release criterion and were based on the most "restrictive" standards between the Boeing DCGL and the 2006 EPA PRG 10^{-4} Risk Level, as indicated below.[57]

DCGLs for Radionuclides of Concern

Constituent	Residential Soil Concentration (pCi/g)	
	Boeing DCGL [1]	EPA PRG 10^{-4} Risk Level [2]
Americium-241	**5.44** [3]	187
Cobalt-60	**1.94**	4
Cesium-134	**3.33**	16
Cesium-137	9.2	**6**
Europium-152	4.5	**4**
Europium-154	**4.1**	5
Tritium	31,900	**228**
Manganese-54	**6.1**	69
Plutonium-238	**37.2**	297
Plutonium-239	**33.9**	259
Plutonium-240	**33.9**	-
Plutonium-241	**230**	40,600
Strontium-90	36	**23**
Thorium-228	**5**	15
Thorium-232	**5**	**5**
Uranium-234	**30**	401
Uranium-235	30	**20**
Uranium-238	**35**	74

[55] The Boeing Company, *Rocketdyne Propulsion and Power DOE Operations Annual Site Environmental Report 1997*, A4CM-ZR-0012, November 23, 1998.
[56] Zenco Engineering, Inc., Letter Re: ETEC Demolition Package A, Building 4023, Not to Exceed Estimate for Asbestos Abeatement, May 21, 1999.
[57] Cabrera Services, Inc., *Final Status Survey Report: Final Status Survey Post Historical Site Assessment Sites, Block 1*, March 2007.

[1] Boeing, Approved Sitewide Release Criteria for Remediation of Radiological Facilities at the SSFL, 1998

[2] Source: Based on EPA preliminary remediation goals (PRGs) for residential soil at a 10^{-4} risk level. OSWER 9355.01-83A. "Distribution of OSWER Radionuclide Preliminary Remediation Goals (PRGs) Superfund Electronic Calculator." February 7, 2002. http://epa-prgs.ornl.gov/radionuclides. Data retrieved October 26, 2006.

[3] More restrictive standard for each constituent is bolded.

Radiological Use Authorizations: As indicated above, Use Authorization 105 was issued in November 1976 for Building 4023.[58] It allowed the use of a small section of activated stainless steel Experimental Boilers Reactor fuel cladding in a small sodium test loop to gather data on transport characteristics of radiological contamination in sodium loops.[59]

Former Radiological Burial or Disposal Locations: Building 4023 had its own radioactive liquid waste holdup system that included above- and below-grade drain lines and a below-grade storage tank located in an uncovered concrete vault east of the building. The system serviced two sinks and a fume hood where it was reported that small quantities of radioactive materials were handled. The water was reported to have had "trivial contamination." "All of the drain lines" ran along the exterior of the building to a "double fixture fitting near the holdup tank vault." The drain line then ran underground approximately 6 feet, through the vault wall and into the tank.[60][61] Rocketdyne removed the liquid waste holdup tank and associated drain and vent lines in 1993 and transported the tank to the RMHF for size reduction. Information regarding the final disposal of the Building 4023 liquid waste holdup tank could not be located by the research team.[62]

Aerial Photographs: Beginning in 1962, the area comprising the future Building 4023 site is under development and the site contains medium-toned mounded material. By 1965, the building has been constructed and the area surrounding the building appears to be recently paved. There are limited observations at the building until May 1978 when two probable vertical tanks appear on the east side of the building, and a possible overhead pipeline connects Building 4023 to Building 4042. By 1980, the vertical tanks are no longer present on the west side of the building; however, a vertical tank is located north of the building along 12th Street and remains visible until 1995. There are also apparent aboveground pipelines on the north and west sides of the building; however, these pipelines could not be confirmed with historical documents. By June 2005 the building has been removed and the area is vegetated.

Radionuclides of Concern: Operations in Building 4023 resulted in the radiological contamination of the laboratory radioactive sink system, the liquid waste holdup tank, and old sodium loop control room. Possible radionuclides of concern identified in a 2007 Final Status Survey Report at Building 4023 include americium-241 (Am-241), isotopes of plutonium (Pu-238, Pu-239, Pu-240, and Pu-241); fission products cesium-134 (Cs-134), Cs-137, strontium-90 (Sr-90); source and uranium products, thorium-228 (Th-228), Th-232, uranium-234 (U-234), U-

[58] HGL has not yet located the actual use authorization for this building.

[59] DOE, *Certification Docket for the Release of Building 023 at ETEC*, Docket No. DOE/CD-ETEC-023, February 1997.

[60] Tuttle, R.J., Rockwell International Internal Letter Re: Sources of Radioactively Contaminated Water at Santa Susana, February 17, 1981.

[61] Rocketdyne Report, 023-AR-0002, "Building 023 D&D Operations Final Report," September 21, 1993.

[62] Rocketdyne, *Building 023 D&D Operations Final Report*, 023-AR-0002 Rev. A., March 7, 1996. p. 4-5

235, U-238; isotopes of neptunium (Np-237); and activation products, cobalt-60 (Co-60), manganese-54 (Mn-54), europium-152 (Eu-152), Eu-154, and tritium (H-3).[63,64,65] In the 2005 HSA, Sapere also indentified nickel-63 (Ni-63), iron-55 (Fe-55), and tantalum-182 (Ta-182).[66,67] All radionuclides of concern listed with the exception of Ta-182 are included in the August 2009 Final Field Sampling Plan for the Santa Susana Field Laboratory radiological background study. Ta-182 has a half-life of less than 1 year and thus does not meet the criteria for analysis. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: The 1964 and 1994 plot plans of Building 4023 show an "A.C. ditch" on the northern and eastern side of the building, which is also depicted in aerial photographs.[68,69] The research team did not locate any documented information regarding the construction of this ditch, or the final grading of the ditch when Building 4023 was demolished; however, 1964 plot plans show the ditch to terminate at B Street at a catch basin and then flow into an 18-inch corrugated metal pipe. The corrugated metal pipe then directed flow to a drainage channel along the northeast side of 12th Street to G Street and ultimately southwest to the concrete spill apron at the intersections of 17th Street and G Street to "R-2A Pond." Additionally, a 2-inch drain appears to have directed flow from the southwest corner of the concrete slab to the north of the building to a catch basin located west Building 4023. This drainage then flows into a 12-inch corrugated metal pipe that directs flow south of the building to the same drainage channel along the northeast side of 12th Street to G Street.[70]

Radiological Contamination Potential: Class 1 because of the former use of Building 4023 and gaps in operational information regarding use of building for other non-DOE radiological purposes.

Recommended Locations for Soil/Sediment Sampling: Plate 1 and Figure 2.1 provide a convenient reference for the following recommendations.

Based on the available information, soil sampling is recommended in the Building 4023 area. As discussed above, there were radiological incidents at Building 4023 and documented evidence of radiological releases. Significant information is lacking regarding the excavation activities at Building 4023.

In addition, previous characterization studies for the Building 4023 area were focused on delineating the extent of contamination to standards that were applicable at the time. Therefore, additional characterization is recommended for the Building 4023 area. This includes the following Building 4023 areas and appurtenances:

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[63] Cabrera Services, Inc., *Final Status Survey Report: Final Status Survey Post Historical Site Assessment Sites, Block 1*, March 2007.
[64] Rocketdyne, Rockwell International, *Building 023 Final Survey Procedure*, 023-SP-001, August 3, 1993
[65] Rockwell International, *Revised TRUMP-S Project Radioactive Materials Usage Application*, 190T1000001, October 31, 1989.
[66] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 -- Area IV Site Summaries*, May 2005
[67] Sapere Consulting, Inc. referenced a January 20, 1993, internal letter regarding potential contaminants at T023. The research team has not located this document in the documents provided to date.
[68] Atomics International, Santa Susana Facility Plot Plan, Drawing 303-GEN-C38, Sheet 4 of 14, June 4, 1964.
[69] ORISE Report, 94/K-14, "Verification Survey of Buildings 005, 023, and 064, Santa Susana Field Laboratory, Rockwell International, Ventura County, California," October 1994. p. 17
[70] Atomics International, Santa Susana Facility Plot Plan, Drawing 303-GEN-C38, Sheet 4 of 14, June 4, 1964.

- Previous location of underground radioactive holding tank and the associated drain lines. The waste holdup system for Building 4023 included above- and below-grade drain lines and a below-grade storage tank located in an uncovered concrete vault east of the building. "All of the drain lines" ran along the exterior of the building to a "double fixture fitting near the holdup tank vault." The drain line then ran underground approximately 6 feet, through the vault wall and into the tank.[71] Sampling should be conducted along the underground drain line and at the previous location of the vault wall where the drain line entered the vault.

- Former location of "A/C Ditch" north and east of building, as well as the surrounding catch basins as depicted in Figure 2.1.1c. If radioactive materials were released from the handling of any material in the radioactive holding tank, which is located near the ditch, residual contamination above background values may exist.

- Location of unknown 2-inch drain line located at northwest corner of building. Information regarding a 2-inch drain line depicted in a 1964 plot plan of the building could not be located; however the line extends from the northwest corner of the building from the concrete apron to a catch basin located west of the building.

- In 1976, a use authorization allowed the use of a small section of activated stainless steel Experimental Boilers Reactor fuel cladding in a small sodium test loop to gather data on transport characteristics of radiological contamination in sodium loops.[72] The sodium loop tests were halted in 1983 and the loop was dismantled in 1986.[73] Sampling at the former sodium loop locations in the northern half of Building 4023 and the former connections to the tank is recommended.

2.1.2 Building 4024 Area

Site Description: The Building 4024 area comprises Building 4024, substation Building 4725, Cooling Tower 4928, and the land surrounding these buildings located on G Street.[74] Constructed in 1959, Building 4024 is a 13,972-square foot facility. Figures 2.1.2a through 2.1.2n provide a current photograph and the best available building-specific drawing(s) that the research team could find. Plate 1 presents a summary of all identified features for this site.

Building Features: Building 4024, the SETF, is a 13,972-square foot facility consisting of a "main high-bay superstructure containing a sub grade reactor vault complex, with an open pit access area adjacent to the vault, and two prefabricated steel low-bay buildings attached to opposite sides of the superstructure to provide administrative and operational support areas." The main "superstructure" consisted of a rigid steel-frame building, with insulated metal siding and roofing and continuous concrete floorings. This portion of the building housed the shielded vault complex that included two reactor test cells and a transfer lock, the vault access area adjacent to the vault complex, and the high-bay area, which provided unobstructed access to the vault complex and access area. This complex is constructed of a special type of boron-

[71] Rocketdyne Report, 023-AR-0002, "Building 023 D&D Operations Final Report," September 21, 1993.
[72] DOE, *Certification Docket for the Release of Building 023 at ETEC*, Docket No. DOE/CD-ETEC-023, February 1997.
[73] Rocketdyne, *Building 023 D&D Operations Final Report*, 023-AR-0002, September 21, 1993.
[74] SSFL Area IV, ETEC Industrial Planning Maps, 1962-1992.

impregnated shielded concrete walls ranging from 2 feet to 9 feet thick, penetrated by various through-tubes, conduits and cooling pipes.[75,76,77,78]

The sub-grade test cell complex consists of the three parallel cells (two power test cells and a center transfer cell), a partial rear corridor that interconnects the cells, and the operating gallery. The remote handling operating gallery included a sump pit with pump. To ensure gas tightness, the cells were completely lined on the inside with 3/16-inch thick aluminum plate. This plate was seal welded to T-bar anchors in the structural concrete. The top of the cells' 8-foot thick roof is at ground level and serves as the high bay floor. The subsurface construction of the facility was designed to provide natural shielding for neutron and gamma radiation attenuation provided by the earth and rock on four sides of the complex. The side wall structural concrete is nominally 3 feet thick, the south wall concrete is 2 feet thick and the floor concrete varies from 6.5 to 8 feet thick as the rock elevation varies. The concrete walls separating the three cells are 4.5 feet thick. The front wall of the transfer cell is 4.5 feet thick while the front walls of the two test cells are 9 feet thick. A 3-foot thick concrete partial wall was built across the rear of each test cell, creating the common corridor. Nine floor storage vaults were constructed in the floor of the corridor, three at the rear of each cell.[79, 80] These vaults were used to store various pieces of contaminated equipment.[81]

The operating gallery is at two levels. The lower level is the same elevation as the cell floors, at 28 feet below ground surface. The upper level is formed by a bolted steel floor 14 feet above the lower floor. The west end is partitioned off by a concrete wall that extends from the lower floor to the high bay floor. Personnel access to the gallery floors and equipment rooms is provided by a single stairway. Material and equipment was moved to either floor of the operating gallery by a 5-ton bridge crane.[82]

The low-bay structure on the north side of the high-bay area consisted of the general administrative and operating areas, which included two "standard" prefabricated metal buildings attached to each other and the north wall of the high bay superstructure. One portion of this building, the test mock-up area, was used as a "cold" experimental area and shop area and an office area. The remainder of the building included a control room, a locker room and change room, and a "cold" mechanical equipment room. The low-bay structure on the south side of the

[75] Atomics International, Document NAA-SR-7300 Special, "Evaluation of the Atomics International Nuclear Development Field Laboratory as a Location for Reactor Facilities," May 25, 1962.
[76] Atomics International, Document N704FDP990006 Rev. A., "Building T024 (SETF) Facilities Dismantling Plan," July 31, 1981.
[77] Johnson, T., "Action Memorandum for the Decommissioning of the System for Nuclear Auxiliary Power Environmental Test Facility, Building 4024, at the Energy Technology Engineering Center at Santa Susana Field Laboratory, California," May 1, 2007.
[78] Tomlinson, R.L., Atomics International NAA-SR-MEMO-5103, Experimental Shielding Evaluation of the SETF Using SDR-I and SNAP 10 as Radiation Sources, March 29, 1960.
[79] Areva NP, Inc., Survey Package C4024 101C1, SETF, Building 4024, SGTCC Test Cell B-102, April 20, 2007.
[80] Rockwell International, Document N704TI990044, "Radiological Survey Results – Release to Unrestricted Use, Building 024, SSFL," November 28, 1978.
[81] DOE, NNSA Service Center, *Environmental Assessment for Cleanup and Closure of the Energy Technology Engineering Center*, March 2003.
[82] Areva NP, Inc., Survey Package C4024 101C1, SETF, Building 4024, SGTCC Test Cell B-102, April 20, 2007.

high-bay area included service equipment for the facility and a vault complex that consisted of a filter and hot gas compressor room and mechanical and electrical equipment room.[83]

In 1962, modifications to the building included the construction of an additional control room adjacent to the existing control room, as well as the construction of a wall and ceiling to divide a section of the lower access area, forming a room opposite "Vault No. 2". The new room was used to contain vacuum pumps and other heavy equipment associated with one of the experimental reactor programs.[84]

Below-ground radioactive waste storage facilities are located under asphalt in the yard. The buried tanks include three radioactive gas holdup tanks 6 feet in diameter and 40 feet long, eight solid radioactive waste storage vaults 3 feet in diameter and 4 feet deep, and two 500-gallon liquid radioactive waste holdup tanks. These tanks were placed on top of a concrete box filled with gravel designed to contain any accidental leakage.[85,86]

According to facility drawings, the Cooling Tower 4928 included a sump.[87]

Former Use(s): Constructed in 1959, Building 4024 was used for testing SNAP reactors in a simulated operational environment. Power test vault no. 1 (the eastern cell) housed a SNAP-2 Demonstration Reactor (S2DR) that operated for 5,000 hours at 30 and 50 thermal kilowatts (kWt) between April 1961 and December 1962. This experimental program involved a test of the core without power-conversion-system equipment. According to an August 1994 description of the reactor, the S2DR was[88]:

> . . .the second reactor, designed and constructed to demonstrate the operability of a complete power plan system. Fabrication processes were refinements of the SER system. Hastelloy N tubing and end caps were introduced for cladding for better material properties than the 347 stainless steel and better workability than the Hastelloy B . . . The reactor core consisted of a hexagonal array of 37 fuel assemblies eight inches across flats and nine inches across corners surrounded by beryllium reflector shims. The primary coolant was changed from sodium to the eutectic sodium-potassium alloy, NaK-78 (22% sodium, 78% potassium) . . .

The reactor generated 13 MWd of power and contained 390×10^3 Ci of radioactivity at the end of operation. The hot lab, Building 4020, was used to examine the fuel and components from the reactor following operation. A May 1991 facility report indicated there to have been "no problems of any consequence with the S2DR." Radioisotopes listed as having been used in the S2DR include Sr-90, Cs-137, U-234, U-235, U-238, Pu-238, Pu-239, Pu-240, Pu-241, Am-241, Co-60, Eu-152, Eu-154, Th-232, and H-3. Following completion of the S2DR program, the

[83] Atomics International, Document NAA-SR-7300 Special, "Evaluation of the Atomics International Nuclear Development Field Laboratory as a Location for Reactor Facilities," May 25, 1962.
[84] Atomics International, Document NAA-SR-7300 Special, "Evaluation of the Atomics International Nuclear Development Field Laboratory as a Location for Reactor Facilities," May 25, 1962.
[85] Atomics International Document, N704FDP990006 Rev. A., "Building T024 (SETF) Facilities Dismantling Plan," July 31, 1981.
[86] Remley, M.E., Atomics International, Letter Re: Comments on Draft Reactor Safety Survey Report for Building 024, July 21, 1965.
[87] Ralph Mr. Parsons Company, Drawing 303-024-C1 *Vicinity Map, Site and Utilities Plan*, May 1, 1959.
[88] Lords, R.E., Westinghouse Idaho Nuclear Company, Inc., *SNAP and Al Fuel Summary Report*, Report WINCO-1222, August 1994.

reactor was removed from the building and was sent offsite for disposal.[89,90,91] Additional historical operational information regarding the operation of this reactor could not be located.

According to a 1962 document, power test vault no. 2 was scheduled to provide shielding and containment for the SNAP-10A Flight System (S10A-FS-1) in a vacuum chamber located within the test vault. The reactor system test was scheduled to begin in late 1962 and would be completed and removed some time in 1963.[92,93] The research team has not found any documentation indicating the S10A-FS-1 was tested at Building 4024; however an S10FS-3 reactor was tested in Building 4024.

The Prototype SNAP 10 Flight System (S10FS-3) reactor operated for 10,000 hours at about 40 kWt in the west cell between January 1965 and March 1966. The reactor operated in a simulated space environment on the ground, and set the record for the longest continuous operation of a nuclear reactor system with 10,000 uneventful hours of operation. On April 27, 1966, a preliminary draft radiation engineering analysis report by the Radiation Safety Unit of Atomics International presented information on the removal of the S10FS-3 reactor core, coolant pump, and associated piping from the building. The materials were to be transported in a shielded cask to the Hot Laboratory, Building 4020. At the time of removal, the reactor was to have been shut down for a period of 45 days. According to the radiation engineering analysis, the task of removing the items would be carried out in the following sequence, but does not provide information to indicate the route that may have been followed during the transfer:[94,95]

- The Test Cell 2 shield plug in the Building 4024 high bay floor will be removed and the thru-roof handling system will be installed.
- The vacuum chamber sections will be removed from the test cell by the roof handling system.
- The thru-roof handling system will be removed following the removal of the vacuum chamber sections and a polar manipulator will be mounted in the shield plug opening.
- The plug will be shielded by shield blocks places over the opening on the high bay floor.
- The reactor reflector assembly will be removed and the core will be cut free from the converter section of the FS-3 system by using the polar manipulator and the General Mills manipulator in the test cell.
- The core will be moved to the transfer cell and inserted in the transport cask using the General Mills manipulator.

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[89] Rockwell International, Document N001ER000017, Rev. C.,*Nuclear Operations at Rockwell's Santa Susana Field Laboratory – A Factual Perspective*, May 30, 1991.
[90] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 - Area IV Site Summaries*, May 2005
[91] Clark, R., and Potter, G., *SEC Petition Evaluation Report Summary: SEC-00093, Santa Susana Field Laboratory-Area IV*, April 28, 2009.
[92] Atomics International Document, N704FDP990006 Rev. A., "Building T024 (SETF) Facilities Dismantling Plan," July 31, 1981.
[93] Atomics International, Document NAA-SR-7300 Special, "Evaluation of the Atomics International Nuclear Development Field Laboratory as a Location for Reactor Facilities," May 25, 1962.
[94] Heine, W.F., Atomics International, *Preliminary Draft Radiation Engineering Analysis: Radiation Safety Analysis*, April 27, 1966. HDMSP001852876.
[95] Lords, R.E., Westinghouse Idaho Nuclear Company, Inc., *SNAP and AI Fuel Summary Report*, Report WINCO-1222, August 1994.

- The transfer cell shield plug in the high bay floor will be removed and the transport cask lid will be inserted in the cell and positioned on the cask utilizing the high bay overhead crane.
- The cask lid will be attached to the cask by installing 15 bolts by means of the General Mills manipulator.
- The cask will be removed from the transfer cell utilizing the high bay gantry crane and will be placed on a wheeled dolly mounted on a fork truck positioned just outside the high bay door.
- The fork truck will transport the cask to Building 4020, at which point the cask and dolly will be transferred to the Building 4020 electric fork truck.
- The fork truck will place the cask in Building 4020 Cell 4 utilizing the wheeled dolly as partial support for the cask.
- The bolts attaching the cask lid to the cask will be loosed and at that time the transfer will be complete.

On July 14, 1966, an internal letter reported that the Building 4024 cells were being decontaminated following the conclusions of the SNAP10FS-3 ground tests. At the time of the letter there was no immediate work planned for the cells, and the letter therefore requested the maximum permissible contamination levels the cells could be left for standby status.[96] A November 1976 document entitled "Dismantling and Removal of 10FS3 (SNAP) Vacuum Vessel from Building T024, Detailed Working Procedure" outlined the working procedures to be used to remove the vacuum vessel from the west cell of Building 4024. The document was in advance of a general radiological survey of the cells. According to the report, the vacuum vessel was slightly activated. While the document outlined the dismantling procedure, the document did not indicate the date of final removal.[97]

SNAP Critical Assembly 4B, operated in the east cell for a short time at low power. SNAP Transient Test (SNAPTRAN-1) support reactor, also critical, operated in the east cell for a short time. Typically SNAPTRAN-1 was operated at low power, except for some pulsed operation. This reactor last operated in 1971. It was the last reactor to be tested in Building 4024.[98]

According to an undated Rocketdyne Environmental Affairs document, following termination of each project, all equipment and fuel was removed from the facility. The document does not indicate where all the equipment and fuel were taken upon removal; however, an August 1994 SNAP and Atomics International Fuel Summary Report states that within a few months of shutdown, reactors were disassembled (either on site or after having been transported whole to the Hot Laboratory, Building 4020), and select elements were examined in extensive post-irradiation studies at Building 4020. Following examination, the fuels were sent to the Idaho Chemical Processing Plant (ICPP). As of 1994, the fuels remained in underwater storage at the ICPP.[99,100] Additional historical information for the termination of each project could not be located.

[96] Wilson R.F., Atomics International Letter Re: Building 024 – FS-3 Vault and Transfer Cell Contamination Levels, July 14, 1966.
[97] Rockwell International Document, N704DWP990024, "Dismantling and Removal of 10FS3 (SNAP) Vacuum Vessel from Building T024, Detailed Working Procedure," November 16, 1976.
[98] Atomics International Document, N704FDP990006 Rev. A., "Building T024 (SETF) Facilities Dismantling Plan," July 31, 1981.
[99] Rocketdyne Environmental Affairs, *Building 4024 – SNAP Environmental Test Facility*, Undated.

On January 30, 1973, permission was granted in an internal letter for the storage of Building 4019's SNAP 10A FS-5 system in Building 4024.[101] A document drafted on December 13, 1972, outlined the procedures for the transfer of the reactor from Building 4019 to Building 4024. According to the document, the SNAP 10A FS-5 was a complete power system that was loaded with fuel and NaK and acceptance tested. The fuel was identified as 93% enriched U-235 with a total mass of 5 kilograms of material, 4.75 kilograms comprising U-235. Following acceptance testing, the reflectors were replaced with the shipping sleeve and the system was placed in a shipping container for storage in Building 4019. It was determined that the system was to be removed from Building 4019 and transferred to Building 4024 for permanent storage some time in 1973. The reactor was to have been transported from the south end of Building 4019 to the east roll-up door of the high bay of Building 4024.[102] Procedures for the disassembly of the 10FS-5 system were to be reviewed by the Reactors Committee. The permission letter also reported that a nuclear safety analysis (NSA) should be prepared for handling the elements outside the reactor and should be reviewed by the Fuels Committee.[103] Information regarding the final transfer of the system to, and the removal of the system from, Building 4024 could not be located.

According to a December 1976 radiological survey plan for Building 4024, the Building 4024 test vaults became radioactively contaminated during the dismantling of the reactors upon completion of operations. The plan stated that the test vaults were lined with aluminum and were decontaminated by site personnel to safe limits of less than 50 dpm. Radiation surveys performed after decontamination of the test vaults indicated activation of the vault walls and equipment within the vaults, including TV camera traverse rails, vault light fixtures, and the environmental test vacuum vessel for S10FS3. In addition, beryllium metal contamination was also detected to be present during the SNAPTRAN reactor operations. According to the plan, the beryllium contamination resulted from the use of bare (not anodized) beryllium metal plates as neutron reflectors for the SNAPTRAN. The plan stated the beryllium contamination was cleaned up to less than 0.1 $\mu g/100\ cm^2$ following SNAPTRAN operations.[104]

According to the 1976 plan, no significant radioactive contamination was ever detected in the radioactive liquid waste retention tanks. The radioactive gaseous waste retention tanks contained atmosphere from the test vaults. Rockwell International stated in the plan that analysis of the gas within the tanks identified only argon-41, which has a decay half-life of 1.83 hours. No other long-lived isotopes were reported to have been detected during reactor operations.[105]

Decontamination and disposition of Building 4024 began on August 27, 1977, and concluded some time before September 1, 1978. Within the vaults, all components such as rails, fixtures, surface-mounted conduits and all wires in through-tubes were removed between August 1977 and September 1978. The vacuum system, piping and tanks, and concrete seal door with an 18-

[100] Lords, R.E., Westinghouse Idaho Nuclear Company, Inc., *SNAP and Al Fuel Summary Report*, Report WINCO-1222, August 1994.
[101] Ketzlach, N., Internal Letter Re: New MBA for SNAP 10FS-5 Storage, January 30, 1973. HDMSP001840067.
[102] Heneveld, W.H., NSA-652-160-001 *Transfer of SNAP 10A FS-5 from Bldg 019 to Bldg 024*, December 13, 1972, HDMSP001856104.
[103] Ketzlach, N., Internal Letter Re: New MBA for SNAP 10FS-5 Storage, January 30, 1973. HDMSP001840067.
[104] Rockwell International Document, N704TP99009, "Radiological Survey Plan, Support of D&D Program Operations – T-024 (SNAP 2 and 10), December 9, 1976.
[105] Rockwell International Document, N704TP99009, "Radiological Survey Plan, Support of D&D Program Operations – T-024 (SNAP 2 and 10), December 9, 1976.

inch diameter gas exhaust pipe were removed. The liquid and gas waste holdup tanks and associated piping also were removed. Contaminated or activated components throughout the facility were packaged for offsite burial or decontaminated to meet applicable limits that are presented in the summary of the survey below. The locations of these materials are unknown. All areas of Building 4024 except the two power test vaults were determined by radiological survey by Rockwell International to be suitable for release for unrestricted use.[106,107]

Following the termination of the SNAP program, Building 4024 was used intermittently on different Liquid Metal Fast Breeder Reactor (LMFBR) tasks. In 1987, the most recent program to utilize the building was the testing of a mockup of the Clinch River fuel handling systems.[108] According to an undated long-range plan for decommissioning surplus facilities, the upper portion of the building was partially occupied. A remote handling refueling mockup of the CRBR Project was located in the high bay over the operating gallery area, and some surplus equipment was warehoused in the general support area. The remainder of the building was unoccupied. The facility support and operating equipment was intact with the exception that the filter elements in the cell ventilation system were removed and not replaced.[109]

Progress reports for maintenance and surveillance of facilities in 1987 show that monthly maintenance and surveillance activities included radiation surveys and groundwater sampling. In April 1987, it was reported in the progress report that no significant removable activity was found during the monthly radiation survey. The report also reported that sampling of ground water showed no radioactivity above background.[110] In January 1987, samples of water from the pipe chase room showed low levels of Co-60. It is important to note the monthly report did not provide information to indicate what other radionuclides were included in the sampling program, how frequently samples were taken, or what the reportable levels were.[111] Weekly surveillance and maintenance activities were conducted in 1988 and 1989.[112] According to a 1989 factual perspective of the SSFL ETEC facilities, Building 4024 contained approximately 15 mCi of confined activation radioactivity in concrete. Because of the design of the facility, the cost of D&D of the facility was determined to be expensive. According to the report, "the confined radioactivity is decaying and will meet release criteria when the SSFL is released for unrestricted use." Accordingly, the report stated that Rockwell would continue surveillance of the facility in the interim.[113]

According to Boeing's 1997 site environmental report for DOE operations, Building 4024 was used as a staging and decontamination area for the Hot Lab concrete blocks. A portable tent was set up with a portable HEPA ventilation system to provide negative pressure within the tent during block decontamination. Weekly monitoring measured airborne releases to the

[106] Rockwell International Document, N704TI990044, *Radiological Survey Results Release to Unrestricted Use, Building 024, SSFL*, November 28, 1978.
[107] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005
[108] ETEC, *Site Consolidation Assessment*, April 16, 1987. p. 41.
[109] Rockwell International, N001T1000200, *Long-Range Plan for Decommissioning Surplus Facilities at the Santa Susana Field Laboratories*, Undated?
[110] Wieseneck, H.C., *ETEC Monthly Progress Report-April 1987*, May 20, 1987.
[111] Wieseneck, H.C., *ETEC Monthly Progress Report-January 1987*, February 20, 1987.
[112] Gaylord, G.G., *SFMP Weekly Reports*, 1988 through 1989.
[113] Rockwell International, N001ER000017, *Nuclear Operations at Rockwell's Santa Susana Field Laboratory – A Factual Perspective*, December 20, 1989.

environment, which are summarized in the yearly site environmental reports. Monitoring included, but was not limited to, the following radionuclides that were determined to possibly be present in the process of decontaminating the blocks: Sr-90, Cs-137, Th-230, U-234, U-235, U-238, Pu-238, Pu-239, Pu-240, and Am-241. During the course of the monitoring (through 1999), only the natural isotopes Po-210 were detected.[114,115] According to information obtained from Boeing and Authorization No. 1121, the period of staging and decontamination operations at Building 4024 was from 1997 through 1999.[116]

The above-grade structure of Building 4024 has been cleaned, surveyed, and designated as decommissioned materials. The above-grade structures and equipment associated with the general support/operating area and the mechanical/electrical support areas were removed in 2005, leaving the concrete foundations of those portions of the building.[117] According to the 2006 site environmental report, during 2005 and in early 2006, most of the demolished structure was transported to "Kettleman Hills" following certification as decommissioned material by the DHS. The 2006 site environmental report also reported the ventilation stack was removed and a geophysical study supporting the final building demolition of those portions of Building 4024 that were removed was completed. The 2006 site environmental report did not include a summary of the geophysical study.[118]

In 2007, Areva initiated characterization surveys of Building 4024 and began preparing for the demolition of the building and foundations. The results of these surveys are presented below. D&D activities were halted in May 2007 following the issuance of a DOE stop work order.[119]

Information from Interviewees: According to an interviewee (255) who worked for Atomics International from 1967 to 1985 as an atomic inspector and certified x-ray technician:[120]

> *Some tanks were removed from the outside of the Building 4024 years ago and I understand that the tanks were potentially holding radioactive gases at one time. The tanks were pulled out and everything around the tanks was removed. If it was contaminated it was hauled off. The tanks were located between Building 4024 and 4027, just outside and to the east of the Building 4024. The only reason I am aware of the Building 4024 tank is that at that time our department was headquartered at Building 4027 and they came in and took out the 4024 tank while we were nearby in 4027.[121] I didn't know what Building 4024 was used for originally, although I think it was for a reactor that went out into space. It's still up there. They may have built that reactor in*

[114] The Boeing Company, Rocketdyne Propulsion and Power DOE Operations Annual Site Environmental Report 1997, A4CM-ZR-0012, November 23, 1998.
[115] Tuttle, R.J., Rockwell Internal Letter Re. Exemption from NESHAPs Approval to Construct for Operation of Portable Ventilators for T024 Decon Tent, January 14, 1997.
[116] Barnes, J.G., and Rutherford, P.D., Authorization No. 1121, January 14, 1997.
[117] Johnson, T., "Action Memorandum for the Decommissioning of the System for Nuclear Auxiliary Power Environmental Test Facility, Building 4024, at the Energy Technology Engineering Center at Santa Susana Field Laboratory, California," May 1, 2007.
[118] The Boeing Company, *Site Environmental Report for Calendar Year 2006 DOE Operations at The Boeing Company Rocketdyne Propulsion* & Power, September 2007.
[119] The Boeing Company, *Site Environmental Report for Calendar Year 2007 DOE Operations at The Boeing Company Rocketdyne Propulsion* & Power, September 2008.
[120] Approved DOE/EPA Interview 255, July 9, 2010.
[121] Initially, Interviewee 255 references "tanks" being removed from between Buildings 4024 and 4027; however, the interviewee then later only refers to one tank being removed. The interviewee also does not state whether the tank was an above-ground or below-ground tank.

> *Building 4024 or there was also another reactor that was built up, but never had fuel placed in it, so that reactor could have been in Building 4024 as well, I'm not sure. So, there was the possibility of radioactive material in the basement pit of Building 4024, but I was never down there.*

Radiological Incident Reports: There have been two documented incidents associated with Building 4024 that could have resulted in a release to the environment. The following table provides information presented in an incidents database provided by Boeing. It includes incidents not related to radioactive materials. Summaries of the incident reports are provided following the table, when available.

Building 4024 Incident Report Summary

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A0535	3/6/1962	SETF High bay	Activation Corrosion Products*	Welder burned with NaK in high bay.
A0634	2/19/1970	Building 4024 General Mills	None identified	Maintenance workers unknowingly worked on contaminated general mills.
A0686	4/28/1998	Building 4024 Yard	None identified	Non-contaminated skin rash.

*Activation corrosion products have been defined as typically comprising Co-60, Mn-54, Ni-59, Ni-63, and Fe-55).

- On March 6, 1962, a welder began grinding on the upper weld of the "PCS" in the high bay. The welder stopped, removed the tape over the lower weld and NaK ran out onto his hands and left leg. The welder "flipped" the NaK off of his hands and his coveralls started to burn. The welder removed the coveralls and entered the shower. The Fire Department cleaned up the approximately ¼ cup of NaK. According to the incident report, health and safety personnel found no detectable beta and gamma contamination in the high bay or on the welder (A0535).[122]

- On February 19, 1970, maintenance workers unknowingly worked on contaminated general mills (A0634).[123]

- On April 28, 1998, an employee working at Building 4024 developed a skin rash on left thigh and both ankles. The employee believed the rash to be "beta burns" caused by beta radiation. A thorough investigation of the worker and the area, found no radiation or contamination. The employee was diagnosed with poison oak at the West Hills Medical Center (A0686).[124]

Current Use: Decontamination and decommissioning activities of the Building 4024 activated test vaults are not complete. In addition, a recent 2008 survey recommended the following activities for the interior of the building: completely remove the shield wall; remove up to an 8-inch depth of activated concrete from the west, north, and east walls; remove up to a 10-inch depth of activated concrete from the south wall; remove up to a 6-inch depth of activated

[122] Sessions, S.D., "Radiological Safety Incident Report A0533, SETF High Bay, Building 24," March 21, 1962.
[123] The research team has not yet received the incident report for this incident. The incident was documented in Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 - Area IV Site Summaries,* May 2005, p. V-3.
[124] Liddy, Patricia, "Incident Report File A0686, Worker Concern Over Skin Rash," May 1, 1998.

concrete from the floor and ceiling surfaces. Additionally, the aluminum liner and concrete rubble material generated during decontamination should be packaged and shipped to the Nevada Test Site for disposal. The piping for the former contaminated gas and contaminated liquid waste UST systems, floor drain systems and connecting piping in Room B-101, and "scabbling" dust should also be packaged and shipped to the Nevada Test Site for disposal.[125]

Eight empty vaults, previously used for the storage of solid radioactive waste, remain below the paved yard surrounding the building. These vaults are 3 feet in diameter by 8.5 feet deep with a 4.5-foot thick shield block cover and are located on the east side of Building 4024 in the crane runway area. During the 2008 survey, the vault covers were removed from the storage vaults to conduct characterization and confirmatory surveys but were found to contain approximately 4 feet of water, believed to be from rain events and surface water infiltration. The water was left as found and the vault covers were replaced following sampling activities, which are summarized below.[126, 127]

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): A chronology of radiological investigations at this building is as follows:

- A radiation survey was carried out in test cell 2 of Building 4024 on April 1, 1966, to establish the dose rates surrounding the S10FS-3 reactor core. The purpose of the survey was to provide measured dose rate data for comparison with calculated dose rate data prior to the removal of the test cell shield blocks. At the time of the survey, the reactor had been shut down for a period of 15 days. The data were obtained by taking measurements in 1-foot increments by lowering the detection instrument into the #3 reactor instrument thimble. The radiation dose rates varied from 24.0 R/hr 8 feet lowered from the high bay floor to 87.0 R/hr at the midline of the reactor core 15 feet lowered from the high bay floor to 36.0 R/hr 21 feet lowered from the high bay floor at the floor level of reactor test cell 2.[128]

- A remote radiation survey of the transverse corridor of test cell 2 was performed on April 30, 1966. The purpose of the survey was to evaluate the radiation levels at the entrance to the transverse corridor with door B-104 open. The levels at three additional points were also evaluated. At the four points where measurements were taken, the radiation intensity varied from 0.055 R/hr to 22.5 R/hr. The survey concluded that operations personnel could enter the transfer lock with door B-104 open, if necessary.[129]

- On May 3, 1966, an Atomics International internal letter provided the results of a second radiation survey of SNAP 10FS-3, located in test cell 2 of Building 4024. The survey, performed on April 30, 1966, measured radiation of the reactor after the reactor had been

[125] Areva NP, Inc., Report of Radiological Characterization and Confirmatory Survey Results for the SNAP Environmental Test Facility – Building 4024, January 2008.
[126] Johnson, T., "Action Memorandum for the Decommissioning of the System for Nuclear Auxiliary Power Environmental Test Facility, Building 4024, at the Energy Technology Engineering Center at Santa Susana Field Laboratory, California," May 1, 2007.
[127] Areva NP, Inc., Report of Radiological Characterization and Confirmatory Survey Results for the SNAP Environmental Test Facility – Building 4024, January 2008.
[128] Owen, R.K. Atomics International Letter Re: Radiation Survey of SNAP 10FS-3 Reactor in Test Cell 2, Building 024, April 12, 1966.
[129] Owen, R.K., Atomics International Letter Re: Remote Radiation Survey of Transverse Corridor of Test Cell 2, Building 024, May 3, 1966.

shut down for a period of 45 days. The data were obtained by lowering a Victoreen Radacon Model 510 detector into the #3 reactor instrument thimble, approximately 8 feet from the axis of the reactor core. The results measured that, if the reactor core is assumed to be the point source, the maximum dose rate 1 foot from the core was approximated to be 3.07×10^3 R/hr. If the source geometry was assumed to be a 1 foot line source when the detector is located at the midline of the core, the dose rate was approximated to be 2.6×10^3 R/hr at 1 foot from the core.[130] The letter did not provide information to indicate the purpose of the survey; however, it should be noted that the tests on the reactor ceased in March 1966 and decontamination of the cells had begun by July 14, 1966.[131]

- A February 11, 1977, internal letter from R.K. Owen to W.F. Heine of Rockwell International provided preliminary survey results of Building 4024, noting that "the complete radiological survey of Building 024 appears to require more extensive effort than originally expected." According to the letter, test vault 1 (S2DR and SNAPTRAN-1), test vault 2 (SNAP10FS-3), the vacuum equipment room, and radioactive liquid waste system were marked with a 1-meter square grid for a detailed smear and instrument survey. The letter did not indicate the type of instrument used. In test vault 1, the floor showed 55 dpm/100 cm^2 in one location, while the remainder of the survey grids showed less than 20 dpm. The letter does not indicate whether the contamination was fixed or removable. A light fixture that was surveyed on the south wall measured 4 mR/hr. According to the letter, "one storage hold lid was lifted. The liner appears to be floating, suggesting that the lower part of the hole is filled with water, but this could not be checked at the time." The research team did not find any additional information on the "storage hold lid" or its location, and, as a result, cannot, at this time, determine if this is in contact with groundwater.[132]

  The floor of test vault 2 was randomly smear checked following the removal of the vacuum vessel. The letter does not provide information to indicate how many smears were performed; however, the smears found no contamination above 20 dpm. Radiation levels in the vacuum equipment room were reported to be at the 1977 background levels. The letter did not provide 1977 background levels. The radioactive liquid waste system measurements comprised the "low level waste tank water," the "suspect tank water," and the "sump water." The letter did not provide information to indicate the location of these liquid wastes. The results as reported in the letter are presented as follows:[133, 134]

  - Low level waste tank water
    - alpha – 1.2×10^{-9} µCi/mL
    - beta – 1.7×10^{-8} µCi/mL

[130] Owen, R.K., Atomics International Letter, Re: Radiation Survey #2, SNAP 10FS-3 Reactor in Test Cell 2, Building 024, May 4, 1966.
[131] Wilson R.F., Atomics International Letter Re: Building 024 – FS-3 Vault and Transfer Cell Contamination Levels, July 14, 1966.
[132] Owen, R.K., Rockwell International, Re: Preliminary Survey Results – Building 024, February 11, 1977.
[133] Owen, R.K., Rockwell International, Re: Preliminary Survey Results – Building 024, February 11, 1977.
[134] The alpha and beta measurements are those reported in the letter; however, their values are very low. It is important to note that the micro were hand written on the document, which may have been a result of the original document having been drafted on a type writer, or may have been added in error.

- Suspect tank water
  - alpha – 2.1×10^{-9} µCi/mL
  - beta – 1.4×10^{-8} µCi/mL

- Sump water
  - alpha – 8.8×10^{-10} µCi/mL
  - beta – 2.5×10^{-8} µCi/mL

- According to an undated report titled "Long-Range Plan for Decommissioning Surplus Facilities at the Santa Susana Field Laboratories," a partial decontamination project of Building 4024 was performed in 1978. The project included the removal of radioactive waste storage vaults and tanks located below grade outside the building and removing contaminated components within the support and test cell complex, including test equipment, rails, fixtures, wiring in surface-mounted conduit, and wiring in the through-tubes. The vacuum system piping and tanks, as well as a concrete seal door, were also removed. The contaminated items removed were packaged and sent to an unidentified licensed, commercial burial site for disposal or were decontaminated to Rockwell International's "acceptable limits" for unrestricted use. The source document does not indicate how the items were decontaminated or where the decontamination took place.[135] The acceptable limits for residual radioactivity for surface contamination were reported to be 7,500 dpm/100 cm^2 maximum beta-gamma emitters and 300 dpm/100 cm^2 maximum alpha emitters. Accessible surfaces within the cell and support areas were cleaned to acceptable removable contamination limits of 100 dpm/100 cm^2 beta-gamma and 20 dpm/100 cm^2 alpha.[136]

- A November 1978 radiological survey report presents the findings of a September 1978 survey to ensure that the facility met unrestricted release criteria. The survey included 800 smears from the walls, floors, and remaining piping and equipment. No beta contamination in excess of 50 dpm/100 cm^2 was found, and no alpha activity was detected for all areas of Building 4024 including the test vaults, transfer cell, operating gallery, high bay, and equipment rooms and support area. The acceptable limits for residual radioactivity for surface contamination were reported to be 7,500 dpm/100 cm^2 maximum beta-gamma emitters and 300 dpm/100 cm^2 maximum alpha emitters.

  According to the report, smears were counted for alpha and beta activity on a Nuclear Measurements Corporation automatic counting system with an average background of 25 cpm for beta and a counting efficiency factor of 2.35 dpm/cpm for beta. The report stated that alpha contamination was not suspected; however, had there been alpha contamination, it would have been detected by the Nuclear Measurements Corporation system, and during the course of the survey of removable contamination, no alpha activity was detected..

  Rockwell International also performed a survey of surface radiation. This survey was conducted throughout the building and surrounding area using a beta-gamma ion chamber. Beta-gamma surface dose rate limits were 0.1 mrad/hr (average) and 0.5

[135] The summary document does not provide information to indicate how the items were decontaminated.
[136] Rockwell International Document N001T1000200, *Long-Range Plans for Decommissioning Surplus Facilities at the Santa Susana Field Laboratories*, Date Unknown.

mrad/hr (maximum). The maximum beta-gamma surface contamination detected outside of the power vaults was 0.07 mrad/hr with an average background of 0.05 mrad/hr. Inside the power vaults, beta-gamma surface contamination was found to range from 0.5 mrad/hr to 2.5 mrad/hr. Inside the corridor to the power vaults, beta-gamma surface contamination ranged from 0.02 mrad/hr to 1.8 mrad/hr. According to the report, the center floor drain in the lower level operating gallery was found to be contaminated during decommissioning and disposal operations. Following an acid cleaning, water and smear samples indicated 0.08 mrad/hr using the ion chamber and 200 cpm using a Technical Associates Model Pug-1. The report summarized that contamination was "probably located in the threads at the bottom of the vertical pipe."

Soil samples were also collected in the yard during and following the removal of the liquid and gas holdup tanks. According to the report, all samples were less than 30 picocuries per gram (pCi/g). The soil samples were counted on a Nuclear Chicago automatic counting system with a KCl standard, with an average background of 30 cpm and a counting efficiency factor of 3.29 dpm/cpm. The report approximated the natural activity of uncontaminated soil in this area to be 20 to 30 pCi/g; however, the report did not identify or provide a reference to how these natural activity values were determined.

Concrete cores drilled in the power vault walls and corridors were found to have a maximum specific activity of 818 pCi/g. The average specific activity was 103 pCi/g. Rockwell International analyzed fourteen cores at 1-inch increments to a depth of between 10 and 11 inches, for a total of 144 samples. The average specific activity was 103 pCi/g.

Rockwell International collected water samples from the drain pipe int eh operating gallery, the hot waste storage vaults, the cooling system water waste holdup tanks, groundwater during the removal of the waste tanks, and the vacuum cleaning line in Power Vault 2. The report indicated that all of the samples were below 2.2×10^{-7} μCi/ml, which is below the limit of 3×10^{-7} μCi/ml for Sr-90. Water that was found to be contaminated above this limit during decommissioning and disposal work was transferred to the RMHF for disposal. This report did not indicate the volume of water that was found to be contaminated above this limit during decommissioning and disposal work.[137, 138]

- According to the 2005 HSA and the report, "Long-Range Plan for Decommissioning Surplus Facilities at the Santa Susana Field Laboratories," a facilities dismantling plan provides data on additional sampling of Building 4024. On March 26, 1981, additional concrete sampling in the power vaults began to determine the amount of concrete needed to be removed to meet 1981 unrestricted release criteria. Potential radiological hazards were identified as being limited to the high bay area (including cell complex), electrical/mechanical support, and yard areas. Two general areas of concern in the high bay were the cells and the S10FS-3 reactor support equipment room. Additionally, the electrical/mechanical support area contains systems for gas and exhaust filtering, shield cooling water and a vacuum cleaner, all of which were potentially contaminated. As a

[137] Rockwell International Document N001T1000200, *Long-Range Plans for Decommissioning Surplus Facilities at the Santa Susana Field Laboratories*, Date Unknown.
[138] Rockwell International Document, N704TI990044, "Radiological Survey Results – Release to Unrestricted Use, Building 024, SSFL," November 28, 1978.

result of exposure to neutrons escaping from the two operating reactors, the walls, ceiling, floor and remote handling equipment of the test cells were activated. The survey indicated that 12 to 22 inches of concrete would need to be removed for surface radiation to meet the acceptable dose rate of 0.1 mR/hr. Only two radionuclides, Co-60 and Eu-152, were identified as the principal contaminants found to contribute significantly to radiation greater than background. The "Long-Range Plan for Decommissioning Surplus Facilities at the Santa Susana Field Laboratories," also identified the following activation products as contributing to contamination at Building 4024: Fe-55, Mn-54, and Eu-154.[139, 140]

- According to a December 1992 safety review report regarding tritium production and release at the SSFL, production of tritium by the operation of the S2DR, and later the S10FS3, occurred by the following ways[141]:
  - Neutron absorption by lithium-6 present in the concrete biological shield – The concrete used for the inner 2 feet of the shield differed from the concrete usually used at SSFL in that limestone aggregate was substituted for the normally used granitic gravel. The natural lithium content of this concrete was measured in 1992 to be 6.2 ppm. Using this concentration and an average flux of 1.2 x 108 n/cm2/sec at 37 kWt for the first 112 cm of concrete (and considering that this flux was uniform over all the walls, floor, and ceiling in the vault) the activity of tritium produced in the concrete of Vault 1 by operation of S2DR is estimated to be 0.16 Ci at shutdown in December 1962. In a similar manner, adjusting for power level and operating time, the tritium activity produced by operation of S10FS3 in Vault 2 is estimated to be 0.20 Ci at March 1966.
  - Neutron absorption by lithium-6 present in soil surrounding the biological shield – The thick concrete biological shield with the added boron content absorbed nearly all the neutron that escaped from the reactor (less than 1 neutron per million produced by the reactor reached the soil), and so the production of tritium in the soil was negligible.
  - Ternary fission – This was calculated to produce 0.21 Ci in the fuel of the S2DR by December 1962, and 0.26 Ci in S10FS3 by March 1966.
  - Neutron absorption by lithium-6 present as an impurity in NaK coolant – Tritium produced in this manner was negligible for both reactors.
  - Neutron absorption by lithium-6 in the lithium hydride shield – This activity was estimated from the calculation for S8DR at Building 4059, adjusting for power and time, for the S10FS3 operation. The natural isotopic fraction of 7.42 atom percent was used to estimate a production of 2,200 Ci in the S10FS3 shield.
- In September 1995, ORISE conducted an independent verification survey at Building 4024. Surface scans were performed over 50 to 100% of accessible floors and lower walls (up to 2 meters) for alpha, beta and gamma activity. In the fan room, elevated direct beta radiation was identified. While, in all other areas, alpha, beta and gamma radiation was within the 1995 range of ambient site background. Acceptable contamination limits and gamma exposure rates for releasing a facility for unrestricted use

[139] Atomics International Document, N704FDP990006 Rev. A., "Building T024 (SETF) Facilities Dismantling Plan," July 31, 1981. (This document was referenced in the May 2005 HSA but has not yet been obtained.)
[140] Rockwell International Document N001T1000200, *Long-Range Plans for Decommissioning Surplus Facilities at the Santa Susana Field Laboratories*, Date Unknown.
[141] Tuttle, R.J., Rockwell International Report RI/RD92-186, *Tritium Production and Release to Groundwater at SSFL*, December 1, 1992.

are prescribed in the U.S. Department of Energy (DOE), the U.S. Nuclear Regulatory Commission (NRC), and the State of California guidelines. The lowest, most conservative limits were chosen from these guidelines and incorporated into the final survey criteria for Building 4024. The surface contamination limits for alpha and beta were excerpted from DOE Order 5400.5 and NRC Regulatory Guide 1.86 (see Table below). The ambient gamma exposure rate limits at 1 meter were excerpted from an NRC Dismantling Order because at 5 microroentgens per hour (μR/hr) it was more conservative than the DOE value of 20 μR/hr, and more consistent with as low as reasonably achievable principles.[142]

Surface Contamination Guidelines from DOE Order 5400.5 (1990) and NRC Regulatory Guide 1.86 (1974)

Allowable Total Residual Surface Contamination (dpm/100 cm^2)			
Radionuclides	**Average**	**Maximum**	**Removable**
Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-125, and I-129	100	300	20
Th-Natural, Th-232, Sr-90, Ra-223, Ra-224, U-232, I-126, I-131, and I-133	1,000	3,000	200
U-Natural, U-235, U-238, and associated decay products	5,000α	15,000α	1,000α
Beta-gamma emitters (radionuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above	5,000β-γ	15,000β-γ	1,000β-γ
External Gamma Radiation			
The average level of gamma radiation inside a building or habitable structure on a site that has no radiological restriction on its use shall not exceed the background level by more than 20 μR/h.			

Source: U.S. Atomic Energy Commission (now NRC) Regulatory Guide 1.86, Termination of Operating Licenses for Nuclear Reactors, June 1974, p. 1.86-5.U.S. Department of Energy Order 5400.5, Radiation Protection of the Public and the Environment, February 8, 1990, p. IV-6.

Surface activity measurements were conducted at 76 floor and wall locations. Excluding the power vaults, surface activity levels were less than 55 dpm/100 cm^2 for alpha and ranged from less than 1,400 to 33,000 dpm/100 cm^2 for beta. Removable alpha measured less than 12 dpm/100 cm^2, and removable beta measured less than 16 dpm/100 cm^2. The maximum beta-gamma total surface activity guideline (15,000 dpm/100 cm^2) was exceeded in the hot gas compression room of Building 4024. Exposure rate measurements were made at four locations in Building 4024, but none were made in the power vaults. Excluding the power vaults, exposure rates ranged from 11 to 13 micro roentgen per hour (μR/hr). Background was 8 μR/hr. Interior exposure rates satisfy DOE and NRC exposure rate guidelines. ORISE determined that existing documentation for Building 4024 was inadequate to support the determination that DOE guidelines for unrestricted release were met. Deficiencies noted included inadequate final status survey methods, no discussion of specific contaminants, inconsistent specification of all applicable guidelines and presentation of data that may be compared to the guidelines, absence of quantitative laboratory data, and absence of adequate figures documenting remediated areas and measurement and sampling locations.[143]

[142] ORISE Report, 96/C-5, "Verification Survey of Buildings T019 and T024, Santa Susana Field Laboratory, Rockwell International, Ventura County, California," February 1996.
[143] ORISE Report, 96/C-5, "Verification Survey of Buildings T019 and T024, Santa Susana Field Laboratory, Rockwell International, Ventura County, California," February 1996.

- An August 1996 Rockwell/Rocketdyne Area IV Radiological Characterization Survey provides results of over 10,000 stationary ambient gamma radiation measurements, walk-about surface gamma radiation scans and 149 scheduled soil samples. Building 4024 was included as one of the randomly selected sampling locations. Elevated soil activity was located in Sample ID 95-0105 located northeast of Building 4024 with Cs-137 measured at 0.37 pCi/g. Sample ID 95-0106 also contained Cs-137 at 0.34 pCi/g and was located west of Building 4024 in a dirt area. This is above the survey's local background average of 0.09 pCi/g and Area IV background average of 0.15 pCi/g, but within the average U.S. background range of 0.8 pCi/g and the U.S. Department of Energy, U.S. EPA, and U.S. Nuclear Regulatory Commission cleanup standards of 9.2 pCi/g, 9.0 pCi/g, and 9.0 pCi/g, respectively. The cleanup standards were based on uniform contamination and an annual dose limit of 15 millirem per year.[144]

- According to a 2003 site environmental report, as well as a January 2008 survey, additional concrete core data taken in 2003 indicate activation with a maximum of 9.3 pCi/g of Co-60 and a maximum of 105 pCi/g of Eu-152. Measurable activation exists only within the inner 16 inches of concrete of the two power test cells. According to the report, it would take 61.5 years for the 105 pCi/g of Eu-152 to decay to just below the derived concentration guide limit (DCGL) of 4.51 pCi/g. And the Co-60 would have decayed to 0.15% of its DCGL of 1.94 pCi/g.[145,146,147]

- A 2004 site environmental report indicated that during 2004, a survey procedure was prepared for releasing the upper portion of Building 4024. The upper portion of the building was found to be free from contamination. Soil samples were also taken in 2004 to support various site remediation activities. These included three samples from geological core sampling around Building 4024. The report indicated the samples did not have any detectable man-made gamma emitting radionuclides. The 2004 report did not provide any additional information on these field efforts.[148]

- On May 27, 2005, DHS confirmed that the portion of Building 4024 north of the high bay and the lead shield blocks are at 2005 background radiation levels and do not pose significant radiologic health risk.[149] On September 26, 2005, DHS confirmed the high bay, high bay vault, high bay mezzanine, HEPA filter room, electro-mechanical room, and associated plant equipment of Building 4024, plus the leaded glass window, are at 2005 background radiation levels and pose no significant radiologic health risk.[150] On

[144] Rocketdyne, A4CM-ZR-0011, Area IV Radiological Characterization Survey, Final Report, Volume I, August 15, 1996, pgs. 39, 108, 109.
[145] The Boeing Company, RS-00025, *Building 4024 Concrete Sampling*, December 15, 2004.
[146] The Boeing Company, RD04-170, *Site Environmental Report for Calendar Year 2003 DOE Operations at The Boeing Company Rocketdyne Propulsion & Power*, September 2004.
[147] Areva NP, Inc., Report of Radiological Characterization and Confirmatory Survey Results for the SNAP Environmental Test Facility – Building 4024, January 2008.
[148] The Boeing Company, RD05-176, *Site Environmental Report for Calendar Year 2004 DOE Operations at The Boeing Company Rocketdyne Propulsion* & Power, September 2005.
[149] Bailey, Edgar D., Response to 2005RC002061 Request to Perform Confirmatory Surveys of the Office Areas of Building 4024, Santa Susana Field Laboratory, May 27, 2005.
[150] Bailey, Edgar D., Response to 2005RC001000 Request to Perform Confirmatory Surveys of the Upper Portion of Building 4024, Santa Susana Field Laboratory, September 26, 2005.

June 13, 2007, DHS confirmed the stack, lead shot, and diesel generator at Building 4024 pose no significant radiological health risk and no further radiological control is necessary for those items.[151]

- In January 2008, Areva NP Inc., reported the results of a radiological characterization and confirmatory survey on Building 4024. The characterization and confirmatory surveys were completed to prepare for the decontamination of the two activated test cell vaults, the removal of contaminated liquid waste drain system piping, the removal of the facility floor drain system, and the demolition and removal of Building 4024. The findings of the report indicated there were no alpha, beta, and gamma radiation measurements outside of the activated test cells showing contamination above surface contamination limits. The limits are presented in the table entitled Surface Contamination Guidelines from DOE Order 5400.5 (1990) and NRC Regulatory Guide 1.86 (1974), above.

  Building 4024 measurements were generally within the range of background measurements, except for two locations where fixed alpha and beta activity was above background and minimum detectable concentration of 60 dpm/100 cm^2 alpha and 343 dpm/100 cm^2 beta. At the northeast corner, a survey measurement measured 360 dpm/100 cm^2 alpha and 684 dpm/100 cm^2 beta, while a southwest corner survey measurement measured 179 dpm/100 cm^2 alpha and 551 dpm/100 cm^2 beta. Sampling and isotopic analysis of the locations showed Th-232, U-234, U-235, and U-238 present and detectable, but at levels a fraction of the derived concentration guideline level of 1,000 dpm/100 cm^2 for Th-232 and 5,000 dpm/100 cm^2 for U-234, U-235, and U-238. Smear sampling did not indicate the presence of removable contamination.

  Based on the result of the characterization and confirmation surveys, it was concluded that the D&D activities planned for Building 4024 activated test cells should continue as planned but should incorporate the following:

  - Completely remove the shield wall;
  - Remove up to an 8-inch depth of activated concrete from the west, north, and east walls;
  - Remove up to a 10-inch depth of activated concrete from south wall; and
  - Remove up to a 6-inch depth of activated concrete from floor and ceiling surfaces.

  Additionally, the aluminum liner and concrete rubble material generated during decontamination should be packaged and shipped to the Nevada Test Site for disposal. The piping for the former contaminated gas and contaminated liquid waste UST systems, floor drain systems and connecting piping in Room B-101, and scabbling dust, should also be packaged and shipped to the Nevada Test Site for disposal.[152]

Radiological Use Authorizations: A review of a database documenting the use authorizations related to the SSFL, the research team identified two use authorizations relating to Building

[151] Butner, Gary W., Response to Request to Perform Confirmatory Surveys of Building 4024 Stack, Lead shot, and Facility Penetrations, Santa Susana Field Laboratory, June 13, 2007.
[152] Areva NP, Inc., Report of Radiological Characterization and Confirmatory Survey Results for the SNAP Environmental Test Facility – Building 4024, January 2008.

4020. Authorization No. 46 relates to the use of Cs-137 and Pu-Be sources in Building 4024, and Authorization No. 112 relates to the "surveillance of Building 4024."

Authorization No. 46 was issued to Atomics International on August 5, 1971, and expired on September 5, 1971. As indicated above, the authorization was for the use of a Cs-137 source and a Pu-Be neutron source in the high bay section of Building 4024. The authorized materials included 4.5 Ci of sealed source Cs-137, 5 Ci or sealed Pu-Be source identified as Pu-239, and an additional 10 mCi of sealed source Cs-137.[153] According to the user application, dated August 3, 1971, the purpose of the test was to observe the effect of gamma rays and neutrons on an infrared sensor. Atomics International indicated that the source would be placed 6 inches to 30 feet away from the sensor, and sensor readings would be taken. The application noted that there would be no contaminated materials since the sources are encapsulated.[154]

Authorization No. 112 relates to the surveillance of Building 4024 under the Surplus Facilities Management Program. The first available use authorization was issued on January 16, 1978, and expired on January 16, 1979. The authorization operation was listed as "decontamination and disposition of Building 024." The authorized materials were listed as being "activation product radioactivity" of an unknown quantity in the building's structure and concrete.[155] The authorization was renewed yearly, and in March 1992, the authorization was modified to include the following operations; surveillance and maintenance activities for contaminated areas, future decontamination and decommissioning activities (however not schedule for the duration of the 1992 annual authorization), and storage of empty radioactive materials containers.[156] By 1994, Authorization No. 112F included required environmental monitoring at Building 4024. This monitoring included quarterly radiation surveys and quarterly contamination survey.[157]

Authorization No. 112H, dated January 30, 1996, added the storage and survey of contaminated waste materials from Building 4020 decontamination and decommissioning operations. The requirements of these storage activities were that an inventory of Building 4020 materials stored in Building 4024 be maintained. No additional controls for these operations were identified in the authorization.[158] The 1997 authorization, Authorization No. 112I, added operations to include the decontamination of Building 4020 materials. These decontamination operations included the following controls:[159]

- Decontamination activities shall be conducted as described in Controlled Work Permits issued by Radiation Safety personnel.
- Decontamination shall be conducted in containment structures approved by Radiation Safety personnel.
- Decontamination activities shall be conducted under the surveillance of Radiation Safety personnel.

[153] Baumesh, L., and Heine, W., Authorization No. 46., August 5, 1971.
[154] Keshishian, V., Letter Re: Use Application for the Use of Cs-137 Source and a Pu-Be Neutron Source in Bldg. 24 in Santa Susana Facility, August 3, 1971.
[155] Tuttle, R., Authorization No. 112, January 16, 1978.
[156] Barnes, J.G., and Rutherford, P.D., Authorization No. 112D, March 18, 1992.
[157] Barnes, J.G., and Rutherford, P.D., Authorization No. 112F, April 20, 1994.
[158] Barnes, J.G., and Rutherford, P.D., Authorization No. 112H, January 30, 1996.
[159] Barnes, J.G., and Rutherford, P.D., Authorization No. 112I, January 14, 1997.

Additionally, while active decontamination work was occurring, personnel were to perform weekly routine surveys of radiation levels and contamination levels. During periods when decontamination activities did not occur, personnel were instructed to perform monthly surveys.[160]

On March 15, 1999, Authorization No. 112L further expands Building 4024 operations to include the storage of radioactive sources pending transfer to a third party recycling or disposal vendor. The authorization continued to list the storage and survey of contaminated waste material from Building 4020 as an operation; however, the decontamination of building blocks was expanded to include "L-85 laydown area." The authorization does not provide additional detail to describe what is meant by "L-85 laydown area."[161]

On April 7, 2008, a final authorization, Authorization No. 112U, was issued with no expiration date. The operation for Building 4024 in this authorization states "within the scope of any work restrictions imposed by the Department of Energy during 'safe shutdown' periods, preparation for, oversight of, or performance of decontamination, decommissioning, and razing of SSFL Building 24." The required facility monitoring includes monthly radiation surveys during decontamination and decommissioning activities (quarterly when no work is being performed). Other monitoring includes weekly contamination surveys, airborne sampling during decontamination and decommissioning in contaminated areas and effluent sampling when sump water is present. The authorization did not identify the location of the sump to be sampled.[162]

Former Radiological Burial or Disposal Locations: Below-ground radioactive waste storage facilities are located under asphalt in the yard surrounding Building 4024. The buried tanks include three radioactive gas holdup tanks 6 feet in diameter and 40 feet long, eight solid radioactive waste storage vaults 3 feet in diameter and 4 feet deep, and two 500-gallon liquid radioactive waste holdup tanks. These tanks were placed on top of a concrete box filled with gravel designed to contain any accidental leakage.[163] The eight empty vaults were last reported to still be present below the paved yard surrounding the building.[164]

Aerial Photographs: The development of the Building 4024 area is first visible in the 1959 aerial photograph with a large excavation occupying a majority of the area. The 1962 aerial photographs show a building foundation; however, the development in the area does not support that the building was constructed and operational in 1960. By 1965 the site has been fully developed and there is no evidence of construction activities. In 1967 and 1972, an open storage area is visible just west of Building 4024 with drainage trending west, southwest. The open storage area is no longer present in 1978 and the drainage channel has been replaced by an escarpment.[165] In 1980, the open storage area west of the building has returned and dark-toned material is visible at the southeast corner of the building. Additionally, the 1980 aerial photograph appears to show probable container leakage to the northeast on the east side of the

[160] Barnes, J.G., and Rutherford, P.D., Authorization No. 112I, January 14, 1997.
[161] Barnes, J.G., and Rutherford, P.D., Authorization No. 112L, March 15, 1999.
[162] Barnes, J.G., and Rutherford, P.D., Authorization No. 112U, April 7, 2008.
[163] Atomics International Document, N704FDP990006 Rev. A., "Building T024 (SETF) Facilities Dismantling Plan," July 31, 1981. (This document was referenced in the May 2005 HSA but has not yet been provided to HGL.)
[164] Johnson, T., "Action Memorandum for the Decommissioning of the System for Nuclear Auxiliary Power Environmental Test Facility, Building 4024, at the Energy Technology Engineering Center at Santa Susana Field Laboratory, California," May 1, 2007.
[165] The term escarpment appears to refer to a steep slope.

building. Possible leakage is also visible on the west side of the building in the 1983 aerial photographs and two possible stains are visible on the northeast corner of the building where the previous probable container leakage had been visible. In 1988, an open storage area is again present on the west side of the building but is no longer visible in 1995, when open storage is visible on the east side of the building and is accompanied by a vertical tank. The vertical tank is no longer present in 2005 and portions of the building have been removed.[166]

Radionuclides of Concern: The primary radiological constituents of concern have been identified as Co-60 and Eu-152 as a result of activation in the concrete and piping of the subterranean test vaults.[167,168] Secondary radiological constituents of concern at Building 4024 include Cs-137 and Sr-90 (fission products); H-3, Eu-154, Fe-55, Ni-59, Ni-63, Mn-54, potassium-40 (K-40), and sodium-22 (Na-22) (neutron activation products); Th-232, U-234, U-235, and U-238 (nuclear fuel material); and Am-241, Pu-238, Pu-239, Pu-240, Pu-241, and Pu-242 (transuranic elements).[169] All radionuclides of concern listed are included in the August 2009 Final Field Sampling Plan for the Santa Susana Field Laboratory radiological background study. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: There are a number of drainage pathways at Building 4024 including a subsurface drainage trench, storm drain, and sanitary sewer connection. The building also included a number of underground waste tanks. A 1959 grading and drainage plan references a number of these tanks.[170] According to a 1991 evaluation of tritium production and release to groundwater at the SSFL Site, a French drain surrounds Building 4024 and is automatically pumped to the surface; however, the document does not provide a complete description of this system.[171] A 1959 utilities plan of Building 4024 shows a subsurface drainage trench surrounding the perimeter of the original Building 4024 footprint. A sump pump is located at the west side of the building and appears to discharge to a storm drain located north of the building; however this could not be confirmed from the utilities plan drawing. The subsurface drainage trench extends to and surrounds the underground gas holdup tanks. The plan also shows a subsurface drain well to be located on the east side of the building directly north of the crane runway area.[172] A 1959 detailed drawing provides an isometric view of the subsurface drain surrounding Building 4024. It also shows the location of the cooling tower sump at the south side of the building.[173] A 1959 piping plan provides schematic details on the drainage trench along the east side of Building 4024.[174]

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[166] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[167] The Boeing Company, "Building 4024 Decontamination and Decommissioning Engineering Evaluation/Cost Analysis," May 1, 2007.
[168] Tuttle, R.J., Listing of Locations in SSFL Area IV Associated With Radioactive Materials," September 1989.
[169] The Boeing Company, Engineering Evaluation & Cost Analysis (EE/CA) Community Meeting Microsoft PowerPoint® Presentation, February 21, 2007.
[170] Ralph M. Parsons Company, *SNAP-II Facility, Santa Susana, California, Phase II, Grading and Drainage Plan*, May 1, 1959.
[171] Rockwell International, Document N001SRR140120, "Tritium Production and Release to Groundwater at SSFL," December 6, 1991.
[172] Ralph M. Parsons Company, *SNAP-II Facility, Vicinity Map, Site and Utilities Plan*, May 1, 1959
[173] Ralph M. Parsons Company, *SNAP-II Facility, Santa Susana, California, Phase II, Miscellaneous Details No. 3*, May 1, 1959.
[174] Ralph M. Parsons Company, SNAP-II Facility, Santa Susana, California, Phase II, Environmental Test Building, Details, Piping, May 1, 1959.

A 1959 piping diagram provides detailed information on the low-level liquid waste system at Building 4024. This system included two tanks, Tank 103 and 104. Tank 103 was an 850-gallon waste tank for liquid waste suspected of potential contamination. The tank was 4 feet in diameter and 6 feet long. Tank 103 captured waste from subsurface drainage as well as the shower and toilets in Room 102 and the floor drain in Room 112. This waste could be collected and sampled and then released to a drainage ditch if found to be free of contamination. Tank 104 was a 550-gallon waste tank for low-level contaminated waste. The tank was 4 feet in diameter and 5 feet long. Tank 104 had a connection for a tank truck for the transfer of contaminated waste.[175] Tanks 103 and 104 were located east of the Building 4024 subsurface test cell complex in an underground 9-foot by 15-foot liquid waste retention basin.[176]

1959 drawing provides a sewer profile for the line connecting to Building 4024. This drawing also includes septic tank and leach field plans, but a note in the drawing states that these plans are deleted.[177] Piping details for the first floor and basement of Building 4024 are provided in another 1959 drawing.[178]

All non-radioactive sewage wastes are collected by a sanitary sewer system and all wash-down water and emergency releases from the cooling systems are routed to the underground liquid waste holdup tanks via floor sinks and buried drain lines. The liquid waste tanks were removed; however, according to the January 2008 Report of Radiological Characterization and Confirmatory Survey Results for the SNAP Environmental Test Facility – Building 4024, the piping for the former contaminated gas and contaminated liquid waste UST systems and floor drain systems remain at the building and were scoped to be packaged and shipped to the Nevada Test Site for disposal.[179, 180] Additionally, the eight empty vaults, previously used for the storage of solid radioactive waste, remain below the paved yard surrounding the building. These vaults are 3 feet in diameter by 8.5 feet deep with a 4.5-foot thick shield block cover and are located on the east side of Building 4024 in the crane runway area.[181, 182]

As indicated above, aerial photographs show evidence of a short drainage channel west of the building in 1967 and 1972 from an open storage area toward Building 4010. The drainage channel is no longer present in 1978 and has been replaced by an escarpment.[183]

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[175] Ralph M. Parsons Company, *SNAP-II Facility, Santa Susana, California, Phase II, Environmental Test Building, Legend Schedules, Details and Flow Diagrams*, May 1, 199.
[176] Ralph M. Parsons Company, *SNAP-II Facility, Vicinity Map, Site and Utilities Plan*, May 1, 1959
[177] Ralph M. Parsons Company, *SNAP-II Facility, Santa Susana, California, Phase II, Miscellaneous Details No. 2*, May 1, 1959.
[178] Ralph M. Parsons Company, *SNAP-II Facility, Santa Susana, California, Phase II, Environmental Test Building, First Floor Plan and Toilet Room Details Piping*, May 1, 1959.
[179] Atomics International Document, N704FDP990006 Rev. A., "Building T024 (SETF) Facilities Dismantling Plan," July 31, 1981.
[180] Areva NP, Inc., Report of Radiological Characterization and Confirmatory Survey Results for the SNAP Environmental Test Facility – Building 4024, January 2008.
[181] Johnson, T., "Action Memorandum for the Decommissioning of the System for Nuclear Auxiliary Power Environmental Test Facility, Building 4024, at the Energy Technology Engineering Center at Santa Susana Field Laboratory, California," May 1, 2007.
[182] Areva NP, Inc., Report of Radiological Characterization and Confirmatory Survey Results for the SNAP Environmental Test Facility – Building 4024, January 2008.
[183] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.

A 1964 paving drawing indicates a surface drainage channel located north of Building 4024 and a culvert at the south end of a paved area between Buildings 4024 and 4025.[184]

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4024 area is Class 1, due to its site operations, results of previous radiological investigations, and current building status.

Recommended Locations for Soil/Sediment Sampling: Plate 1 and Figure 2.1 provide a convenient reference for the following recommendations.
Based on the available information, soil sampling is recommended in the Building 4024 area. As discussed above, there were radiological incidents at Building 4024 and documented evidence of radiological releases. Significant information is lacking regarding the excavation activities at Building 4024.

In addition, previous characterization studies for the Building 4024 area were focused on delineating the extent of contamination to standards that were applicable at the time. Therefore, additional characterization is recommended for the Building 4024 area. This includes the following Building 4024 areas and appurtenances:

- The locations of the two August 1996 Area IV Radiological Characterization Survey samples northeast of Building 4024 and west of Building 4024 in a dirt area. Elevated soil activity was located in Sample ID 95-0105 located northeast of Building 4024 where Cs-137 measured at 0.37 pCi/g. Sample ID 95-0106 also contained Cs-137 at 0.34 pCi/g and was located west of Building 4024 in a dirt area.[185]

- The location of the gas holdup tanks and liquid waste tanks. Interviewee 255 made reference to the removal of tanks that were "potentially holding radioactive gases at one time"; however, it is unclear whether the tanks being referred to include those identified as possible sampling locations.

- The outside storage area west of Building 4024. In 1967 and 1972, an open storage area is visible just west of Building 4024 with drainage trending west, southwest. The open storage area is no longer present in 1978 and the drainage channel has been replaced by an escarpment. In 1980, the open storage area west of the building has returned and dark-toned material is visible at the southeast corner of the building. Possible leakage is visible on the west side of the building in the 1983 aerial photographs. In 1988, an open storage area is again present on the west side of the building but is no longer visible in 1995.[186]

- The Cooling Tower 4928 sump and the footprint of Site 4927 (nitrogen storage tank) should be sampled due to limited information on cooling tower operation and sump use during building operations.

[184] Asph. Conc. Paving, S.E.T.F. Building 024 Santa Susana, 1964.
[185] Rocketdyne, A4CM-ZR-0011, Area IV Radiological Characterization Survey, Final Report, Volume I, August 15, 1996. pgs. 39, 108, 109.
[186] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.

- The area east of the building where reactors were brought in and removed from the facility. This area also includes the waste storage tanks. Below-ground radioactive waste storage facilities are located under asphalt in the yard. The buried tanks include three radioactive gas holdup tanks 6 feet in diameter and 40 feet long, eight solid radioactive waste storage vaults 3 feet in diameter and 4 feet deep, and two liquid radioactive waste holdup tanks. These tanks were placed on top of a concrete box filled with gravel designed to contain any accidental leakage.[187,188]

- The former location of the apparent leakage of an unknown container at Building 4024 that appears to leak north-northeast toward the northwest corner of Building 4027 in 1980 aerial photographs. In the 1983 aerial photographs two possible stains are visible on the northeast corner of the building where the previous probable container leakage had been visible.[189]

2.1.3 Building 4027 Area

Site Description: The Building 4027 area includes Building 4027, Building 4625, substation Building 4727, and the land surrounding these buildings. Building 4027 was one of a series of buildings that supported the 1950- and 1960-era SNAP program and was located along B Street, south of 12th Street and west of G Street.[190] Figures 2.1.3a through 2.1.3e provide a current photograph and the best available building-specific drawing(s) that the research team could find. Plate 1 presents a summary of all identified features for this site.

Building Features: Building 4027 was constructed in 1961 and was expanded in 1963 to include Building 4625. Building 4625 initially measured approximately 1,240 square feet. Building 4027 was expanded approximately 2,842 square feet, filling the space between Buildings 4027 and 4625.[191] The expanded building measured 9,240 square feet and included a 4,589-square foot high bay laboratory area. The remainder of the building included offices and shop support. The building was reported as being steel frame with steel siding and roof. The high bay measured 37 feet in height and included a 6-ton bridge crane.[192] In the interior of the building, the building featured a pipe trench and sump pit.[193] A large darkroom was located in Building 4027 at one time; however, the exact period is unknown.[194]

Former Use(s): According to a 1988 radiological survey of Building 4027, Building 4027 was constructed in 1961 and served as one of many buildings that were used as engineering

[187] Atomics International Document, N704FDP990006 Rev. A., "Building T024 (SETF) Facilities Dismantling Plan," July 31, 1981.
[188] Remley, M.E., Atomics International, Letter Re: Comments on Draft Reactor Safety Survey Report for Building 024, July 21, 1965.
[189] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[190] ETEC Document, GEN-ZR-0013, "Radiological Survey of Buildings T049, T042, T027, T032, and T025," August 26, 1988.
[191] ETEC Document, GEN-ZR-0013, "Radiological Survey of Buildings T049, T042, T027, T032, and T025," August 26, 1988.
[192] ETEC Document, GEN-ZR-0013, "Radiological Survey of Buildings T049, T042, T027, T032, and T025," August 26, 1988.
[193] Atomics International, Drawing 303-027-S6, Expansion of Non-Nuclear Mechanical Vibration and Shock Testing Building 027 Expansion, January 16, 1963.
[194] Approved DOE/EPA Interview 255, July 9, 2010.

development and test sites for the SNAP program.[195] Building 4625 operated as a Non-Nuclear Component Storage Building.[196] Vibration and shock tests were performed in Building 4027 in support of the SNAP launch schedule.[197] According to an August 15, 1963, incident report, the building conducted acceleration tests on the S10FS-1 system. These tests included the use of beryllium and $NaNO_2$ to simulate NaK in the S10FS-1 system. The acceleration tests typically involved vibration and shock tests to evaluate the effects of high acceleration experienced during Atlas rocket missions. Additional information regarding these acceleration tests could not be located in historical site documents.[198]

According to an August 6, 1964, Atomics International internal letter, the use of cyclohexane and/or cycloheptane in the NaK system of the SNAP 10FS-3 in Building 4027 was authorized.[199] In 1965, such tests included the testing of the SNAP 8 drum drive mechanism and the 10FS-5.[200] Launch vehicle simulation testing was conducted at the building through 1968. In 1970, the equipment was removed from the building and the building was used for quality assurance and materials and components acceptance. The 1988 radiological survey indicated sealed, fully-encapsulated, radiography sources and/or equipment may have been stored in Building 4027; however, no known loose radioactive or nuclear material was handled.[201]

According to an April 1987 Site Consolidation Assessment, Building 4027 was inactive; however, a 1988 radiological survey indicated Building 4027 was being used for storage purposes.[202,203] In 1989, R.J. Tuttle indicated that sealed sources for gamma-radiography were stored in Building 4027.[204] In 2001, according to a radioactive waste certification plan, Building 4027 served as a hazardous (non-radioactive) waste storage area.[205] Additional information regarding these operations could not be located. The research team has been unable to determine the operations in Building 4027 from 1988 to 2003, when the building is reported to have been demolished. It is important to note that an undated listing of SSFL Site waste generators, as well as a 2003 Environmental Assessment for Cleanup and Closure, identifies Building 4027 as a weld shop.[206,207]

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[195] It is important to note that 1962 aerial photographs do not show the presence of any structures at the Building 4027 area. The exact date of construction and start of operations at Building 4027 is unknown.
[196] Drawing 303-027-A4, "Expansion of Non-Nuclear Mechanical Vibration and Shock Testing, Building 027 Expansion, Floor Plan, as built," 1964.
[197] ETEC Document, GEN-ZR-0013, "Radiological Survey of Buildings T049, T042, T027, T032, and T025," August 26, 1988.
[198] Busick, D.D., Internal Letter North American Aviation, Inc., Re: Water Supply in Building 027, August 15, 1963.
[199] Atomics International Internal Letter, Letter Re: SNAP 10FS-3, Building 027, Santa Susana, August 6, 1964.
[200] Wilmes, R.F., Atomics International Internal Letter Re: Weekly Progress Report for Industrial Hygiene and Safety Unit, Santa Susana, Period Ended 1-16-65, January 19, 1965.
[201] ETEC Document, GEN-ZR-0013, "Radiological Survey of Buildings T049, T042, T027, T032, and T025," August 26, 1988.
[202] ETEC, *Site Consolidation Assessment*, April 16, 1987. p. 22.
[203] ETEC Document, GEN-ZR-0013, "Radiological Survey of Buildings T049, T042, T027, T032, and T025," August 26, 1988.
[204] Tuttle, R.J., Listing of Locations in SSFL Area IV Associated With Radioactive Materials," September 1989.
[205] Boeing, *Radioactive Waste Certification Plan (WCP) for ETEC Facilities*, EID-04758, February 21, 2001. p. 5.
[206] Unknown, SSFL Waste Generators, Undated.
[207] DOE, *Environmental Assessment for Cleanup and Closure of the Energy Technology Engineering Center*, DOE/EA-1345, March 2003. p. 2-10

Information from Interviewees: According to an interviewee (255) who worked for Atomics International from 1967 to 1985 as an atomic inspector and certified x-ray technician, Building 4027 included a large dark room where the interviewee developed photographs for reports.[208]

Radiological Incident Reports: There have been no known radiological incidents at Building 4027 that may have resulted in a release of contamination to the environment. The only incident on file at Building 4027 is summarized in the table below.

Building 4027 Incident Report Summary

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A0023	8/13/1963	SSFL, Building 4027	None identified	Improper use of drinking water bottles for storage of chemicals.

- On August 13, 1963, an Atomics International employee notified the Health and Safety Department at Santa Susana that a bottle of water that had been exposed to possible radioactive and beryllium contamination had been used for a drinking water supply in Building 4027. The contents of the bottle had been used to simulate NaK in the S10FS-1 system during acceleration tests in Building 4027. The employee removed the bottle from the water cooler because employees were complaining about the taste of the water. Upon doing so, the employee noted a strip of masking tape that had written on it: "Do not drink water contaminated with $NaNO_2$." According to the investigation, on July 19, 1963, personnel drained the water from the 10FS-1 assembly into two 5-gallon water bottles of the type used for drinking water supply at Santa Susana. The bottles were tagged and sealed for chemical analysis. An unknown person moved the bottles to the water cooler, and one of the bottles was placed on the water cooler on August 12, 1963. By August 13, 1963, approximately one half of the contents of the bottle had been consumed by approximately 30 people. Tests of the contents of the water showed beta and gamma contamination of less than 5×10^{-8} uc/cc, alpha contamination of less than 1×10^{-8} uc/cc, and beryllium contamination of 0.21 ug/cc. The incident report did not provide the results of the $NaNO_2$ concentrations, and did not indicate the ultimate disposal of the remainder of the contaminated water (A0023).[209]

Current Use: Buildings 4027 and 4625 were demolished in 2003 by American Wrecking, Inc. The action included the demolition and removal of Building 4625, Building 4027, and an "amplifier room;" the removal of asphalt parking areas and walk ways; and the removal of existing sub-station and underground utilities. The dimensions of the excavations made during building demolition are unknown.[210] Boeing reported the demolition of the building to the DOE on March 22, 2004.[211]

[208] Approved DOE/EPA Interview 255, July 9, 2010.
[209] Busick, D.D., Internal Letter North American Aviation, Inc., Re: Water Supply in Building 027, August 15, 1963.
[210] American Wrecking, Inc., *Demolition Proposal*, November 3, 2003.
[211] Lee, Majelle, Letter Re: Contract No. DE-AC03-99SF21530, Notification of Completion of GFY 2004 Contract Milestone "Demolish Buildings 4027, 4487 and 4641 per Multi-Year Work Plan 1st and 2nd Quarter GFY2004, RD01-269-03," March 22, 2004.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): As part of the DOE SSFL Site Survey, Building 4027 was surveyed to determine if any residual radioactivity was accidentally left behind as a result of operations in support of the SNAP program. According to the 1988 survey report, "only gamma exposure rate measurements were acquired in order to assess radiological condition because no radioactive or nuclear materials are known to have been handled here." The high bay and storage portions of Building 4027 were surveyed as separate units due to variations in "ambient background." In the high bay, the maximum net gamma measured 3.8 μR/hr (corrected for background and statistically tested against an NRC acceptance limit of 5 μR/hr). The average net gamma measured 0.46 μR/hr. Based on the median value of exposure rate measurements in the vicinity of Building 4027, the ambient background value for gross gamma was determined to be 9.09 μR/hr. All beta surface activity measurements made "for indication" showed no detectable activity. Based on the results of the interior survey of Building 4027, the conclusion was made that this area passed the NRC criteria at the time for unrestricted use.[212]

Within the storage area, the maximum net gamma measured 2.8 μR/hr (corrected for background and statistically tested against an NRC acceptance limit of 5μR/hr). The average net gamma measured –1.26 μR/hr. Based on the median value of exposure rate measurements in the vicinity of Building 4027, the ambient background value for gross gamma was determined to be 17.40 μR/hr. All beta surface activity measurements made "for indication" showed no detectable activity. Based on the results of the exterior survey of Building 4027 and the storage yard, the conclusion was made that this area was not contaminated and passed the NRC criteria at the time for unrestricted use.[213]

Radiological Use Authorizations: Based on the review of currently available documents, there was no radiological use authorizations associated with Building 4027.

Former Radiological Burial or Disposal Locations: None found.

Aerial Photographs: 1959 aerial photographs show light-toned mounded material in the area surrounding the future location of Building 4027. As indicated above, according to a 1988 radiological survey of Building 4027, Building 4027 was constructed in 1961; however, the 1962 aerial photographs do not show a building to be present. By 1965, the building is clearly visible and has already been expanded to include Building 4625. There are no notable features surrounding the building until 1980 when the apparent leakage of a container at Building 4024 appears to leak north-northeast toward the northwest corner of Building 4027. By 2005, the building is no longer visible in aerial photographs.[214]

Radionuclides of Concern: Building 4027 is located in proximity to the RMHF; therefore, direct radiation and skyshine from RMHF affects ambient radiation conditions in the area.[215] Radionuclides of concern at the RMHF include all radionuclides that are included in the background study plus any additional radionuclides identified during the HSA. Additionally,

[212] ETEC Document, GEN-ZR-0013, "Radiological Survey of Buildings T049, T042, T027, T032, and T025," August 26, 1988.
[213] ETEC Document, GEN-ZR-0013, "Radiological Survey of Buildings T049, T042, T027, T032, and T025," August 26, 1988.
[214] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[215] ETEC Document, GEN-ZR-0013, "Radiological Survey of Buildings T049, T042, T027, T032, and T025," August 26, 1988.

sealed, fully-encapsulated, radiography sources and/or equipment may have been stored in Building 4027; however, no known "loose radioactive material" was handled in the building.[216] All radionuclides of concern listed are included in the August 2009 Final Field Sampling Plan for the Santa Susana Field Laboratory radiological background study. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Little information could be located regarding the drainage surrounding Building 4027. An "A.C. Ditch" (asphaltic concrete ditch) was located around the north and northeast perimeter of the building and led to an underground culvert located just east of the Building 4036/4037 stairway located south of Building 4036/4037.[217] In general, water runoff in the area of the building is directed to the south to the retention reservoirs that are part of the SSFL industrial effluent control system. Liquid effluent discharge from the final retention pond into the Bell Canyon drainage occurs only after controlled effluent hold-up and sampling.[218]

Radiological Contamination Potential: Because of limited information regarding the possible storage of sealed sources for gamma-radiography in Building 4027, and the presence of staining indicative of a possible leak of unknown material from Building 4024 toward Building 4027 in 1980 aerial photographs, a preliminary MARSSIM Class of 2 has been assigned to Building 4027.

Recommended Locations for Soil/Sediment Sampling: Plate 1 and Figure 2.1 provide a convenient reference for the following recommendations.

Based on the available information, soil sampling is recommended in the Building 4027 area. Significant information is lacking regarding the possible storage of sealed sources for gamma radiography in Building 4027 and excavation activities at Building 4027.

There have been limited characterization studies for the Building 4027 area and they were focused on delineating the extent of contamination to standards that were applicable at the time and only included gamma exposure rate measurements. Therefore, additional characterization is recommended for the Building 4027 area. This includes the following Building 4027 areas:

- Former location of the ditch north and northeast of building. An "A.C. Ditch" was located around the north and northeast perimeter of the building and led to an underground culvert located just east of the Building 4036/4037 stairway located south of Building 4036/4037.[219] If radioactive materials from the RMHF were released and drained into the Building 4027 area, residual contamination above background values may exist to the north and northeast of the building.

- The former location of the apparent leakage of an unknown container at Building 4024 that appears to leak north-northeast toward the northwest corner of Building 4027 in 1980

[216] ETEC Document, GEN-ZR-0013, "Radiological Survey of Buildings T049, T042, T027, T032, and T025," August 26, 1988.
[217] Atomics International, Drawing No. 303-027-C2 Expansion of Non-Nuclear Mechanical Vibration and Shock Testing Building 027 Expansion, Topographic Plan, February 4, 1963.
[218] ETEC Document, GEN-ZR-0013, "Radiological Survey of Buildings T049, T042, T027, T032, and T025," August 26, 1988.
[219] Atomics International, Drawing No. 303-027-C2 Expansion of Non-Nuclear Mechanical Vibration and Shock Testing Building 027 Expansion, Topographic Plan, February 4, 1963.

aerial photographs. Because the contents of the unknown container cannot be confirmed to be non-radioactive material, it is possible radioactive materials may have been released from this container toward the northwest corner of Building 4027.

- As indicated above, in the interior of the building, the building featured a pipe trench and sump pit.[220] The use or purpose of the trench and sump pit is unknown, as a result, it is recommended this area of the former building be included for sampling.

2.1.4 Building 4032 Area

Site Description: The Building 4032 area includes Building 4032, substation Building 4727, and the surrounding area. Located on B Street, Building 4032 was constructed between 1962 and 1965 near Building 4027.[221, 222] Figures 2.1.4a through 2.1.4c provide a current photograph and the best available building-specific drawing(s) that the research team could find. Plate 1 presents a summary of all identified features for this site.

Building Features: Building 4032 measured 4,580 square feet and had a steel frame, steel sides, and steel roof. It contained approximately 4,200 square feet of laboratory space in support of the SNAP program.[223] The building appears to have had a single below-ground sodium drain tank (UT-23) with a capacity of 5,500 gallons; however, the former location of the drain tank is unknown. In 1997, the drain tank was removed and cleaned using a water-vapor-nitrogen process.[224,225] Building 4032 was serviced by Substation 4727.[226]

Former Use(s): According to an August 1988 radiological survey of the building, Building 4032 was used as a space environmental test facility for thermal vacuum systems. Vacuum chamber equipment was installed in the building and heaters were used for the SNAP system's thermal simulation testing. Following completion of thermal vacuum testing in 1970, the vacuum equipment was removed and the facility was redesignated as an ETEC General Test Building. The facility was used for component and instrumentation testing. From 1978 through 1983, mock-ups in the building used a radiological source to determine the positioning of non-radioactive rods for use in developing the fuel rod control system. A June 1975 site development plan indicated that small sodium test facilities in Building 4032 were involved with tests associated with the "FFTF program." The site development plan did not define the "FFTF program." The radiological survey indicated that in 1988, the building was still an "active

[220] Atomics International, Drawing 303-027-S6, Expansion of Non-Nuclear Mechanical Vibration and Shock Testing Building 027 Expansion, January 16, 1963.
[221] ETEC Document, GEN-ZR-0013, "Radiological Survey of Buildings T049, T042, T027, T032, and T025," August 26, 1988.
[222] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005.
[223] ETEC Document, GEN-ZR-0013, "Radiological Survey of Buildings T049, T042, T027, T032, and T025," August 26, 1988.
[224] The Boeing Company, *Rocketdyne Propulsion and Power DOE Operations Annual Site Environmental Report 1998*, RD99-115, September 22, 1999.
[225] Rockwell Aerospace, *Rocketdyne Division Annual Site Environmental Report Santa Susana Field Laboratory and De Soto Sites 1993*, RI/RD94-126, October 21, 1994.
[226] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005.

sodium test loop," with many pipes occupying the premises.[227, 228] According to the May 2005 HSA, after support work for SNAP tests ceased, Building 4032 was used as a sodium component and instrumentation test facility.[229]

Building 4032 also housed the Liquid Metal Development Laboratory 1 (LMDL-1), which carried out applied research in support of liquid metal cooled reactors. In 1996, during environmental restoration activities, approximately 15,390 pounds of sodium were removed from a below-ground drain tank and was transferred to a sodium supplier for reuse. In 1997, the drain tank was removed and cleaned. Approximately 1,542 pounds of sodium were converted to sodium hydroxide during the cleaning process and were recycled. The tank was cut up and sold as scrap. By 1998 the sodium piping had been removed and the facility was being used for storage and component size reduction in support of water-vapor-nitrogen (WVN) cleaning. WVN cleaning of all piping and components was completed in 1998 and the sodium hydroxide generated was recycled and the clean steel was sold as scrap.[230]

After 1998, the building was being used for storage and component size reduction in support of the WVN cleaning.[231,232] The research team has been unable to determine the building operations from 1998 until 2003 when the building was reportedly demolished.

Information from Interviewees: According to an interviewee (255) who worked for Atomics International from 1967 to 1985 as an atomic inspector and certified x-ray technician:[233]

> We had a couple of mishaps up there with an x-ray technician that wasn't paying attention. An example occurred in Building 4032. I was in Buildings 4036 and 4037, which served as office areas near Building 4032. A guy was x-raying in Building 4032 with a cobalt source and I was up there to make sure the people in the office were in a safe area because cobalt splatters all over and can go through 7 inches of steel and 1 inch of lead. I noticed the radioactivity went up as the x-ray technician was running the pill back into the "pig," as we called it. The pill went up and never came down. The technician tried to lock the source up in the pig, but it was still hanging out of the pig a little bit. So the technician got exposed to a little bit of radiation. That was what I called clean radiation.[234,235]

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[227] ETEC Document, GEN-ZR-0013, "Radiological Survey of Buildings T049, T042, T027, T032, and T025," August 26, 1988.
[228] Rockwell International Corporation, *Site Development Plan 1977-1981, United States Energy Research and Development Administration Liquid Metal Engineering Center*, June 1975.
[229] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005.
[230] The Boeing Company, Rocketdyne Propulsion and Power DOE Operations Annual Site Environmental Report 1998, RD99-115, September 22, 1999.
[231] The Boeing Company, *Rocketdyne Propulsion and Power DOE Operations Annual Site Environmental Report 1999*, RD00-159, September 2000.
[232] The Boeing Company, *Sodium Component Test Installation (SCTI) Demolition Final Report*, EID-08336, October 1, 2003. p. 36.
[233] Approved DOE/EPA Interview 255, July 9, 2010.
[234] The research team has been unable to confirm whether this incident is related to Incident No. A0299. The interviewee did not provide information on when the incident occurred during his employment at the SSFL.
[235] It should be noted that radiography was often called "x-raying" because the resultant film image looks like an x-ray. The use of the term "x-ray" by the interviewee is slang. Personnel did not use "x-rays" and the personnel were referred to as radiography technicians.

Radiological Incident Reports: There have been several incidents associated with Building 4032 that could have resulted in a release to the environment. The following table provides information presented in an incidents database provided by Boeing. Summaries of the incident reports are provided following the table, when available.

Building 4032 Incident Report Summary

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A0299	3/27/1971	Outside	Ir-192	Radiographer made exposure adjacent to building with employee inside building.
A0586	4/20/1974	Welded pipe	Ir-192	Unattached collimator allowed gamma graph source to fall out of guide tube.
A0058	6/29/1977	East End Building 4032	Ir-192	Employee walked through barrier and approached exposed gamma graph source.
A0319	8/13/1981	Test area	Co-60	Gamma graph source failed to return and went undetected.
A0098	2/16/1982	High bay	Ir-192	Off scale dosimeter response.
A0310	3/17/1987	High bay	None identified	Security, on rounds, entered radiation area of field radiography set up.

- On March 27, 1971, during the performance of field radiography on pipe welds located just outside Building 4032, an Liquid Mental Engineering Center (LMEC) employee entered the building through a posted door. The employee was not observed by the radiographer who exposed the 27 Ci of Ir-192 in a "60° collimator" for a period of 11 minutes. The employee was discovered in the building by the radiographer after the source had been returned to the source safe. An investigation of the incident determined that the LMEC employee was exposed to a maximum radiation level of 6 mR/hr (A0299).[236]

- On April 20, 1974, while gamma graphing pipe welds in Building 4032, the 65 Cu iridium-192 (Ir-192) source was driven out for a routine exposure. The source went completely out the end of the guide tube and fell to the floor. When the remote hand crank was operated in an attempt to retrieve the source, it was discovered that the drive-cable was disconnected from the hand crank mechanism. Recovery of the source was done by disassembling the guide tube on the remote hand crank assembly and exposing the end of the drive cable. The drive cable and source were pulled back through the guide tube by hand until the source was replaced in the source storage container. A contamination survey of the area, guide tubes, and the source storage container found no detectable contamination. The maximum radiation exposure received by personnel involved in the recovery was 12 mrem as indicated by pocket dosimeter readings. The area was secured approximately 2 hours following the incident (A0586).[237]

- On June 29, 1977, a pipe joint weld was being radiographed in Building 4032. The source, Ir-192, was in an Iriditron Model 520 source projector with a collimator (70o

[236] Heine, W.F., Internal Letter Re: Radiography Incident Report A-0299, April 2, 1971.
[237] Klostermann, J.P., Rockwell International Internal Letter Re: Gammagraph Source Incident Building T032, April 24, 1974.

beam) oriented vertically upward. The source had an activity of 81.3 Ci on June 29, 1977. The radiographic operation was conducted near the east end of Building 4032 when unauthorized personnel entered the building on the west. His presence within the building was not observed by the radiographer until he was approximately 20 feet from the source for approximately 15 seconds before being instructed to vacate the premises. The investigation of the incident estimated the total dose to the employee to have been less than 10 mrem (A0058).[238]

- On August 13, 1981, an employee conducted a field radiography of the "SASS-ACA" test article in Building 4032. After completing the fourth exposure, the employee retracted the source and set the brake on the control unit. He approached the source with his radiation monitor and detected no activity strength on his meter, which was set on the X1 scale. At a distance of approximately 4 feet from the exposed source, the meter went off-scale. The meter continued to go off-scale when the meter was switched to X10 and X100 scale. Following investigation, it was found the source "did not crank completely into the projector after the exposure. It has apparently hung up approximately ¼ to ½-inch outside the projector in the guide tube. The monitor did not register a reading until being 4 feet from the exposed source because the projector orientation was such that it provided shielding from his approach direction. The source project contained approximately 56 curies of Co-60 (A0319).[239]

- On February 16, 1982, an employee checked his dosimeter and found the gamma exposure meter to be off scale while performing a fourth exposure on a test article in Building 4032. The employee shut down radiographic operations immediately. Investigation of the occurrence found the dosimeter to be defective (A0098).[240]

- On March 17, 1987, security personnel entered Building 4032 while the building was being "x-rayed." The film badge of the employee was analyzed for exposure; however, the findings of the analysis are not presented in the incident report. The incident did not result in any environmental contamination.[241]

Current Use: Building 4032 appears to have been demolished in 2003. According to soil and compaction reports dated May 1, 2003, the area was excavated 5 feet into firm compact material.[242] Based on available information, the dimensions of the excavation made during building demolition are unknown.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): A chronology of radiological investigations at this building is as follows:

- During a 1988 beta survey, a stainless steel catch pan was found to be contaminated with Co-60 at a level of about 25,000 dpm/100 cm^2. According to the survey, the catch pan

[238] Tuttle, R.J., Rockwell International Internal Letter Re: Radiography Incident A-0058, July 5, 1977.
[239] Breese, J.W., Rockwell International Internal Letter Re: Radiation Exposure Occurrence, August 20, 1981.
[240] Breese, J.W., Rockwell International Internal Letter Re: Off-Scale Reading of Personal Dosimeter, February 19, 1982.
[241] Unknown Author, Industrial Security Preliminary Investigation Report, Incident A-0310, March 17, 1987.
[242] The Soil Guys, Letter Re: Soil Engineering Testing of Soil Compacted at SSFL Area IV Facility, Building B-4032, Ventura County, California, May 1, 2003.

was most likely from Building 4059 or related to the SNAP facility and ended up in Building 4032 accidentally. The radioactivity was fixed in the steel and did not spread to surrounding areas. The pan was reported to have been disposed of as radioactive waste; however, the report did not indicate the method of disposal.[243]

As part of the DOE SSFL Site Survey, Building 4032 was surveyed to determine if any residual activity was accidentally left behind as a result of operations in support of the SNAP program. Gamma exposure rate measurements were made at 63 locations inside Building 4032. The maximum gamma exposure rate (corrected for background and statistically tested against an NRC acceptance limit of 5 μR/hr) in Building 4032 was 4.4 μR/hr. The average value was 0.43 μR/hr. Based on the median value of exposure rate measurements in the vicinity of Building 4032, the ambient background value for gamma was determined to be 7.27 μR/hr. All beta surface activity measurements made "for indication" showed no detectable activity, except for the stainless steel catch pan described above. Based on the results of the survey of Building 4032, the conclusion was made that Building 4032 passed the 1988 NRC criteria for unrestricted use.[244]

Radiological Use Authorizations: As indicated above, Building 4032 was used for mock-ups using a radiological source to determine the positioning of non-radioactive rods for use in developing the fuel rod control system from 1978 to 1983. On June 29, 1978, by internal letter, Rockwell International personnel submitted an application for use to R.J. Tuttle, the Radiation and Nuclear Safety Manager, for the purchase of 80 to 100 μCi Co-60 source. The purpose of which was for use in the assembly of the "articulated rod for ISSS [Inherently Safe Shutdown System] Test Program." According to the application, the source was stated to be intergral to a measuring technique to determine the free-fall time of the rod during loss of flow. According to the letter, the source was to be installed in Building 4032 for the intended use of 1,050oF and was to experience "free-fall" mechanical shock. The source was reported to be sealed and clad in stainless steel and had a source qualification radiation level of less than 2 MR/hr at 1 foot.[245]

On August 22, 1978, Rockwell International received Authorization No. 118. The authorization listed the operation as being "shutdown rod measurement" and approved the use of 100 μCi of Co-60 in Building 4032.[246] According to correspondence with the source vendor, Isotope Products Laboratories, Rockwell International received two 100 μCi C-60 sources. It appears one may have been for use in Building 4032, while the other was for use in Building 4059, under Authorization No. 117.[247][248]

According to the test procedure for the ISSS test program, the ISSS-Articulated Control Assembly (ACA) was assembled and installed in the Static Sodium Test Facility (SSTF) Building 4032 Test Rig 2.[249] On August 22, 1979, Rockwell International received a renewed

[243] ETEC Document, GEN-ZR-0013, "Radiological Survey of Buildings T049, T042, T027, T032, and T025," August 26, 1988.
[244] ETEC Document, GEN-ZR-0013, "Radiological Survey of Buildings T049, T042, T027, T032, and T025," August 26, 1988.
[245] DeVita, V., Rockwell International Internal Letter Re: Application for Use, Purchase Requisition No. 43182, June 29, 1978.
[246] Tuttle, R.J., Authorization No. 118, August 22, 1978.
[247] Marsh, Richard, Isotope Products Laboratories, Letter No Subject Line, October 31, 1978.
[248] Tuttle, R.J., Authorization No. 117, August 22, 1978.
[249] Bryan, R.L. Document P-067E-B01-AM032, "SSTF (032) Assembly and Installation – Inherently Safe Shutdown System-Articulated Control Assembly," August 28, 1978.

authorization, Authorization No. 118A, for the continued shutdown rod measurement operations in Building 4032. This authorization expired August 22, 1980.[250] Authorization No. 118B was issued on August 22, 1980, and the test article was renamed the Self Actuated Shutdown System-Articulated Control Assembly (SASS-ACA).[251] The final authorization, Authorization No. 118D, for these operations was issued on August 22, 1982, and expired on August 22, 1983. At the conclusion of these operations, the source was 97.2 μCi of Co-60. The form was sealed source S/N 43014, which was checked annually to ensure no leakage occurred.[252,253, 254]

Incident reports show that Ir-192 was also used as a source under Use Authorization 18.[255]

Former Radiological Burial or Disposal Locations: No former radiological burial or disposal locations have been associated with this building, although the building appears to have had a single below-ground sodium drain tank (UT-23) with a capacity of 5,500 gallons; however, the former location of the drain tank is unknown. In 1996, approximately 15,930 pounds of sodium was removed from the stainless steel vaulted tank. In 1997, the drain tank was removed and cleaned using a water-vapor-nitrogen process. During this process, approximately 1,542 pounds of sodium was converted to sodium hydroxide.[256, 257]

Aerial Photographs: Prior to the construction of Building 4032, the area was used for open storage during construction activities. Building 4032 appears in aerial photographs in 1965. Between 1972 and 1978, Building 4032 is expanded on the northwest corner of the building. In the 1978 aerial photographs a pipeline is visible directly east of the building leading from Building 4023 south to Building 4042. A possible horizontal tank appears to be located immediately north of Building 4032 in 1995 aerial photographs. By 2005 the building has been removed and minor ground scarring remains visible.[258]

Radionuclides of Concern: Based on incident reports alone, Co-60 and Ir-192 would be the radionuclides of concern at Building 4032; however, Ir-192, with a half life of 74.2 days is not included in the August 2009 Final Field Sampling Plan. Co-60 is included in the August 2009 Final Field Sampling Plan for the Santa Susana Field Laboratory radiological background study. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: A 2-inch drain line was located on the north end of the building and extended east to a 12-inch corrugated metal drain pipe. Storm drains were located on the west and east sides of the building.[259]

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[250] Tuttle, R.J., Authorization No. 118A, August 22, 1979.
[251] Tuttle, R.J., Authorization No. 118B, August 22, 1980.
[252] Remley, M.E., Authorization No. 118D, August 22, 1982.
[253] Authorization Series 118, Shutdown Rod Measurement, J. V. Menteer, August 1978.
[254] The research team is awaiting receipt of Use Authorization 118. The information presented above was summarized in Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 - Area IV Site Summaries,* May 2005.
[255] Tuttle, R.J., Rockwell International Internal Letter Re: Radiography Incident A-0058, July 5, 1977.
[256] The Boeing Company, *Rocketdyne Propulsion and Power DOE Operations Annual Site Environmental Report 1998*, RD99-115, September 22, 1999.
[257] Rockwell Aerospace, *Rocketdyned Division Annual Site Environmental Report Santa Susana Field Laboratory and De Soto Sites 1993*, RI/RD94-126, October 21, 1994.
[258] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[259] Atomics International, Santa Susana Facility Plot Plan, Drawing 303-GEN-C38, Sheet 4 of 14, June 4, 1964.

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4032 area is Class 2 based on the building's location within ETEC and incident history.

Recommended Locations for Soil/Sediment Sampling: Plate 1 and Figure 2.1 provide a convenient reference for the following recommendations.
Based on the available information, soil sampling is recommended in the Building 4032 area. Incident reports involving Co-60 occurred at Building 4032. Information is lacking regarding the excavation activities at Building 4032 during building demolition.

There have been limited characterization studies for the Building 4032 area and they were focused on delineating the extent of contamination to standards that were applicable at the time. Therefore, additional characterization is recommended for the Building 4027 area. This includes the following Building 4027 areas:

- The 2-inch drain located along the northern exposure of Building 4032. Incident reports indicate that a radiographer performed exposures on the exterior of the building; however, the nature of these operations is unknown. If radioactive materials were released during these operations, residual contamination above background values may have been released into the 2-inch drain, which drained to the corrugated metal pipe located east of the building. Sampling is recommended at the former location of the 2-inch drain and the in-fall at the corrugated metal pipe.

- Storm sewer lines located south of the Building 4032 footprint. If radioactive materials were released into the sewer system, residual contamination above background values may exist in the materials surrounding the sewer lines.

- Sanitary sewer line located west and east of the Building 4032 footprint. If radioactive materials were released into the sewer system, residual contamination above background values may exist in the materials surrounding the sewer lines.

- The former Building 4032 footprint. While the extent of the excavations during building demolition are unknown, soil and compaction reports dated May 1, 2003, indicate the area was excavated 5 feet into firm compact material.[260] Building 4032 measured 4,580 square feet.[261] Past contamination may have left residual contamination above background values in the area.

- The building appears to have had a single below-ground sodium drain tank (UT-23) with a capacity of 5,500 gallons; however, the former location of the drain tank is unknown. In 1996, approximately 15,930 pounds of sodium was removed from the stainless steel vaulted tank. In 1997, the drain tank was removed and cleaned using a water-vapor-nitrogen process. During this process, approximately 1,542 pounds of sodium was

[260] The Soil Guys, Letter Re: Soil Engineering Testing of Soil Compacted at SSFL Area IV Facility, Building B-4032, Ventura County, California, May 1, 2003.
[261] ETEC Document, GEN-ZR-0013, "Radiological Survey of Buildings T049, T042, T027, T032, and T025," August 26, 1988.

converted to sodium hydroxide.[262, 263] Should the former location of the tank be determined, sampling at the tank would be warranted.

2.1.5 Building 4036/4037 Area

Site Description: The Building 4036/4037 area includes Building 4036/4037, substation Building 4727, and the surrounding area. Building 4036/4037 was constructed between 1962 and 1965 and consisted of two one-story metal buildings joined together, each with a concrete slab floor and concrete foundation. The building had approximately 7,380 square feet of floor space.[264,265,266] Buildings in proximity to Building 4036/4037 include Buildings 4027 and 4032, which are discussed above. Figures 2.1.5a through 2.1.5c provide a current photograph and the best available building-specific drawing(s) that the research team could find. Plate 1 presents a summary of all identified features for this site.

Building Features: The support structure of Building 4036/4037 consisted of steel beams with corrugated steel siding and roof. The building contained numerous internal partition walls with wood framing and drywall surfaces.[267] A March 15, 1962, layout of the building shows there to be approximately 40 offices in the building.[268] The building included an ambient radiation dosimeter at the east side of Building 4036/4037.[269]

Former Use(s): As indicated above, Building 4036/4037 was constructed between 1962 and 1965. A review of industrial planning maps shows that Building 4037 appears distinctly only on the 1962 map; thereafter, it is labeled as part of Building 4036.[270] Building 4036/4037 operated as a non-nuclear office building for the SNAP program.[271,272,273]

Information from Interviewees: There have been no interviews to date with personnel familiar with operations in Building 4036/4037.

Radiological Incident Reports: None found.

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[262] The Boeing Company, *Rocketdyne Propulsion and Power DOE Operations Annual Site Environmental Report 1998*, RD99-115, September 22, 1999.
[263] Rockwell Aerospace, *Rocketdyned Division Annual Site Environmental Report Santa Susana Field Laboratory and De Soto Sites 1993*, RI/RD94-126, October 21, 1994.
[264] Boeing Document, EID-04366, "Removal of DOE Buildings, Demo Pak A," May 18, 1999.
[265] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[266] ETEC, *Site Consolidation Assessment*, April 16, 1987. p. 13.
[267] Boeing Document, EID-04366, "Removal of DOE Buildings, Demo Pak A," May 18, 1999.
[268] Unknown, *Room and Area Numbering Plan Santa Susana Building 0036-0037, Snap Office Building*, March 15, 1962.
[269] Rocketdyne, *Rocketdyne Propulsion and Power DOE Operations Annual Site Environmental Report 1997*, November 23, 1998. p. 59.
[270] SSFL Area IV, ETEC Industrial Planning Maps, 1962-1992.
[271] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005
[272] Approved DOE/EPA Interview 255, July 9, 2010.
[273] Rockwell International, *Site Development Plan 1977-1981, United States Energry Research and Development Administration, Liquid Metal Engineering Center*, June 1975.

Current Use: Building 4036/4037 appears to have been demolished in 1999. Based on available information, the dimensions of the excavation made during building demolition are unknown, and radiological controls were not required during building demolition.[274]

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): To date, the research team has not located any radiological investigations at or near the Building 4036/4037 area.
Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Locations: There have been no radiological burial or disposal locations identified in relation to the operations of Building 4036/4037. It is important to note, however, that Building 4036/4037 is located close to the RMHF and Buildings 4021 and 4022.

Aerial Photographs: Prior to the building's construction, the 1962 aerial photographs show minor staging activities occurring at the site area. By 1965, the building has been fully constructed and the area is operational. The building is no longer present in 2005 aerial photographs and the surrounding area is vegetated.[275]

Radionuclides of Concern: The research team did not find evidence that high activity radioactive materials were used or stored within Building 4036/4037. However, Building 4036/4037 is located in proximity to RMHF; therefore, direct radiation and skyshine from RMHF may affect ambient radiation conditions in the area.[276] Radionuclides of concern at the RMHF include all radionuclides addressed in the background study plus any additional radionuclides identified during the HSA. All radionuclides of concern listed are included in the August 2009 Final Field Sampling Plan for the Santa Susana Field Laboratory radiological background study. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: The general slope of Area IV, including Building 4036/4037, is in a southerly direction. Water runoff is directed to the retention reservoirs which are part of the SSFL industrial effluent control system. Liquid effluent discharge from the final retention pond into the Bell Canyon drainage occurs only after controlled effluent holdup and sampling.[277] The Building 4036/4037 elevation appears to be higher than buildings located immediately south of the building. Based on aerial photographs, it appears drainage from the building would be to the south-southwest.[278] Corrugated metal pipes located south of the building at the base of the stairway leading from the building likely directed surface drainage to the retention reservoirs.[279]

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4036/4037 area is Class 2, due to its location within ETEC, proximity to Building 4021 and 4022 and the RMHF, and because no site investigation has been conducted.

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[274] Boeing Document, EID-04366, "Removal of DOE Buildings, Demo Pak A," May 18, 1999.
[275] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[276] ETEC Document, GEN-ZR-0013, "Radiological Survey of Buildings T049, T042, T027, T032, and T025," August 26, 1988.
[277] Map located at: http://dtsc-ssfl.com/files/maps/SSFL%20-%20Western%20Half.pdf.
[278] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[279] Atomics International, Santa Susana Facility Plot Plan, Drawing 303-GEN-C38, Sheet 4 of 14, June 4, 1964.

Recommended Locations for Soil/Sediment Sampling: Plate 1 and Figure 2.1 provide a convenient reference for the following recommendations.

Based on the available information, soil sampling is recommended in the Building 4036/4037 area. To date, the research team has not located any characterization studies for the Building 4036/4037 area. Therefore, characterization is recommended for the Building 4036/4037 area. This includes the following Building 4036/4037 areas:

- Due to the proximity of RMHF Buildings 4021 and 4022 to Building 4036/4037, there is a high probability that radionuclide concentrations in soil will exceed background values. It is recommended that the soil characterization at Building 4036/4037 be conducted in conjunction with characterization activities that will be conducted for the facilities comprising the RMHF. It is also recommended this characterization include the Building 4036/4037 footprint.

- The storm sewer line located south of Building 4036/4037, east and west of the stairway.[280] If radioactive materials from the RMHF were released and drained into the Building 4036/4037 area, residual contamination above background values may exist to the south of the building.

2.1.6 Site 4927 Area

Site Description: The Site 4927 area is located along B Street, southwest of Building 4024. The area comprises Site 4927 and the surrounding area. The building appears to have been constructed sometime between 1962 and 1965 to serve as a nitrogen gas storage tank.[281] Plate 1 presents a summary of all identified features for this site.

Building Features: Based on a 1969 plot plan, it appears Site 4927 comprised a concrete pad and did not include a physical structure other than the nitrogen gas storage tank.

Former Use(s): The precise date of construction of this site is unknown. Building 4927 was identified on industrial planning maps as a nitrogen storage tank. Documents outlining which buildings the storage tank serviced could not be located; however, a Facility Area Plan of inert gas shows that the adjacent Building 4025 was serviced by a high-pressure nitrogen system. Most likely, Site 4927 serviced Building 4025 for the time period before the high-pressure nitrogen system was installed.[282] Site 4927 was most likely demolished in the 1970s, when Area IV began using the high-pressure nitrogen system. This involved piping in nitrogen from Area III, eliminating the need for most Area IV nitrogen storage tanks.[283,284]

[280] Atomics International, Drawing No. 303-027-C2 Expansion of Non-Nuclear Mechanical Vibration and Shock Testing Building 027 Expansion, Topographic Plan, February 4, 1963.
[281] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries,* May 2005.
[282] Drawing, 303-GEN-C254, "Santa Susana Facility Area Plan Inert Gas Master East," As Built to Date, February 22, 1991, Ref # PEWR 75184.
[283] Personnel Interview, Randy Ingersoll, September 23, 2003.
[284] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries,* May 2005.

Information from Interviewees: To date, there have been no interviews with personnel familiar with operations at Site 4927.

Radiological Incident Reports: There have been no incident reports relating to Site 4927; however, incidents associated with Building 4024 may have impacted the area surrounding Site 4927. Incidents associated with Building 4024 are presented above in Section 2.1.2.

Current Use: Site 4927 was likely demolished in the 1970s, sometime between 1972 and 1978 as evidenced in aerial photographs.[285,286]

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): Radiological surveys specific to Site 4927 have not been conducted; however the building site was included in the Area IV Radiological Characterization Survey, conducted in 1994 through 1995. The survey was designed to locate and characterize any previously unknown areas of elevated radioactivity in Area IV. Background was determined to be 15.6 μR/hr, and the acceptable limit was less than 5 μR/hr above background. The survey found the area to be below acceptable limits in 1995.[287]

Radiological Use Authorizations: None.

Former Radiological Burial or Disposal Locations: None.

Aerial Photographs: The development of the Site 4927 area is first visible in the 1959 aerial photograph with a large excavation occupying a majority of the area. In 1962 the area is still being developed. By 1965 the site has been fully developed and there is no evidence of construction activities; however, it is difficult to discern whether Site 4927 is present. In 1967 and 1972, a structure is visible at the Site 4927 location. By 1978, the structure appears to be gone with a foundation being the only sign of a building's presence. The foundation remains visible in aerial photographs until 2005.[288]

Radionuclides of Concern: None.

Drainage Pathways: Aerial photographs show evidence of a short drainage channel west of Building 4024 in 1967 and 1972 from an open storage area toward Building 4010. The drainage channel is no longer present in 1978 and has been replaced by an escarpment.[289] The research team did not locate any other drainage information for the area. It is possible however, that drainage from the area entered the drainage channel that ran along 17th Street in relation to the operations at Building 4005.

Radiological Contamination Potential: Based on historical site operations, it is unlikely radiological contamination resulted from the operations as a nitrogen storage tank. However, the site's proximity to Building 4024 and the sump associated with Cooling Tower 4928 may have

[285] Personnel Interview, Randy Ingersoll, September 23, 2003.
[286] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[287] Rocketdyne Document, A4CM-ZR-0011, Rev. A, Area IV Radiological Characterization Survey, August 15, 1996.
[288] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[289] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.

resulted in contamination at or around Building 4927. As a result, this site has been designated MARSSIM Class 1.

Recommended Locations for Soil/Sediment Sampling: It is recommended this area be included in the sampling plan for Building 4024, discussed above in Section 2.1.2.

2.2 GROUP 2

The Group 2 index map is presented in Figure 2.2. Following Figure 2.2, the site photograph and layout drawings for each building area within HSA-5A Group 2 are presented. HSA-5A Group 2 includes nine building areas including Building 4073, the Kinetic Experiment Water Boiler (KEWB) reactor, and Building 4093, the AE-6/L-85 reactor and their associated buildings.

2.2.1 Building 4073 Area

Site Description: The Building 4073 area includes Building 4073 and the surrounding area. Constructed in 1955, Building 4073 served as the KEWB reactor building and consisted of an underground concrete structure and an above-ground wood and metal changing/workroom. Other buildings within the vicinity of Building 4073 include Building 4123, Building 4643, and Building 4793 discussed below. Figures 2.2.1a through 2.2.1g provide a current photograph and the best available building-specific drawing(s) that the research team could find. Plate 1 presents a summary of all identified features for this site.

Building Features: The Interim Radiological Survey Report indicated the KEWB reactor facility consisted of the reactor test building (Building 4073), an exhaust blower building (Building 4643), an electrical control building (Building 4793), and a waste storage building (Building 4123).[290] It should be noted that Building 4123 is also identified as a "fuel" storage building in some survey layout drawings. The KEWB reactor test building consisted of an underground concrete structure and an above-ground wood and metal changing/workroom. The underground portion of the reactor building measured 15 by 26 feet and was 10 feet tall and contained four rooms. The reactor test building housed the reactor test core, control rods, gas handling and fuel storage systems, and the necessary detection instrumentation. The facility included a waste disposal system west of Building 4073 comprising three underground tanks and a 60-foot exhaust stack with a 2,000-cubic foot per minute blower system. A 300-gallon collection tank was used to collect gas directly from the reactor system. A 1,000-gallon storage tank buried beneath floor level and adjacent to the test building retained all liquid waste from the facility. The tank was equipped with pump-out connections for removal of the liquid waste when necessary. Another 1,000-gallon tank was originally used to retain the reactor cooling water so that it could be checked for activity prior to release. The tank appears to have drained through a 2-inch line to the west to an open drainage channel along the northern boundary of 12th Street and then south of the KEWB facility. This drainage channel continues along 12th Street to G Street and flows southwest along G Street to the 17th Street drainage channel, where flow is directed below G Street to a concrete spill apron for discharge to the "R-2A" pond in Area

[290] Argonne National Laboratory Report, no document number, "Surplus Facilities Management Program, Interim Post Remedial Action Survey Report for Kinetic Experiment Water Boiler (KEWB) Facility, Santa Susana Field Laboratory, Rockwell International, Canoga Park, California," May 1983.

III.[291,292,293] The ventilation system for Building 4073 was housed in Building 4643, which was connected to the reactor building.[294]

Former Use(s): Initial construction of the facility was completed in 1955, and operations began in July 1956. The KEWB reactor was a small graphite-encased research reactor that used a water solution of uranyl sulfate as fuel. Transient testing of the first core began in the fall of 1956 and was concluded in the summer of 1959. During this period, more than 900 transient tests were conducted under a variety of initial core conditions and for various reactivity inputs and injection rates. Following these tests, the "A" Core (spherical) was replaced by the "B" core (cylindrical) that was used in a series of experiments utilizing the cylindrical core geometry. The reactor had a capacity of 50 kWt, but did not normally operate at full power; the majority of reactor operations were conducted at a power level of 1 kWt or less.[295] In May 1962, the reactor was operating as a neutron burst facility with 30% of KEWB's operating time devoted to the investigation of void formation in organic reactor transients and the remaining operation time being used by outside organizations, such as Space Technology Laboratory, University of California, and North American Aviation Space and Information Systems Division.[296] As of August 1966, inspection of Building 4073 indicated that activities at the building had been reduced to "caretaker status" and out-of-reactor fuel inventories had been reduced accordingly.[297] Operations in the building halted in November 1966. All control consoles and reactor instrumentation were removed following closure, and the fuel was drained from the fuel storage tank and shipped to a recovery plant.[298]

A June 4, 1969, nuclear safety analysis provided information for the removal of fuel from the KEWB reactor as part of the KEWB deactivation. According to the nuclear safety analysis, the nuclear fuel at the KEWB comprised 18 liters of 93% enriched uranium, uranyl sulfate solution containing 1,800 grams of U-235. The analysis indicated that the fuel would be loaded in five 912 containers and stored temporarily at the "Santa Susana Vault" prior to being shipped for reprocessing. As of June 1969, the fuel was located in the storage tank of the KEWB reactor. The fuel, according to the nuclear safety analysis, was to be transferred to polyethylene bottles prior to being places in 912 containers that were reported to have water tight steel tubes to serve as secondary containment. Following storage, and in preparation for final shipment for the purpose of recovery, the five 912 containers were to be repackaged into polyethylene bottles for

[291] Rockwell International Report, AI-ERDA-13159, "KEWB Facilities Decontamination and Disposition Final Report," February 25, 1976.
[292] Flora, J.W., Atomics International, *KEWB Radiological Emergency Plan*, January 14, 1960. HDMSP01637672
[293] Atomics International, FDP-704-990-002, *Dismantling Plan for KEWB Facility (Bldgs 073,123 and 793)*, October 17, 1974.
[294] Atomics International, Document NAA-SR-7300 Special, "Evaluation of the Atomics International Nuclear Development Field Laboratory as a Location for Reactor Facilities," May 25, 1962.
[295] Rocketdyne Report, N001ER000017, "Nuclear Operations at Rockwell's Santa Susana Field Laboratory – A Factual Perspective," September 1991.
[296] Atomics International, Document NAA-SR-7300 Special, "Evaluation of the Atomics International Nuclear Development Field Laboratory as a Location for Reactor Facilities," May 25, 1962.
[297] Atomics International, Internal Letter Re: Tour and Inspection of AI Fuel Handling and Storage Facilities, August 8, 1966.
[298] Atomics International, Document PP-704-990-002, *Decontamination and Disposition of Facilities Program Plan*, January 23, 1975.

shipment in DOT SP 5061 shipping containers. This repackaging was to occur in the decontamination room of Building 4021.[299]

The KEWB reactor facility, including Building 4073, was demolished in 1975. Contaminated or activated equipment and materials were removed and sent to the RMHF for decontamination and disposal for unrestricted use, or package for shipment to the Nuclear Engineering Company burial site in Beatty, Nevada, for burial. The above-grade structures and roof of Building 4073 were demolished. The remaining concrete floors and walls were decontaminated to levels that were "as low as practicable," and levels established as "acceptable" for unrestricted use of the site. These levels were identified in Rockwell International's dismantling plan as follows:[300,301,302]

Contamination Limits for Decontamination and Disposition of the KEWB Facility

	Total	Removable
Beta-gamma Emitters	0.1 mrad at 1 cm with 7 mg/cm2 absorber	100 dpm/100 cm2
Alpha Emitters	100 dpm/100 cm2	20 dpm/100 cm2

The reactor room was dismantled by removing, surveying and salvaging the overhead wiring and cable trays and hot water heaters. The control rod drivers and controls were removed, surveyed, and placed in containers for shipment to a burial site. The north and west plates of the reactor enclosures were unbolted to permit removal of the graphite logs that surrounded the reactor vessel. The decontamination and disposition report noted that six of the graphite logs located directly beneath the reactor vessel on the floor of the enclosure were contaminated with what appeared to be uranium salts. The source of the uranium salts could not be determined from the information provided in the report. The graphite logs were wrapped in plastic sheet, tagged as radioactive waste, and transferred to the RMHF for final packaging and shipment to Beatty, Nevada, for burial.[303]

Following removal of the logs, the pipe lines to the reactor vessel were crimped to contain any residues and then were cut with a saw. The vessel was spray painted to fix the contamination (360 to 40,555 dpm/100 cm^2) and was then removed, wrapped in a 55-gallon bag, and placed in a shipping container for transport to Beatty, Nevada. The remainder of the reactor enclosure was cut out using a welding machine and carbon rod. Smear surveys of the concrete pad directly below the reactor and the concrete wall adjacent to the reactor revealed no removable contamination. However, concrete samples from these areas did indicate induced radioactivity.

[299] Schumann, G., Atomics International Document NSA-001-14-001, *KEWB Deactivation Nuclear Safety Analysis*, June 4, 1969.
[300] Rockwell International Report, AI-ERDA-13159, "KEWB Facilities Decontamination and Disposition Final Report," February 25, 1976.
[301] Argonne National Laboratory Report, no document number, "Surplus Facilities Management Program, Interim Post Remedial Action Survey Report for Kinetic Experiment Water Boiler (KEWB) Facility, Santa Susana Field Laboratory, Rockwell International, Canoga Park, California," May 1983.
[302] Rockwell International Report, FDP-704-990-002, *Dismantling Plan for KEW Facility (Bldgs 073, 123, and 793)*, October 17, 1974.
[303] Rockwell International Report, AI-ERDA-13159, "KEWB Facilities Decontamination and Disposition Final Report," February 25, 1976.

All concrete contained detectable induced activity was removed so the levels documented in the table above became the natural radiation level of the concrete.[304]

The fuel handling room contained the process systems for controlling, mixing, monitoring, and storing the reactor fuel. Reactor liquids had been drained during the reactor deactivation in 1968, and during the D&D the systems were thought to be empty and dry. However, when cutting through a horizontal line to the gas recombiner, a dark brown liquid spilled out and contaminated the protective and personal clothing of a technician. The contamination measured 40 mrad/hr. All system components of the fuel handling room were removed, package, and shipped to the RMHF for disposal. The walls, ceiling, and floor were lined with sheet metal and the seams in the panels were soldered to form a leak-tight barrier. Beta and alpha contamination in the walls were decontaminated by foaming, wet vacuuming, and wiping to allow the removal of the sheet metal room liner without spreading contamination to the bare concrete walls and floor. The liner was placed in boxes for shipment to Beatty, Nevada, for burial.[305]

The instrumentation piping passing through the 2-foot thick concrete wall was highly contaminated. Enough contamination remained following wet swabs that removal of the pipes was necessary. A total of twelve pipes were removed. A fuel storage tank located in a 5-foot deep, 1-foot diameter pit in the fuel handling room was removed. The pit had a metal liner that was found to be contaminated. Because decontamination of the liner was impractical due to the inaccessibility of the inner surfaces, the liner was removed by demolishing the floor adjacent to the pit and lifting the liner out with a crane. The liner was transferred to the RMHF for disposal.[306]

The final demolition of the KEWB facilities included the removal of the asphalt paving over the entire KEWB area, the removal of the concrete foundations for the exhaust and electrical buildings; the removal of the concrete pads for the air conditioners, compressor and filter plenum wooden structure at the KEWB entrance; the removal of the concrete roof over the KEWB; the removal of the above-grade portions of the retaining wall; the removal of three underground tanks and their associated fill and drain lines; and the removal of the waste storage building, Building 4123.[307]

Following the confirmation by a final survey of Building 4073 that contamination levels were within "prescribed limits," the Building 4073 rooms were backfilled with concrete and asphalt rubble and covered with soil. The prescribed limits, as defined in the 1974 dismantling plan, were 100 dpm/100 cm2 removable beta and 20 dpm/100 cm^2 removable alpha. A total of 3,045 cubic feet of radioactive waste was removed during D&D efforts.[308,309,310] The site was released for unrestricted use on March 3, 1976, by the ERDA.[311]

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[304] Rockwell International Report, AI-ERDA-13159, "KEWB Facilities Decontamination and Disposition Final Report," February 25, 1976.
[305] Rockwell International Report, AI-ERDA-13159, "KEWB Facilities Decontamination and Disposition Final Report," February 25, 1976.
[306] Rockwell International Report, AI-ERDA-13159, "KEWB Facilities Decontamination and Disposition Final Report," February 25, 1976.
[307] Rockwell International Report, AI-ERDA-13159, "KEWB Facilities Decontamination and Disposition Final Report," February 25, 1976.
[308] Rockwell International Report, AI-ERDA-13159, "KEWB Facilities Decontamination and Disposition Final Report," February 25, 1976.

Information from Interviewees: Interviewee 5 had extensive knowledge on the operations of the KEWB and Building 4073. Interviewee 5 served as the responsible engineer for the KEWB and was one of three operators that ran the reactor. The following are excerpts from that interview:

> The KEWB reactor was a water-boiler type reactor. The originally designed reactor was a solution-fueled reactor designed for university research. It was a steady-state reactor and was very low-powered, 50kW. The purpose of the KEWB program was to demonstrate that the reactor was completely safe and that anything they could do to it in a college environment would be safe. We would run tests to try and simulate the worst kinds of accidents we could imagine and the reactor would always shut itself down as a safety feature. All of the experiments we did were designed to test the safety of the KEWB reactor. KEWB was used solely for safety demonstrations. Subsequent to the KEWB program, we used the reactor as a pulse reactor for pulse neutron radiation experiments...
>
> ...There were radioactive gases and liquids associated with KEWB. The KEWB did generate fission gases. The fission gases were held in an underground storage tank and then vented up to a stack after a decay period. The only contamination that might still remain from that would be in the underground storage tank[312]...We had fission gases that were generated and sent to the underground tank. Then we had argon-41 that was generated in the reactor vault, but this was not held in the underground tank, it was just vented up the stack. We would have to ventilate the room anytime we had to do work in the reactor room because of the radioactive argon gas...
>
> ...The reactor fuel was liquid, uranyl sulfate. The coolant was water. There were cooling coils. I think the coolant was recycled. There was essentially no radioactivity in the coolant and none was discharged to the environment. There were two different reactor core vessels at KEWB. The first was a 12-inch spherical core that used highly enriched (93%) uranium, U-235. There was a stack on the reactor that was an overflow chamber. When we pulsed the reactor, gas would form and it would expel the fuel solution up and it would become subcritical... There was a fuel and gas handling system for the reactor located in an adjacent room in the KEWB Building.
>
> ...There were three rooms in the concrete vault below grade. One room was the reactor vault, one room was the valve control room, and the third room was where the gas holdup tank, liquid drain tank, and associated plumbing were located. There was a hydrogen recombiner located in that room as well that we ran a few tests on. The radiation levels in the fuel and gas handling room became very high. We hardly went into that room. The fuel would end up there and the piping would get highly contaminated...
>
> ...When the fuel was drained out of the reactor it went into the below-grade drain tank. We also had a precipitate material in the lines and we did some chemical flushing to try and recover the precipitate material. That process generated a lot of liquid that ended up getting stored in glass carboys. We would flush the pipes and drain the rinse into the

[309] Rocketdyne Report, N001ER000017, "Nuclear Operations at Rockwell's Santa Susana Field Laboratory – A Factual Perspective," September 1991.
[310] Rockwell International, FDP-704-990-002, *Dismantling Plan for KEWB Facility (Bldgs 073, 123 and 793)*, October 17, 1974.
[311] Stamp, Stanley, Letter Re: "Decontamination and Disposition of ERDA Facilities," March 3, 1976.
[312] The 1975 D&D report confirms that the underground storage tank was removed during disposal activities.

carboy containers. The containers were stored outside Building 4123 across from the KEWB reactor building...[313]

...Halfway through the KEWB program we changed the reactor vessel shape. We took the original 12-inch spherical vessel out and replaced it with a 12-inch cylindrical vessel. We cut the spherical vessel out and stored the reactor in Building 4123, which was a storage building designed for holding the reactor vessel...There are vents located in the bermed area of Building 4073, which were the vents that allowed us to draw fresh air into the building and blow the argon gas out of the stack...

...An incident report (A0504) associated with the KEWB reactor building noted that between April 1 and June 30, 1961, a research engineer received quarterly exposures to gamma and neutron radiation at levels greater than 3 rem. This occurred while conducting core experiments required for termination of the KEWB program and resulted in high radiation in the reactor room. The engineer was aware of his high cumulative exposure in early May, but because of the importance of the tests and lack of other qualified operators, he continued to conduct "unreflected" core experiments without prior approval to exceed the 3 rem quarterly limit. That incident report is referring to me. I was that research engineer referenced...

...We did very little on-site storage of waste. I mentioned the first KEWB reactor vessel and the rinse solution, but there was little else. The reactor vessel stayed on site until the area was decontaminated and the rinse solution was eventually taken to RMHF...

...We used sulphurous acid H_2SO_3, once over a period of a few days to chemically flush the plumbing lines at KEWB... The whole idea was to dissolve fuel that had precipitated out into the gas lines or other lines. The acid also took off a bit of the steel from the piping. We were tense when we flushed the lines with sulphurous acid because the 1/8" drain lines coming out of the 1/4" piping were getting plugged up and it wasn't draining fast enough. We didn't want the sulfurous acid to be in the system very long so we wanted to get it out fast. I never did learn exactly what caused the plugging of the lines. We had to go into the gas handling room that was highly contaminated to unplug the drain lines. We went in very quickly and closed the valves and cleaned out the drain lines with a wire. The drain lines went into the glass carboy containers so that is where the rinse solution was contained. We got our gloves contaminated on that work. We would take our gloves and overalls and anything contaminated from our work on the KEWB and throw the items in the radioactive waste. We were a good customer of the RMHF...

...The reason we had to flush the system was because when the reactor was pulsed and the foam solution that included the liquid uranium fuel would rise in the overflow chute and it would splash and go into the gas piping. We were trying to recover the fuel, which is why we used the sulphurous acid. Using the sulphurous acid was a one-time situation. It was driven by material accountability. Since the fuel was highly enriched uranium, it had to be fully accounted for. Every so often we would have to calculate the amount of uranium in the core and things like that. We discovered that we had to add a little bit of fuel and our calculations weren't finding all the fuel. That's when we realized that a small amount was splashing into the gas lines. So our calculations of fuel in the core were always a bit low because some of the fuel was in the piping. So then we got into

[313] The research team has not located any information to indicate that carboys were used to collect and store material that was flushed from the pipes. There is also no evidence of any containers larger than carboys (i.e. 55-gallon drums) being used for this purpose.

> discussion about how to recover the fuel. We talked to "Mad Chemist" and came up with the idea to use sulphurous acid to recover the fuel. The fuel was recovered, but was not recycled. It was contained in the carboys. The first couple of carboys were pretty hot and went to the RMHF. We flushed the system pretty heavily to make sure we got all the sulphurous acid out, so we generated a lot of liquid waste from that process. The carboys were stored temporarily at Building 4123, but eventually it was all sent to RMHF…
>
> …There were no restroom facilities in Building 4073, so nothing was drained down any toilets. We used the AE-6 building restrooms. The general rule was that once anything was inside the fence it stayed there. I don't recall any problems with underground sumps, pumps, tanks, or piping. I can't recall any leaking tanks or pipes in our system. Most of the piping was welded, stainless steel…

Interviewee 104 also had experience with Building 4073. Interviewee 104 worked for Atomics International beginning in 1956 and was an engineer. Of Building 4073, the former employee stated:

> The only other reactor at SSFL that I reviewed was a little boiling water reactor – I believe it was the Kinetic's Experiment Water Boiler (KEWB). The fuel was uranyl sulfate dissolved in water in a 12- to 15-inch spherical core and was a prototype and test reactor used to prove the safety for the AE-6 reactor. The design was from Los Alamos. We referred to the experiments done on this reactor as BURP experiments because during the tests, the power was increased rapidly so that the liquid appeared to boil and then the reactor would automatically shut down. I believe that AI sold several of the AE-6 reactors to universities and other research institutions that needed a neutron source for the production of radioisotopes and to perform other reactor experiments.

Interviewee 2 began working for Atomics International in November 1955, transferred to Rocketdyne in 1965 or 1966, and worked there until March 1968. Interviewee 2 also had knowledge of Building 4073 operations and provided the following information.

> I do remember doing some work on the hill at the KEWB reactor. I remember testing a piece of electronic equipment with a pulse of nuclear radiation from the reactor. The KEWB reactor is a water boiler reactor, which is essentially a big pot with water and a solution of uranium in it. If you pull the control rod part of the way it, the reactor goes critical and starts to generate power. If you pull the control rods all of the way out, the reactor goes supercritical and then "poof." It explodes and puts out a lot of nuclear radiation in a very short time and then of course it shuts itself down automatically. Then you have to wait 45 minutes before you can set it up again. I spent one day doing that. We eventually discovered a much easier piece of equipment to use for our tests that gave equally useful results to the reactor, it was a flash x-ray machine. We had the flash x-ray machine at DeSoto. It doesn't rely on a nuclear reactor. It is an x-ray tube with a cold cathode. The cathode has a lot of tiny spikes on it to generate intense electric fields at the points of the spike and draw electrons out of the cathode. Then the electrons slam into an anode and generate x-rays. It was a lot simpler to use than the KEWB and cheaper as well…
>
> . . .Going back to my one day at the KEWB reactor, I remember that the technician that was supposed to make sure the cameras had film in them forgot to load the cameras and we missed the first shot. We didn't get any data on our first pulse of the reactor. I was waiting outside the KEWB building when we ran a test. It was a safety precaution. We didn't want to be near the thing when it went "poof." We would set everything up and get

> it ready to go. I went outside. I don't know how they got the reactor to go off, maybe there was a timer or something. I don't remember that detail. Maybe there was a timer with a delay so that we could leave the building before the control rods were pulled out. The system would pull the control rods out then put them back in. When the control rod came out you would get this "explosion" and then you would drop the control rod back in and wait for things to cool down. Then you set it up and do it again. The measurements would be recorded on an oscillograph or camera. An oscillograph was an oscilloscope with a camera looking at it. The "poof" is the release of radiation from the removal of the control rod. The reactor liquid is completely contained in the tank, it just expands to a greater volume when the reactor goes supercritical. The KEWB itself was below grade level and the reactor itself was in the cellar of the building. This provided additional shielding. The KEWB was a stand-alone experiment and not related to the other experiments at the SSFL except that AI was running all of them. I don't recall what the other buildings surrounding the KEWB building were used for. I was doing this in 1964 or 1965, so it was at least 45 years ago. I left in 1966, and this was one of the last things I did before I left.

Interviewee 291 began working at SSFL in 1956 and also had some experience working with the KEWB and stated that:

> I also worked at the KEWB (Kinetics Experiment Water Boiler). It simulated an atomic bomb with a very short, very intense period of radiation. We were working on experiments to see what would happen to insulators exposed to high level fast radiation. I never did get to operate the reactor... When I first went up to Santa Sue I was working on instrumentation in tents because, oh my gosh, they hadn't yet built the buildings!

Of Building 4073, Interviewee 296, who began working at SSFL in 1956, stated the following:

> I transferred up to the Liquid Metals Engineering Center in 1959. I was an engineer and I worked on the Kinetic Experiments for Water Boilers (KEWB). I designed a water boiler reactor. I had worked on a very similar reactor on a project in the 200 Area at Hanford before moving to California. The KEWB was underground. They eventually filled it in and put a cover on it. I assume it was cleaned up before it was filled in, although I have no knowledge that this was done.
>
> I didn't have to wear a film badge in the beginning because we were just designing the facility. Film badges weren't necessary until the reactor went critical. The KEWB was the first reactor to go critical at SSFL, even before the Sodium Reactor Experiment. That was in about 1957. The SRE furnished power to the city of Moorpark for a little while. SRE was a lot bigger than the KEWB. I did not work on the SRE design.
>
> I never handled any radioactive materials at SSFL. I handled radioactive materials at Hanford before I moved here, but I never handled any at SSFL.
>
> KEWB was an experimental reactor. Once I had finished my job, contributing to the design of the reactor, I worked on other projects. My involvement was really only during design and construction. I wasn't involved once the reactors were operational.

Radiological Incident Reports: There have been several incidents associated with Building 4073 that could have resulted in a release to the environment. The following table provides information presented in an incidents database provided by Boeing. Summaries of the incident reports are provided following the table, when available.

Building 4073 Incident Report Summary

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A0522	2/10/1958	KEWB	None identified	KEWB reactor operators received exposures above weekly guidelines.
A0504	4/1/1961	SS KEWB Building	None identified	KEWB reactor core experiments caused exposure above guidelines to employee.
A0291	9/26/1961	KEWB Reactor	Mixed Fission Products*	Radiation exposure in excess of guidelines.

*Mixed fission products have been identified as typically including Cs-137 and Sr-90.

- On February 10, 1958, KEWB reactor operators received weekly exposures greater than 300 mrem while performing core maintenance activities. Upon further investigation, it was concluded that the elevated levels were a result of dosimeter error, and that actual exposures were within permissible levels (A0522).[314]

- From April 1 to June 30, 1961, a research engineer conducting KEWB reactor core experiments received a quarterly exposure to gamma and neutron radiation at levels greater than 3 rem. These core experiments were required for successful termination of the KEWB Program and resulted in high radiation levels in the reactor room, and consequently caused the employee's exposure. The employee was aware of his high cumulative exposure in early May; however, due to the importance of the tests and lack of other qualified operators, he continued to conduct "unreflected" core experiments without prior approval to exceed the 3 rem quarterly limit (A0504 and A0291).[315, 316, 317]

Based on log book entries for the KEWB there may have been other incidents associated with the operations of the KEWB. On May 18, 1960, a log book entry at 1100 hours indicated that "oil from EG&G experiment leaked out – this area contamination level from 18 to 132 dpm. Area marked off to be cleaned A.S.A.P." An entry on the same day at 1300 hours read "contamination level in Reactor Rm. 3 100 dpm. Decontaminate A.S.A.P." At 1400 hours on the same day, an entry described as a smear of the "oil spot from dumping" indicated a contamination level of $3x10^4$ dpm. At 1415 hours, the log book reports that equipment from the reactor room was covered with oil and smears of the equipment found a contamination level of $28x10^4$ dpm. "EG&G" personnel were checked at 1445 hours that day and were found to have contaminated hands and shoes. The log entry indicates that complete decontamination of hands and shoes were performed. The next entry in the log books was made on May 19, 1960, at 900 hours, and indicates the building was opened and surveyed. The maximum reading was documented to have been 2 R/hr. On May 20, 1960, the health physicist entered the following into the log book: "Survey and smear all EG&G equipment used in test bldg. All equipment packed and sealed for shipment to EG&G Boston, Mass." At 1330 hours on the same day, the

[314] Gerber, L.A., Atomics International Inter-Office Letter Re: Personnel Radiation Exposures, Incident A0522, March 5, 1958.
[315] Hickey, E.C., Atomics International Inter-Office Letter Re: Radiation Exposure, Incident A0504, August 1, 1961.
[316] Remley, M.E., Letter Re: Quarterly Radiation Over-Exposure, Incident A0291, October 13, 1961.
[317] These two incident reports appear to reference the same employee and relate to the same time period of increased radiation exposure.

test building was cleaned and decontaminated. The log book did not provide the results of any additional surveys in relation to this incident.[318,319]

Current Use: The KEWB reactor facility, including Building 4073, was demolished in 1975. The ERDA released the facility and surrounding area for unrestricted use in 1976, and aerial photographs do not show any disturbances at or near the Building 4073 area.[320]

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): A chronology of radiological investigations at this building is as follows:

- According to the 1975 decontamination and disposition of facilities program plan, Building 4073 had a number of moderately contaminated or activated structures, including, the reactor core vessel, the graphite reflector, the recombiner and gas handling system, the fuel storage tank, and contaminated underground lines and tanks including the exhaust and liquid waste systems. According to the plan, the excavation of the underground lines and tanks would eliminate the potential for soil contamination and the removal of the remaining contaminated system would eliminate the need for continued surveillance of the facility. The plan did not include specific information regarding the level of contamination within Building 4073.[321]

- In 1975, Rocketdyne performed a final radiological survey during decontamination and demolition of the facility and published results in the final D&D report.[322] Survey results found that all remaining surfaces were decontaminated to levels as low as reasonably achievable; in all cases below the levels for future unrestricted use (removable contamination of 20 dpm/100 cm^2 α or 100 dpm/100 cm^2 β). According to the report, survey results were below the 1976 acceptable limits identified above.

- In July 1975, Rocketdyne performed a surface scan of the KEWB site following demolition to confirm that no radiological contamination remained.[323] The survey found no levels of beta-gamma surface contamination above the measured background (0.15 – 0.25 mrad/hr). The report did not provide information to indicate how background was measured. According to the report, survey results were below 1975 background limits and were, as a result, below acceptable limits.

- In May 1983, Argonne National Laboratories performed a post-remediation radiological survey.[324] The survey included a surface scan to determine ambient gamma exposure rate

[318] Sessions, Health Physicist, KEWB and AE-6 Log Book, pg 44-50.
[319] Additional information regarding this apparent incident could not be located. The research team has been unable to identify EG&G or determine the precise location of the oil spill or the contents of the oil.
[320] Stamp, Stanley, Letter Re: "Decontamination and Disposition of ERDA Facilities," March 3, 1976.
[321] Atomics International, PP-704-990-002, Decontamination and Disposition of Facilities Program Plan, January 23, 1975.
[322] Rockwell International Report, AI-ERDA-13159, "KEWB Facilities Decontamination and Disposition Final Report," February 25, 1976.
[323] Letter from R.K. Owen (Rockwell International) to R.J. Tuttle, "Radiation Survey T073 (KEWB) Site," July 17, 1975.
[324] Argonne National Laboratory Report, no document number, "Surplus Facilities Management Program, Interim Post Remedial Action Survey Report for Kinetic Experiment Water Boiler (KEWB) Facility, Santa Susana Field Laboratory, Rockwell International, Canoga Park, California," May 1983.

and low-level radiation level. Additionally, soil samples were taken and analyzed for gamma radiation and uranium. The survey found no measurements above background. According to the report, the 1983 background levels were relatively high (40 μR/hr and 8,000 cts/min) due to shine from nearby RMHF buildings, Building 4021 and Building 4022. The survey concluded that the site could be released for unrestricted use.

- In August 1988, Rocketdyne performed a surface scan measuring ambient gamma exposure rate to ensure no contamination existed as a result of radioactive materials movement in a "field" between Building 4073 and the RMHF. The mean exposure rate was 17.4 ± 0.96 μR/hr (–0.2 ± 0.96 μR/hr when corrected for background). And background was measured as 17.0 μR/hr. The acceptable limit was 5.0 μR/hr above background. As a result, the survey results were below the 1988 acceptable limits.[325] As indicated above, the Argonne National Laboratories report determined background levels to be 40 μR/hr.[326] The research team has been unable to locate any documentation addressing this discrepancy.

- In 2000, Rocketdyne conducted vegetation sampling in Area IV at the SSFL that included Buildings 4073 and 4093. The report summarized that the only radionuclide found in the vegetation samples was naturally occurring K-40. The report stated that no man-made radionuclides were found in either on- or off-site vegetation samples. The report provided minimum detectable activities of various radionuclides from the sample (ENV00102) collected near Buildings 4073 and 4093. These were Mn-54 at 0.0467 pCi/g, Co-60 at 0.0699 pCi/g, Cs-137 at 0.0606 pCi/g, Eu-155 at 0.0887 pCi/g, Pb-210 at 0.434 pCi/g, and Ra-226 at 0.794 pCi/g.[327] The report did not provide an approximate location of the sample taken near Buildings 4073 and 4093.

Radiological Use Authorizations: According to a 1975 site-wide D&D program plan, the KEWB was exempt from licensing requirements as a U.S. Energy Research and Development Administration facility. The plan noted; however, that in the event the facilities and the associated U.S. Energy Research and Development Administration-optioned land would be reverted to Atomics International, the regulations of the State of California Bureau of Radiological Health would apply to the site. As a result, the facilities included in the plan were to be decontaminated to a level that was "acceptable to the State of California."[328]

As a result, Authorization No. 84 was issued on January 16, 1975, for the decontamination and disposition of the KEWB facility. The authorization listed enriched uranium, activation products, and mixed fission products of unknown quantity as being distributed throughout the facility. Authorization No. 84 identified the limits and requirements of the authorization as being

[325] ETEC Document, GEN-ZR-0009, "Radiological Survey of the T513 Parking Lot; Old R/A Laundry Area; Plot 333; and Areas Between the SRE to RMHF, and KEWB to RMHF," August 26, 1988.
[326] Argonne National Laboratory, "Surplus Facilities Management Program, Interim Post Remedial Action Survey Report for Kinetic Experiment Water Boiler (KEWB) Facility, Santa Susana Field Laboratory, Rockwell International, Canoga Park, California," May 1983.
[327] Boeing, RD01-152, *Site Environmental Report for Calendar Year 2000, DOE Operations at the Boeing Company Rocketdyne Propulsion & Power*, September 2001.
[328] Atomics International, Document PP-704-990-002, *Decontamination and Disposition of Facilities Program Plan*, January 23, 1975.

those identified in the decontamination and disposal procedure for Building 4073.[329]

Former Radiological Burial or Disposal Locations: There have been no on-site radiological burial or disposal locations identified during the operational period of Building 4073 operations. However, it is important to note that asphalt and concrete from D&D activities were used as backfill at the site in 1975. While the concrete was decontaminated to levels presented above that were "as low as practicable," these levels are not in compliance with the requirements of SB-990.

Aerial Photographs: Aerial photographs do not show any staining or unusual site operations in the Building 4073 area. The only feature visible in the area, other than the buildings, is a water pipeline that extends from 12th Street across the area to Building 4003 in Subarea HSA-6.[330,331]

Radionuclides of Concern: Reactor fuel for the KEWB reactor was U-235 dissolved as uranyl sulfate in solution. Based on radiological investigations and historical documents, the radionuclides of concern include Co-60, Cs-137, Eu-152, Eu-154, Eu-155, Mn-54, Pb-210, Ra-226, Sr-90, U-235 and U-238.[332] All radionuclides of concern listed are included in the August 2009 Final Field Sampling Plan for the Santa Susana Field Laboratory radiological background study. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Drainage at the site is to the south-southwest to a "paved ditch" adjacent to a dirt road that leads to 12th Street. Here the flow of drainage proceeds southeast along 12th Street to G Street and continues southwest to 17th Street.[333] Building 4073 and the surrounding buildings were not serviced by any other storm drains or sanitary sewer lines. An undated photograph shows a "KEWB-area cave-in" with rebar and cement exposed. Additional information regarding this cave-in could not be located.[334]

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4073 area is Class I because of previous site use, incident reports, and radioactive material use during building operations.

Recommended Locations for Soil/Sediment Sampling: Plate 1 and Figure 2.1 provide a convenient reference for the following recommendations.

Extensive soil sampling is recommended in the Building 4073 area. As discussed above, previous investigation found radiological contamination in Building 4073. In addition, previous characterization studies for the Building 4073 area were focused on delineating the extent of contamination to standards that were applicable at the time. Therefore, additional characterization is recommended for the Building 4073 area. This includes the following Building 4073 areas and appurtenances:

[329] Heine, W., Authorization No. 84, January 16, 1975.
[330] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[331] Atomics International, Santa Susana Facility Plot Plan, Drawing 303-GEN-C38, Sheet 4 of 14, June 4, 1964.
[332] Rocketdyne Report, N001ER000017, "Nuclear Operations at Rockwell's Santa Susana Field Laboratory – A Factual Perspective," September 1991.
[333] Atomics International, Drawing 303-00C-C2, "Misc. Paving, Patching & Drainage Improvements – KEWB," Date illegible, circa 1969. HDMSE00457545.
[334] Rockwell International, Photo 7704-621252, Undated, HDMS00015748.

- The former locations of the underground storage tanks and their drain lines associated with building operations. Located west of Building 4073, the tanks comprised three underground tanks and a 60-foot exhaust stack with a 2,000-cubic foot per minute blower system. A 300-gallon collection tank was used to collect gas directly from the reactor system. A 1,000-gallon storage tank buried beneath floor level and adjacent to the test building retained all liquid waste from the facility. The tank was equipped with pump-out connections for removal of the liquid waste when necessary. Another 1,000-gallon tank was originally used to retain the reactor cooling water so that it could be checked for activity prior to release. That tank appears to have drained through a 2-inch line to the west and then south of the KEWB facility.[335,336,337] Removal of the tanks and lines, as well as their operation, may have left residual contamination above background values in the area.

- The former Building 4073 footprint. Asphalt and concrete from D&D activities were used as backfill at the site in 1975. While the concrete was decontaminated to levels presented above that were defined "as low as practicable" in 1975, these levels are not in compliance with the requirements of the AOC. These samples should be taken at depths greater than 6 feet below ground surface.

- The ditch adjacent to the former dirt road. The ditch leads to 12th Street where the flow of drainage proceeds southeast along 12th Street to G Street and continues southwest to 17th Street.[338] . If radioactive materials were released the ground surface near Building 4073, residual contamination above background values may exist in the materials surrounding the ditch.

2.2.2 Building 4074 Area

Note: To date, the research team has been unable to locate many documents relating to the construction and operation of Building 4074. As a result, the information provided below is limited.

Site Description: The Building 4074 area comprises Building 4074 and the surrounding area, and is located between 11th and 12th Streets. Numerous other buildings surround Building 4074, including Buildings 4083, 4093, 4103, 4633, and 4893. These buildings are discussed in sections below. Constructed in 1958, Building 4074 was a storage building consisting of a steel frame covered in sheet metal located near Parking Lot 4523.[339] Figures 2.2.2a through 2.2.2c provide a current photograph and the best available building-specific drawing(s) that the research team could find. Plate 1 presents a summary of all identified features for this site.

[335] Rockwell International Report, AI-ERDA-13159, "KEWB Facilities Decontamination and Disposition Final Report," February 25, 1976.
[336] Flora, J.W., Atomics International, *KEWB Radiological Emergency Plan*, January 14, 1960. HDMSP01637672
[337] Atomics International, FDP-704-990-002, *Dismantling Plan for KEWB Facility (Bldgs 073,123 and 793)*, October 17, 1974.
[338] Atomics International, Drawing 303-00C-C2, "Misc. Paving, Patching & Drainage Improvements – KEWB," Date illegible, circa 1969. HDMSE00457545.
[339] Atomics International, AI-70-73, *Safety Analysis Report for L-85 Nuclear Examination Reactor*, November 25, 1970.

Building Features: Very little information could be located regarding the features of Building 4074. Constructed in 1958, Building 4074 was a storage building consisting of a steel frame covered in sheet metal located near Parking Lot 4523. The building contained two rooms and was connected to Building 4083 by a walkway.[340,341] Environmental reports indicate the building had a sampling station for measuring the ambient air radioactivity concentration on a quarterly basis. The sampling station was located at the south side of Building 4074. See the summary of previous radiological investigations below for additional information.[342]

Former Use(s): Building 4074 was constructed in 1958 to serve as a storage and film processing building where personnel processed photographic oscillograph paper for the KEWB. The building stored emergency supplies and did not contain radioactive materials.[343] According to the May 2005 HSA, Building 4074 was demolished in 1995; however, recent site photographs show the foundation of the building to still be present.[344]

Information from Interviewees: To date, there have been no interviews with personnel familiar with operations at Building 4074.

Radiological Incident Reports: There have been no incident reports associated with the operations of Building 4074 located to date.

Current Use: Building 4074 appears to have been demolished in 1995 with the foundation of the building left in place.[345]

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): A chronology of radiological investigations at this building is as follows:

- As indicated above, environmental reports indicate Building 4074 had a ground sampling station for measuring ambient air radioactivity concentration on a quarterly basis. The following table presents the annually averaged ambient air radioactivity concentration from 1971 to 1975.[346]

[340] Rocketdyne, N001SSR140087, *Radiation Survey for Release for Unrestricted Use L-85 Reactor Facility*, March 6, 1986.
[341] Atomics International, AI-70-73, *Safety Analysis Report for L-85 Nuclear Examination Reactor*, November 25, 1970.
[342] Rockwell International, *Environmental Impact Assessment of Operations at Atomics International Under Special Nuclear Materials License No. SNM-21*, AI-76-21, April 30, 1976.
[343] Rocketdyne, N001SSR140087, *Radiation Survey for Release for Unrestricted Use L-85 Reactor Facility*, March 6, 1986.
[344] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005.
[345] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005.
[346] Rockwell International, *Environmental Impact Assessment of Operations at Atomics International Under Special Nuclear Materials License No. SNM-21*, AI-76-21, April 30, 1976.

Building 4074 Ground Sample Station
Annually Averaged Ambient Air Radioactivity Concentration (1971-1975)

Year	α (pCi/m^3)	β (pCi/m^3)
1971	<0.0087	0.33
1972	<0.0085	<0.14
1973	<0.0066	<0.037
1974	<0.0056	<0.15
1975	<0.0061	<0.072

Source: Rockwell International, *Environmental Impact Assessment of Operations at Atomics International Under Special Nuclear Materials License No. SNM-21*, AI-76-21, April 30, 1976.

Additional air sample results were not identified during the drafting of this TM.

- In 1985, Rocketdyne conducted a final radiological survey, releasing the final report in March 1986. (The survey included buildings 4073, 4074, 4083, 4084, 4093, 4453 and 4453). Because radioactive materials were not reported to have been used in Building 4074, the survey applied reduced sampling with a 1-square meter sample being measured from every other 9-square meter grid, rather than every 3-square meter grid.[347]

  Average contamination measurements were taken with an alpha (Ludlum Model 43-1 or equivalent) or beta (Ludlum, Model 44-9 or equivalent) probe. According to the survey results, soil samples showed no evidence of radioactivity due to facility operations. The maximum average alpha detected was 17.2 dpm/100 cm^2 (limit is 5,000 dpm/100 cm^2) and the maximum average beta detected was 1,987 dpm/100 cm^2 (limit is 5,000 dpm/100 cm^2). According to the report, the limits for the release for unconditional use of Building 4074 were taken from the U.S. Nuclear Regulatory Commission Regulatory Guide 1.86 and the U.S. Nuclear Regulatory Commission Dismantling Order, Docket No. 50-375. The report indicated that these criteria were in agreement with the guidance found in the January 1985 version of the American National Standards Institute/Health Physics Society Standard ANSI N13.12, and in the DECON-1 document issued by the State of California in 1977.
  The maximum ambient exposure rate presented in the report was for Buildings 4083, 4074 and 4453 and was found to be 23.1 μR/hr. The limit was listed as being 19.7 μR/hr. It is important to note the report did not provide information to indicate how the ambient exposure rate was measured or how the limit was derived; however, the report did attribute ambient exposure rates over the limit to the nearby RMHF and were reported to not represent residual contamination. Additionally, the survey found that measured radiation levels were below 1985 acceptable limits, making the site acceptable for unrestricted use.[348]

Radiological Use Authorizations: There have been no radiological use authorizations identified for Building 4074.

Former Radiological Burial or Disposal Locations: None.

[347] Rocketdyne, N001SSR140087, "Radiation Survey for Release for Unrestricted Use – L-85 Reactor Facility," March 6, 1986.
[348] Rocketdyne, N001SSR140087, "Radiation Survey for Release for Unrestricted Use – L-85 Reactor Facility," March 6, 1986.

Aerial Photographs: Aerial photographs do not show any disturbances near Building 4074, with the exception of a water pipeline that crosses the site from 12th Street to Building 4003.[349,350] The pipeline remains present today.

Radionuclides of Concern: None.

Drainage Pathways: A ditch was located between Buildings 4074 and 4083/4103. Drainage in the ditch appears to have been directed by a 6-inch galvanized pipe southwest to a "paved ditch" adjacent to a dirt road that leads to 12th Street. Here the flow of drainage proceeds southeast along 12th Street to G Street and continues southwest to 17th Street.[351] Building 4074 does not appear to have been serviced by any other storm drains or sanitary sewer lines.[352]

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4074 area is Class 1 because of the building's proximity to Building 4093 and the limited operational information available for the building.

Recommended Locations for Soil/Sediment Sampling: Recommended sampling locations based on historical and site information include the following:

- The former Building 4074 footprint and the passageway and ditch between Building 4074 and Building 4083. If radioactive materials were released into the ditch as a result of operation in Building 4093, residual contamination may exist in the materials surrounding the ditch.

2.2.3 Building 4083/4103 Area

Note: To date, limited historical documents relating to the construction and operation of Buildings 4083 and 4103 has been located. As a result, the information provided below is limited.

Site Description: The Building 4083/4103 area includes Building 4083, Building 4103, and the surrounding area. Building 4083 was constructed around 1958 and is separated from the KEWB reactor test building by approximately 200 feet. In the early 1970s, the building was modified to include Building 4103. Other building surrounding these two structures include Building 4074, discussed above, and Buildings 4093 and 4893, discussed below.[353] Figures 2.2.3a through 2.2.3c provide a current photograph and the best available building-specific drawing(s) that the research team could find. Plate 1 presents a summary of all identified features for this site.

Building Features: Building 4083 was a 12- by 20-foot, prefabricated, sheet-steel building comprising six rooms, located near Building 4073. A separate structure, Building 4103, was attached to the building for office functions. Building 4083 housed all recording and control instrumentation necessary to operate the KEWB reactor located in Building 4073. The building

[349] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[350] Atomics International, Santa Susana Facility Plot Plan, Drawing 303-GEN-C38, Sheet 4 of 14, June 4, 1964.
[351] Atomics International, Drawing 303-00C-C2, "Misc. Paving, Patching & Drainage Improvements – KEWB," Date illegible, circa 1969. HDMSE00457545.
[352] Atomics International, Santa Susana Facility Plot Plan, Drawing 303-GEN-C38, Sheet 4 of 14, June 4, 1964.
[353] Atomics International, Document NAA-SR-7300 Special, *Evaluation of the Atomics International Nuclear Development Field Laboratory as a Location for Reactor Facilities*, May 25, 1962.

also included the special instrumentation needed for initiating and recording transient operation.[354]

Former Use(s): Constructed in 1958, Building 4083/4013 served as the office and control building for the KEWB reactor in Building 4073.[355] The May 2005 HSA summarized that Building 4083/4103 was included in an NRC license, dated January 5, 1972 (R-118 Docket No. 50-375); however, the research team has not been able to locate any documentation indicating that Building 4083/4103 was included in the license for the L-85 reactor located in Building 4093.[356]

The May 2005 HSA lists two different dates for when Building 4083/4103 was demolished, 1980 and 1995. Aerial photographs show the building to still be present in 1983 and 1988 aerial photographs, but no longer present in 1995.[357,358]

Information from Interviewees: Interviewee 5, who provided information regarding Building 4073 and the KEWB reactor, indicated during his interview that "Building 4083 is probably the KEWB office building and Building 4103 is the control building."

Radiological Incident Reports: There have been no radiological incident reports associated with the operations in Building 4083 located to date.

Current Use: Building 4083/4103 appears to have been demolished sometime between 1988 and 1995.[359] The foundations of Building 4083/4103 remain at the site today.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): A chronology of radiological investigations at this building is as follows:

- In 1985, Rocketdyne conducted a final radiological survey, releasing the final report in March 1986. (The survey included buildings 4073, 4074, 4083, 4084, 4093, 4453 and 4453). Because radioactive materials were not reported to have been used in Building 4083, the survey applied reduced sampling with a 1-square meter sample being measured from every other 9-square meter grid, rather than every 3-square meter grid.[360]

  Average contamination measurements were taken with an alpha (Ludlum Model 43-1 or equivalent) or beta (Ludlum, Model 44-9 or equivalent) probe. According to the survey results, soil samples showed no evidence of radioactivity due to facility operations. The maximum average alpha detected was 17.2 dpm/100 cm^2 (limit is 5,000 dpm/100 cm^2) and the maximum average beta detected was 1,987 dpm/100 cm^2 (limit is 5,000 dpm/100

[354] Atomics International, Document NAA-SR-7300 Special, *Evaluation of the Atomics International Nuclear Development Field Laboratory as a Location for Reactor Facilities*, May 25, 1962.
[355] Rocketdyne, N001SSR140087, *Radiation Survey for Release for Unrestricted Use – L-85 Reactor Facility*, March 6, 1986.
[356] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005.
[357] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005.
[358] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[359] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[360] Rocketdyne, N001SSR140087, "Radiation Survey for Release for Unrestricted Use – L-85 Reactor Facility," March 6, 1986.

cm^2). According to the report, the limits for the release for unconditional use of Building 4074 were taken from the U.S. Nuclear Regulatory Commission Regulatory Guide 1.86 and the U.S. Nuclear Regulatory Commission Dismantling Order, Docket No. 50-375. The report indicated that these criteria were in agreement with the guidance found in the January 1985 version of the American National Standards Institute/Health Physics Society Standard ANSI N13.12, and in the DECON-1 document issued by the State of California in 1977.

The maximum average ambient exposure rate presented in the report was for Buildings 4083, 4074 and 4453 and was found to be 23.1 μR/hr. It is important to note the findings were the average of the three buildings. The report does not provide the findings of each building individually. The limit was listed as being 19.7 μR/hr. It is important to note the report did not provide information to indicate how the ambient exposure rate was measured or how the limit was derived; however, the report did attribute ambient exposure rates over the limit to the nearby RMHF and were reported to not represent residual contamination. Additionally, the survey found that measured radiation levels were below 1985 acceptable limits, making the site acceptable for unrestricted use.[361]

- On February 2, 1987, a letter from Rockwell International to the U.S. Nuclear Regulatory Commission presented the findings of a post-repair survey to determine the ambient exposure rate following the repair of the reactor floor in Building 4093. As part of this survey, Rockwell International performed readings with a Reuter-Stokes RS-111 high-pressure ion chamber in Building 4083 to provide "a concurrent determination of natural background." The average ambient exposure rate of Building 4083 measured 10.9 uR/hr, while the maximum ambient exposure rate measured 12.0 uR/hr.[362]

Radiological Use Authorizations: None.

Former Radiological Burial or Disposal Locations: None.

Aerial Photographs: Aerial photographs do not show any disturbances near Building 4083/4103, with the exception of an unknown pipeline that crosses the site from 12th Street to Building 4003.[363]

Radionuclides of Concern: None.

Drainage Pathways: A ditch was located between Buildings 4074 and 4083/4103. Drainage in the ditch appears to have been directed by a 6-inch galvanized pipe southwest to a "paved ditch" adjacent to a dirt road that leads to 12th Street. Here the flow of drainage proceeds southeast along 12th Street to G Street and continues southwest to 17th Street.[364] Building 4083/4103 does not appear to have been serviced by any other storm drains; however, a 6-inch vitrified clay pipe appears to provide sanitary sewer service to the building. The outfall of this pipe is outside of

[361] Rocketdyne, N001SSR140087, "Radiation Survey for Release for Unrestricted Use – L-85 Reactor Facility," March 6, 1986.
[362] Rockwell International, "Summary Report of Ambient Exposure Rate Measurements at the L-85 Research Reactor Facility After Repair of Concrete Floor," February 2, 1987.
[363] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[364] Atomics International, Drawing 303-00C-C2, "Misc. Paving, Patching & Drainage Improvements – KEWB," Date illegible, circa 1969. HDMSE00457545.

Building 4083/4103, and in 1964 appears to combine with the flow from the ditch between Building 4074 and 4083/4103.[365]

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4083/4103 area is Class 1 because of the building's proximity to Building 4093.

Recommended Locations for Soil/Sediment Sampling: Plate 1 and Figure 2.1 provide a convenient reference for the following recommendations.

Soil sampling is recommended in the Building 4083/4103 area. Previous characterization studies for the Building 4083/4103 area were focused on delineating the extent of contamination to standards that were applicable at the time. Therefore, additional characterization is recommended for the Building 4083/4103 area. This includes the following Building 4083/4103 areas and appurtenances:

- The former Building 4083/4103 footprint. Because of the building's proximity to Building 4093 and the limited information available regarding building operations, sampling is recommended in and outside the footprint of the building. Radionuclides originating from Buildings 4093 may have migrated to the area between buildings via surface water flow or airborne releases.

- The passageway and ditch between Building 4074 and Building 4083/4103, as well as the former 6-inch galvanized pipe that directed drainage to a "paved ditch" adjacent to the dirt road that leads to 12th Street. Radionuclides originating from Buildings 4093 may have migrated to the area between buildings via surface water flow or airborne releases.366
- The 6-inch vitrified clay pipe that originated from within Building 4083/4103. This pipe appears to have provided sanitary sewer service to the building. The outfall of this pipe was outside of Building 4083/4103, and in 1964 appears to combine with the flow from the ditch between Building 4074 and 4083/4103.[367]

2.2.4 Building 4093 Area

Site Description: The Building 4093 area comprises Building 4093, Pad 4893, a sanitary leach field, and the land surrounding these features located on 11th Street. Building 4093 was constructed in approximately 1958 to house the AE-6 Reactor. The building was constructed of steel beam frames, wood frames, sheet metal and concrete.[368] Figures 2.2.4a through 2.2.4f provide a current photograph and the best available building-specific drawing(s) that the research team could find. Plate 1 presents a summary of all identified features for this site.

Building Features: The AE-6/L-85 installation consisted of a reactor building that housed the reactor and control room, and a separate building used for fuel handling and storage, Building

[365] Atomics International, Santa Susana Facility Plot Plan, Drawing 303-GEN-C38, Sheet 4 of 14, June 4, 1964.
[366] Atomics International, Drawing 303-00C-C2, "Misc. Paving, Patching & Drainage Improvements – KEWB," Date illegible, circa 1969. HDMSE00457545.
[367] Atomics International, Santa Susana Facility Plot Plan, Drawing 303-GEN-C38, Sheet 4 of 14, June 4, 1964.
[368] Atomics International Document, AI-70-73, "Safety Analysis Report for L-85 Nuclear Examination Reactor," November 25, 1970.

4643, discussed below. Building 4093 contained a 12- by 31-foot control room and a 31- by 38-foot high bay. The high bay was a steel-framed superstructure covered with sheet metal siding and roofing. The high bay was serviced by a ½-ton overhead crane. The floor comprised 6 inches of concrete, except under the reactor and concrete shield enclosure, where 30 inches of reinforced concrete was provided.[369,370]

The reactor bay had an open ceiling approximately 10 meters high with an overhead crane.[371] The reactor was situated in the center of the high-bay area and consisted of a spherical core, a graphite reflector and thermal column, a mild steel reflector enclosure, the gas handling systems, the control and safety rod systems, the cooling systems, and the concrete shield enclosure. The core and gas handling system were contained in a stainless-steel system that provided the primary barrier against release of radioactivity. Secondary containment was provided by the mild-steel graphite reflector enclosure tank and the concrete shield walls that completely surrounded the primary system, except on top, where the neutron beam from the thermal column entered a tank containing subcritical lattice assemblies. When the neutron beam was not used, shielding was provided. Channels were also provided in the reflector, through which the neutron flux was available in various magnitudes for experimental purposes.[372] In 1974, polyethylene shielding was added to the top of the reactor and along the east side wall shield. Following the addition of the shielding, it was determined the radiation levels for reactor operation at the 2.75 kW power level were within "acceptable limits;" however, the document does not indicate what the 1972 acceptable limits were.[373]

A concrete fuel storage vault was provided adjacent to the critical assembly for storage of assembled fuel elements to be used in exponential experiments. Additional concrete blocks were available for stacking around the reactor or walls of the high-bay area. The building did not include a stack.[374]

A metal safe was provided within the reactor room for the storage of small quantities of fuel solution (no more than 200 grams of U-235). Other fissile materials were to be stored in approved safe-geometry containers in an array no more reactive than authorized for containers.[375]

The control room included a lavatory that initially drained to the Building 4093 leach field prior to the addition of a sanitary sewer system.[376] During a 1996 Area IV survey of Building 4093, an exploratory trench in the expected area of the leach field uncovered a 4-inch diameter clay pipe supplying the leach field at a depth of approximately 4 feet below ground surface. The pipe

[369] Atomics International Document, AI-70-73, "Safety Analysis Report for L-85 Nuclear Examination Reactor," November 25, 1970.
[370] Atomics International, NAA-SR-7300, *Evaluation of the Atomics International Nuclear Development Field Laboratory as a Location for Reactor Facilities*, May 25, 1962.
[371] Oak Ridge Associated Universities, *Confirmatory Radiological Survey of the L-85 Reactor Facility, Rocketdyne Division, Rockwell International Corporation, Santa Susana, California*, December 1986.
[372] Atomics International, NAA-SR-7300, *Evaluation of the Atomics International Nuclear Development Field Laboratory as a Location for Reactor Facilities*, May 25, 1962.
[373] Felten, L.D. Internal Letter Re: Review of L-85 Reactor-Building 093, May 19, 1972.
[374] Atomics International, NAA-SR-7300, *Evaluation of the Atomics International Nuclear Development Field Laboratory as a Location for Reactor Facilities*, May 25, 1962.
[375] United States Atomic Energy Commission, Docket No. 50-375 Facility License No. R-118, January 5, 1972.
[376] Oak Ridge Associated Universities, *Confirmatory Radiological Survey of the L-85 Reactor Facility, Rocketdyne Division, Rockwell International Corporation, Santa Susana, California*, December 1986.

connected to a 90-degree clay pipe elbow angled down. The elbow connected to a tee pipe section that was positioned transverse to the supply pipe. One end of the tee was plugged. Extending horizontally from the other end of the tee across the top of the leach field on a bed of gravel was a row of butt-end clay pipe sections about 8 inches long.[377]

Former Use(s): Building 4093 was constructed in 1958 to house the AE-6 Reactor. The AE-6 Reactor was originally called the Water Boiler Neutron Source (WBNS) reactor. Built in 1952 in Downey, California, the WBNS had a maximum power of 0.5 Wt. The WBNS was modified to produce a maximum power of 3 kWt and moved to the SSFL site, where it was referred to as the AE-6 Reactor. The AE-6 and its associated experimental facilities were specifically designed to provide a thermal neutron source for evaluating neutron behavior in subcritical exponential-type assemblies, and for irradiating foils and other materials. A 1959 Atomics International brochure also indicated the reactor was "utilized for the performance of exponential experiments, lattice, buckling, and other reactor physics studies." From 1956 through 1972, the facility operated under an AEC contract; however, as of August 1966, inspection of Building 4093 indicated that activities at the building had been reduced to "caretaker status" and out-of-reactor fuel inventories had been reduced accordingly. In 1972, ownership of the building and reactor was transferred from AEC to Rockwell in 1972, and the reactor was renamed L-85. The NRC licensed the facility in 1972 under License R-118 (Docket No. 50-375).[378,379,380,381,382] The L-85 reactor operated as a commercial operation for central station power plant operator training and for neutron radiography inspection of precision forgings, castings, and electronic and explosive devices for manufacturing defects.[383]

The fuel required to maintain the operating characteristics of the L-85 reactor included uranyl sulfate having a U-235 enrichment of at least 90 percent dissolved in a 0.3 to 0.4 molar sulfuric acid solution. The use of fully enriched uranium minimized the critical mass and the sulfuric acid retarded the precipitation of uranyl peroxides. The hydrogen-to-uranium atom ratio was between 400 and 450 to minimize the mass coefficient of reactivity. The fuel solution contained about 30 ppm of copper (as copper sulfate) and about 200 ppm of iron (as iron sulfate) to catalyze the decomposition of hydrogen peroxide that was formed during the radiolytic decomposition of the water. The chloride content of the fuel solution was below 10 ppm to minimize corrosion of the reactor vessel.[384]

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[377] Rockwell International, *Area IV Radiological Characterization Survey, Final Report, Volume 1*, A4CM-ZR-0011, August 15, 1996.
[378] Rocketdyne Report, N001SSR140087, *Radiation Survey for Release for Unrestricted Use – L-85 Reactor Facility*, March 6, 1986.
[379] Atomics International, *Atomics International: A Division of North American Aviation, Inc. Facilities Capabilities*, December 31, 1959.
[380] Oak Ridge Associated Universities, *Confirmatory Radiological Survey of the L-85 Reactor Facility, Rocketdyne Division, Rockwell International Corporation, Santa Susana, California*, December 1986.
[381] Atomics International, NAA-SR-7300, *Evaluation of the Atomics International Nuclear Development Field Laboratory as a Location for Reactor Facilities*, May 25, 1962.
[382] Atomics International, Internal Letter Re: Tour and Inspection of AI Fuel Handling and Storage Facilities, August 8, 1966.
[383] Atomics International, AI-75-31, *Atomics International Environmental Monitoring and Facility Effluent Annual Report 1974*, 1975.
[384] United States Atomic Energy Commission, Docket No. 50-375 Facility License No. R-118, January 5, 1972.

The fuel solution was contained in a 1-foot diameter, spherical, stainless steel vessel that was surrounded by a graphite reflector. Two safety rods and two control rods were also inserted.[385] The reactor had a homogeneous solution-type core and operated at up to 3kWt. It was used as a neutron source for many different tests, and was used for reactor operator training. The reactor operated off and on for 24 years, from November 1956 to February 1980.[386]

According to a May 1980 document titled "Procedure for Dismantling and Decontaminating the L-85 Reactor Facility," the detailed working procedure provided instruction for dismantling the L-85 reactor, decontaminating the facility to levels suitable for unrestricted use, and disposing all materials and equipment. The procedures provided that all items be checked for contamination prior to removal from the facility. Any equipment or material released from the facility for unrestricted use had to have radiation or contamination levels below the pre-determined contamination limits presented in the table below. All contaminated or radioactive components that were to be shipped off site were to be packaged and labeled in accordance with state and federal regulations for hazardous materials.[387]

L-85 Contamination Limits

	Total	Removable
Beta-Gamma Emitters	0.1 mrad/hr at 1 cm with 7 mg/cm^2 absorber	100 dpm/100 cm^2
Alpha Emitters	100 dpm/100 cm^2	20 dpm/100 cm^2

Source: Rockwell International, *Procedure for Dismantling and Decontaminating the L-85 Reactor Facility*, N001DWP000002, May 21, 1980.

On February 22, 1983, the NRC issued an order authorizing Rockwell International to dismantle the L-85 reactor in accordance with their application dated March 10, 1980. According to the order, the NRC prepared an environmental impact appraisal for the dismantling of the reactor and found the action would not result in any significant environmental impact and that an environmental impact statement was not required.[388]
During disposition of the facility the reactor was dismantled and the fuel was transferred to Exxon Nuclear Idaho, a DOE contractor, on September 28, 1982. Radioactively contaminated components were transferred to U.S. Ecology, Richland, and a state-licensed radioactive material disposal site. The Radium-Beryllium neutron source was transferred to Rockwell Richland for disposal at the DOE facility.[389] In December 1982, Rockwell International submitted an amended application for dismantling that indicated that about 1.3 Ci of total residual activity remained in the core vessel, steel reflector tank, and the control rods of the L-85 reactor. The dismantling plan indicated the removal of all components and activated structural materials would be conducted in a manner such that radioactivity readings would be consistent with NRC guidelines. Decontamination activities would reduce contamination to a level of 5 μR/hr above

[385] NRC, N001SRR140087, *Safety Evaluation by the Office of Nuclear Reactor Regulation Supporting Order Authorizing Dismantling of Facility and Disposition of Component Parts, Rockwell International Corporation, L-85 Reactor, Docket No. 50-375*, February 22, 1983.
[386] Rockwell International, *Nuclear Operations at Rockwell's Santa Susana Field Laboratory – A Factual Perspective*, December 20, 1989.
[387] Rockwell International, *Procedure for Dismantling and Decontaminating the L-85 Reactor Facility*, N001DWP000002, May 21, 1980.
[388] Eisenhut, Darrell, Letter Re: Docket No 50-375, February 22, 1983.
[389] Garcia, E.M., U.S. Nuclear Regulatory Commission, Inspection Conducted September 30 through October 31, 1986, December 2, 1986.

background, "or the occupancy of the facility must be limited so that no person will receive more than 10 mRem/year." However, Rockwell International indicated no plans for using the building following D&D efforts.[390]

The site was released for unrestricted use by NRC and the NRC license was terminated March 19, 1987.[391] The rest of the building, excluding the foundation, was demolished in 1995; however, D&D records from 1995 could not be located. The sanitary leach field for Building 4093 was removed in 1999; however, detailed information of the removal could not be located.[392,393]

Information from Interviewees: Interviewee 1 indicated that the majority of his experience was working at Canoga Park beginning in 1958, but he did have some experience working at the SSFL, and more specifically, at Building 4093. According to the interviewee:

> I did work a few times at Building 4093, the AE-6 reactor. There was a nuclear reactor there and because I was a licensed reactor operator I went up there just a couple of times to run the reactor. It was subcritical at the time. As I recall, they were running experiments on the core and they needed a licensed reactor operator at the console. This was probably prior to 1965, probably 1963 or 1964...
>
> ... Going back to the AE-6 reactor, I would be at the console because they needed a licensed reactor operator. The console was separated from the reactor core by a wall or building or something. I would essentially just run the reactor. As I recall, it was all subcritical. I would just run it up a little bit and they would do their experiments or move things around. I don't really know what they were doing. I think it was an open core with graphite. I ran the controls one or two times for about a half-day. It wasn't a part of my everyday routine. My time on the hill was very limited.

Interviewee 196 worked at SSFL from 1959 to 1981 and again from 1991 to 1995. Of Building 4093 and the AE-6 reactor, Interviewee 196 stated the following:

> The AE-6 reactor was a small water boiler, in which the moderately enriched uranium was in an aqueous solution in a shielded sphere. This solution was drained into a shielded container and replaced with a fresh solution. This was in about 1959, and as far as I know was the only time a refueling was done. The shielded container was transferred to the Area IV fuel storage building. The AE-6 reactor was the neutron source for a series of sub-critical arrays of uranium slugs (about 1/2-in. diameter by 6-in. long) in aluminum tubes. The uranium used included natural and enriched forms, as I recall. The enrichment was moderate, I think, but we did get some enriched uranium that required locked storage. (The shipment had an armed guard during transport.)...
>
> ...We had on-site storage. Radiological materials were not transferred between buildings, except for transport of the low-level radiation and short half-life foils for counting their activity. The material used in connection with the operation of the facilities was kept either in a reactor, including the small critical assemblies, or it was solid materials, U-235

[390] Eisenhut, Darrell, Letter Re: Docket No 50-375, February 22, 1983.
[391] Letter from F.J. Miraglia (NRC) to M.E. Remley, "Order Terminating Facility License R-118, for the Rockwell International L-85 Nuclear Examination Reactor," April 8, 1987.
[392] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 - Area IV Site Summaries,* May 2005.
[393] Unknown, *Santa Susana Field Laboratory – Radiological Facility Status*, August 12, 2007.

and U-238. We had a storage building (Building 4096) at the AE-6 for the enriched uranium that required locked storage…

…Between 1959 and 1995 the way materials were handled was basically the same, except there were different configurations. For example, in building 4093 there was a water boiler neutron source – a little reactor about a foot and a half in diameter. There would be a matrix of moderators and aluminum tubes that held uranium slugs, and I guess that's where we would take samples. (My memory is all very vague. It was a long time ago.) This was generally depleted uranium and you'd put the slugs in the tubes.

The only fuel handling at the AE-6 I can remember involved depleted uranium slugs in aluminum tubes. The diameter of the slugs was about the same as the inner diameter of the tubes. Eventually we would have to cut them out because they were too tight to slide them out. We wore respirators; there was a lot of dust. It was a dirty job. I'm sure I must have inhaled some uranium dust…

Radiological Incident Reports: There have been several incidents associated with Building 4093 that could have resulted in a release to the environment. The following table provides information presented in an incidents database provided by Boeing. Summaries of the incident reports are provided following the table, when available.

Building 4093 Incident Report Summary

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A0275	3/25/1959	AE-6 Reactor	Mixed Fission Products*	Fission gas release contaminated employees and part of building.
A0512	10/6/1960	AE-6 Fuel Building	None identified	High radiation alarm malfunctioned during fuel handling.
A0106	7/30/1982	L-85 Reactor Room	U/Mixed Fission Products*	Purging of reactor core resulted in contamination of employee and floor.
A0661	5/24/1995	Building 4093, SSFL	Cs-137	Radioactive material in a non-controlled area.

* Mixed fission products have been identified as typically including Cs-137 and Sr-90.

- On March 25, 1959, one of the instruments controlling the power of the AE-6 malfunctioned and allowed the reactor to exceed the normal power level of 3kWt and approach 4 kWt. The reactor was shut down when the power level was recognized. The operation at the higher power level lasted approximately 1 minute; however, a small amount of fission gas was released into the air, contaminating part of the high bay and employees. Contamination levels were measured from 7.5 mR/hr to 13 mR/hr. The maximum release estimated was 10 mCi of principally xenon-135 (A0275).[394,395]

- On October 6, 1960, an alarm malfunctioned as a result of an "electrical transient". Two employees were handling AE-6 fuel at the time the alarm sounded; however, the nature of the alarm was discovered and the area was released (A0512).[396]

[394] Unknown, Building 4093 – L-85 (AE-6) Research Reactor, Unknown Date.
[395] Blackshaw, G.L., NAA-SR-Memo 3757, "Release of Fission Gases from the AE-6 Reactor on March 25, 1959," April 15, 1959.
[396] Sessions, S.D., Atomics International Inter-Office Letter Re: Radiological Safety Incident Report A0512, November 17, 1960.

- On July 30, 1982, rinse water contaminated with 5 ml of U-235 was spilled during the fuel draining operation, contaminating an employee and an area of the high bay floor. According to the incident report, after all the L-85 fuel solution was drained from the core, and the rinse water was drained without incident, an inline absolute filter was connected to the drain line and nitrogen was flowed through the system to dry it out. Mor moister was in the system than anticipated and got through the absolute filter and dripped off of the plastic covered shield block onto the floor. The employee present observed the spill, stopped the flow of nitrogen, and used "kimwipes" to move the absolute filter further back on the shield block. The incident report indicated that a check of the alpha air monitor located in the reactor room indicated no airborne release, while a smear survey of the reactor room floor spill area showed contamination levels of 930,000 beta, and dropped down to 1,000 dpm further from the spill/work area. According to the 2005 HSA, the area was partially decontaminated at the time and fully decontaminated during facility decommissioning. The incident report does not document how the area was partially decontaminated (A0106).[397][398]

- On May 24, 1995, an encased radioactive high efficiency particulate air (HEPA) filter was found in a pile of debris during the demolition of Buildings 4453 and 4093. While it was not obvious from which building the filter originated, the incident report indicated the filter most likely came from the roof of Building 4093. The incident report did not provide an estimated age of the filter. A survey of the inside of the filter using a Ludlum 12 GM frisker indicated an average of 22 to 300 cpm and a maximum of 500 cpm fixed beta. While below the facility release limits of 5,000 dpm/100 cm2 average and 15,000 dpm/100 cm2 maximum, it did exceed the free release limits of "no detectable activity" for fixed contamination. No detectable fixed beta radiation was observed on the outside of the encased unit. The incident report indicated that smears of the filter showed no removable alpha or beta contamination. The filter was taken to RMHF for further evaluation. Scanning with a portable NOMAD gamma spectrometer indicated the presence of Cs-137. The report did not provide the activity levels of Cs-137. At the RMHF, the filter was packaged for disposal as low-level radioactive waste (A0661).[399]

Current Use: The NRC released the site for unrestricted use March 19, 1987.[400] The facility was demolished leaving only the foundation in 1995. Based on available information, the dimensions of any excavations made during building demolition are unknown.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): A chronology of radiological investigations at this building is as follows:

- In order to determine the need for access restrictions in the area surrounding Building 4093, a radiation survey of the perimeter of the AE-6 reactor was conducted on August 13, 1970. The reactor was at a power level of 2 kW, and was operating with the shield

[397] Wallace, J.H., Rockwell International Internal Letter Re: Radiological Safety Incident Report A0106, August 4, 1982.
[398] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005.
[399] Rutherford, P.D., Rockwell Internal Letter Re: Radiological Incident Report A0661, June 7, 1995.
[400] Letter from F.J. Miraglia (NRC) to M.E. Remley, "Order Terminating Facility License R-118, for the Rockwell International L-85 Nuclear Examination Reactor," April 8, 1987.

doors on the east side open and a plastic Lucite rod, approximately 6 feet long, inserted in the one-inch diameter beam hole. A "Technical Associates Lo-Range June" was used for measuring the gamma radiation levels, and a "Ludlum tissue-equivalent neutron detection instrument" was used for the neutron dose rates. Gamma radiation measurements ranged from 1 mr/hr at the operators position at the console to 1,000 mr/hr at the east side of the building directly opposite the core. Neutron dose rates varied from 2.0 mrem/hr at the operators position to 2,500 mrem/hr at the east of the building directly opposite the core.[401]

- On December 9, 1977, Rockwell International completed a routine bi-monthly contamination survey of the L-85 reactor facility. One hundred smears were taken throughout the control room/office and reactor rooms. All smears were less than 50 dpm/100 cm^2 beta and less than 5 dpm/100 cm^2 alpha.[402] These surveys appear to have continued through the end of the reactor's operations. A routine bi-monthly survey on August 13, 1981, included sixty smears throughout the building that showed less than 30 dpm/100 cm^2 beta.[403]

- In 1985, Rocketdyne conducted a final radiological survey of Building 4093, releasing the final report in March 1986. (The survey included buildings 4073, 4074, 4083, 4084, 4093, 4453 and 4453). The sampling inspection plan during the survey was based on a uniform 3-meter square grid that was superimposed on the area, including floors, walls, and ceilings. Within each square defined by the grid, a single 1- meter square area was selected according to the surveyor's judgment and surveyed. The report indicated that the surveyor was to select the area that was most likely to have retained the most residual contamination. The sampling plan for this survey required the inspection of one 1-meter square area out of every 3-meter square grid throughout the area.[404]

  Average contamination measurements were taken with an alpha (Ludlum Model 43-1 or equivalent) or beta (Ludlum, Model 44-9 or equivalent) probe. The maximum average alpha measured was 63.0 dpm/100 cm^2 (limit is 5,000 dpm/100 cm^2), and the maximum average beta measured 3,102 dpm/100 cm^2 (limit is 5,000 dpm/100 cm^2). The survey did not detect any hot spots and, as a result, no maximum alpha or beta measurements were made. It is important to note; however, the report indicated that one location in the Reactor Room that had not been included in the established inspection locations showed beta contamination of 4,923 dpm/100 cm^2. While the value did not exceed the acceptance limit, the area was scabbled and remeasured and was found to have beta contamination of 2,542 dpm/100 cm^2.

  According to the report, the limits for the release for unconditional use of Building 4093 were taken from the U.S. Nuclear Regulatory Commission Regulatory Guide 1.86 and the U.S. Nuclear Regulatory Commission Dismantling Order, Docket No. 50-375. The report indicated that these criteria were in agreement with the guidance found in the

[401] Johnson, B.I., Internal Letter Re: Radiation Survey of the AE-6 Reactor, Building 093, August 13, 1970.
[402] Abbott, M.R., Internal Letter Re: Bi-Monthly Routine Radioactive Contamination Survey of Building 093, L-85 Facility, December 9, 1977.
[403] Owen, R.K., Internal Letter Re: Bi-Monthly Routine Radioactive Contamination Survey of Building 093, L-85 Facility, October 14, 1981.
[404] Rocketdyne Report, N001SSR140087, "Radiation Survey for Release for Unrestricted Use – L-85 Reactor Facility," March 6, 1986.

January 1985 version of the American National Standards Institute/Health Physics Society Standard ANSI N13.12, and in the DECON-1 document issued by the State of California in 1977.

In addition to the above, samples of soil were also taken during this survey outside of Building 4093 to "determine if any environmental release had occurred that could have resulted in soil contamination." According to the report, two samples were taken from the open dirt area directly across the driveway from the large door to the Reactor Room. Three other samples were taken from the drainage ditch leading away from the facility.[405] The report summarized that all five soil samples showed similar amount of "naturally occurring radionuclides associated with natural uranium and natural thorium and K-40." The report also stated that three samples showed "small" amounts of Cs-137 (an average of 0.20 ± 0.13 pCi/g), and may have been the result of "global fallout from weapons testing."[406] Rocketdyne summarized that soil samples showed no evidence of radioactivity due to facility operations.

The maximum ambient exposure rate in the Reactor Room was originally found to be 21.3 μR/hr. The limit was determined to be 18.9 μR/hr because the mean ambient exposure rate in the Reactor Room was found to be 13.9 μR/hr. The concrete was removed from areas in the Reactor Room measuring over the limit and the re-survey showed them all to be under the limit, with the highest measurement at 18.2 μR/hr. Survey results were below the 1985 acceptable limits.

- Oak Ridge Associated Universities conducted a confirmatory radiological survey in 1986; the final report was released in December 1986. The purpose of the survey was to verify the adequacy and accuracy of Rocketdyne's final survey and to confirm the radiological condition of the facility relative to the decommissioning guidelines. The survey included surface measurements, exposure rate measurements, and gamma spectroscopy measurements of the interior of the building. Additionally, random samples of paint were collected by ORAU personnel in the reactor bay area and the control room, in addition to samples of residue on horizontal surfaces, concrete dust and chips, standing water located in "electrical chase", and drain residues. Exterior sampling included walkover surface scans up to 80 meters from the building and soil sampling east, south, and west of the building.. The soil and miscellaneous residue samples were analyzed by gamma spectroscopy for Co-60, Cs-137, Eu-152, Eu-154, U-238, U-235, and "other identifiable photopeaks."[407]

  Building 4453 was used to establish the baseline for gamma exposure rate measurements of 12 μR/hr. According to ORAU, Building 4453 had a similar construction history as Building 4093 and was located in a non-restricted area that had no history of non-sealed source radioactive materials use. ORAU personnel collected exposure rate measurements and gamma spectra using the "pressurized ionization chamber and the gamma spectroscopy system."

[405] The report does not indicate the direction of the samples from the drainage ditch.
[406] The report did not elaborate on the meaning of "global fallout from weapons testing."
[407] Oak Ridge Associated Universities, *Confirmatory Radiological Survey of the L-85 Reactor Facility, Rocketdyne Division, Rockwell International Corporation, Santa Susana, California*, December 1986.

Alpha and beta-gamma scans of the interior of the building identified two areas of elevated alpha activity on the floor of the reactor bay. The areas did not exceed "release guidelines," but according to the report, Rockwell elected to perform additional remedial action to ensure that residual contamination was "as low as reasonably achievable." Surface contamination levels on 56 random floor and lower wall grid blocks contained non-removable activity, as well as removable activity. The total alpha activity range from the minimum detectable activity of 11 dpm/100 cm2 to 460 dpm/100 cm2. The removable alpha activity ranged from a minimum detectable activity of 3 dpm/100 cm2 to 14 dpm/100 cm2. Total beta activity ranged from a minimum detectable activity of 400 dpm/100 cm2 to 4,900 dpm/100 cm2, removable beta activity ranged from 7 dpm/100 cm2 to 12 dpm/100 cm2.

In addition, radionuclides in trace amounts were identified in several samples of dust residues. One sample collected along the west wall ledge indicated the presence of Co-60, Cs-137, Eu-152, Eu-154, and U-238. Two paint samples were collected from the reactor bay and one sample contained Cs-137 and U-238 in trace amounts. A smear from the sink trap of the control room lavatory had no detectable radionuclides. Concrete chips taken from the "scabbled" area of the Reactor Bay contained 11 pCi/g of Eu-152.[408]

The exposure rate levels in Building 4093 measured by ORAU personnel ranged from 12 to 18 μR/hr. A review of the gamma spectra collected at each exposure rate measurement location in Building 4093 identified the presence of Co-60 and Eu-152 in the elevated exposure rate areas. These areas were attributed to the close proximity of the hot spots from the scabbled floor.

Surface measurements of the exterior of the building found no locations of elevated direct radiation levels within 10 meters of the buildings, parking lots, and access roads or drainage ditches. Exposure rates measured at one meter from the ground surface at the soil sampling locations ranged from 16 to 18 μR/hr. The six random soil sampling locations around Building 4093 contained radionuclide concentrations "typical of concentrations in four baseline samples collected offsite."[409]

The survey concluded that the L-85 reactor building (4093) had been remediated to the existing Nuclear Regulatory Commission criteria with the exception of exposure rate criteria. The Nuclear Regulatory Commission guidelines are presented in the table below.

1986 Nuclear Regulatory Commission Contamination Limits

	Average	Maximum	Removable
Beta-Gamma Emitters	1,000 dpm/100 cm2	3,000 dpm/100 cm2	200 dpm/100 cm2
Alpha Emitters	5,000 dpm/100 cm2	15,000 dpm/100 cm2	1,000 dpm/100 cm2

[408] Oak Ridge Associated Universities, *Confirmatory Radiological Survey of the L-85 Reactor Facility, Rocketdyne Division, Rockwell International Corporation, Santa Susana, California*, December 1986.
[409] Oak Ridge Associated Universities, *Confirmatory Radiological Survey of the L-85 Reactor Facility, Rocketdyne Division, Rockwell International Corporation, Santa Susana, California*, December 1986.

The survey summarized that restoration of the remediated area would reduce the exposure rate to the levels established by a Dismantling Order.[410]

- On March 19, 1987, the Nuclear Regulatory Commission submitted the findings of a Nuclear Regulatory Commission inspection to Rockwell International. The inspection occurred in September and October 1986. The results of the inspection determined the maximum exposure rate to be below the 1987 limit of 5 μR/hr above background, with the exception of one location. This area was located in the former Reactor Room where a hole had been generated from previous scabbling activities. According to the report, the licensee was to conduct additional exposure rate measurements when the hole was filled with concrete.

  A second inspection took place on March 13, 1987, that included an in-office review of the findings of a February 3, 1987, licensee report. According to the inspection summary, as part of the decontamination of the facility, a portion of the concrete floor of Building 4093 was excavated to depths ranging from 2 to 22 inches. For "practical" use of the facility, Rockwell International proposed to repair the excavated floor with concrete. Following the repair, Rockwell International conducted additional surveys to determine the radiation exposure rate. These results were submitted to the Nuclear Regulatory Commission on February 3, 1987. According to the inspection report, the maximum radiation exposure rate after the hole was filled with concrete was below the 5 μR/hr above background at a meter from the floor surface. The inspection found that no violations or deviations of the Nuclear Regulatory Commission requirements had been identified.[411]

- In 1996, Rockwell International performed a survey of various area of Area IV, including the Building 4093 leach field. The first leach field sample was collected from an area under the joint between the tee fitting and the first pipe section. The second sample was collected approximately 5 feet "downstream" at the edge of the exploratory trench. Because of the depth of the trench, the soil and gravel mixtures of the leach field were raised to the surface for sample collection from the backhoe bucket.[412] The report did not include any results for the Building 4093 leach field.

- In 1999, confirmatory samples collected after the removal of the septic tank found no detectable activity (limit was 20 dpm/100 cm^2 for alpha and 100 dpm/100 cm^2 for beta).[413]

- In 2000, Rocketdyne conducted vegetation sampling in Area IV at the SSFL that included Buildings 4093 and 4073. The report summarized that the only radionuclide found in the vegetation samples was naturally occurring K-40. The report stated that no man-made radionuclides were found in either on- or off-site vegetation samples. The report

[410] Oak Ridge Associated Universities, *Confirmatory Radiological Survey of the L-85 Reactor Facility, Rocketdyne Division, Rockwell International Corporation, Santa Susana, California*, December 1986.
[411] Letter from Frank Wenslawski (NRC Region V) to Herbert Berkow, *Closeout Inspection for Rockwell International L-85 Reactor, Docket No. 50-375*, March 19, 1987.
[412] Rockwell International, *Area IV Radiological Characterization Survey, Final Report, Volume I*, A4CM-ZR-0011, August 15, 1996.
[413] Boeing Radiation Survey Reports, L-85 Facility Septic Tank Area, July and September 1999.

provided minimum detectable activities of various radionuclides from the sample (ENV00102) collected near Buildings 4073 and 4093. These were Mn-54 at 0.0467 pCi/g, Co-60 at 0.0699 pCi/g, Cs-137 at 0.0606 pCi/g, Eu-155 at 0.0887 pCi/g, Pb-210 at 0.434 pCi/g, and Ra-226 at 0.794 pCi/g.[414] The report did not provide an approximate location of the sample taken near Buildings 4093 and 4073.

Radiological Use Authorizations: On January 5, 1972, the Atomic Energy Commission granted Atomics International Facility License No. R-118, authorizing Atomics International to possess and operate the L-85 Nuclear Examination Reactor at power levels up to 3 kW (thermal). In addition to issuing the license, the Atomic Energy Commission also amended Indemnity Agreement No. B-13 to include the L-85 Reactor. The license authorized the North American Rockwell Corporation to possess and operate the reactor as a utilization facility, and to receive, possess and use up to 830 grams of contained U-235 in connection with the operations of the reactor. Additionally, the license permitted the North American Rockwell Corporation to possess, but not to separate, such byproduct material that has been produced or as may be produced by operation of the reactor.[415]

Former Radiological Burial or Disposal Locations: None.

Aerial Photographs: Aerial photographs do not show any disturbances near Building 4093, with the exception of a water pipeline that crosses near the site from 12th Street to Building 4003. In addition, 1995 aerial photographs show an area of disturbed ground at what is thought to be the former leach field location southwest of the building foundation. The area of disturbed ground is vegetated by 2005.[416]

Radionuclides of Concern: Reactor fuel for the L-85/AE-6 reactor consisted of U-235 (93.11% enrichment), dissolved as uranyl sulfate in 12.5*l* of 0.35 molar H_2SO_4 solution.[417] As a result, the radionuclides of concern are xenon-135, Co-60, Cs-137, Eu-152, Eu-154, Sr-90, U-238 and U-235. All radionuclides of concern listed are included in the August 2009 Final Field Sampling Plan for the Santa Susana Field Laboratory radiological background study. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Surface drainage extends from the northeast side of the building next to the retaining wall to southeast and then flows southwest toward the paved area southwest of the building. The drainage likely continues to the ditch located along the roadway leading to Building 4093 and then flows southeast toward G Street where the flow continues down G Street to 17th Street.[418]

Building 4093 was connected to a sanitary leach field that was removed in 1999.[419] During a 1996 Area IV survey of Building 4093 an exploratory trench in the expected area of the leach field uncovered a 4-inch diameter clay pipe supplying the leach field at a depth of approximately

[414] Boeing, RD01-152, *Site Environmental Report for Calendar Year 2000, DOE Operations at the Boeing Company Rocketdyne Propulsion & Power*, September 2001.
[415] United States Atomic Energy Commission, Docket No. 50-375 Facility License No. R-118, January 5, 1972.
[416] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[417] Atomics International Document, AI-70-73, "Safety Analysis Report for L-85 Nuclear Examination Reactor," November 25, 1970.
[418] Atomics International, Santa Susana Facility Plot Plan, Drawing 303-GEN-C38, Sheet 4 of 14, June 4, 1964.
[419] Boeing Radiation Survey Reports, L-85 Facility Septic Tank Area, July and September 1999.

4 feet below ground surface. The pipe connected to a 90-degree clay pipe elbow angled down. The elbow connected to a tee pipe section that was positioned transverse to the supply pipe. One end of the tee was plugged. Extending horizontally from the other end of the tee across the top of the leach field on a bed of gravel was a row of butt-end clay pipe sections about 8 inches long.[420]

The leach field was reported to comprise 234 total linear feet, receiving flow from a 750-gallon septic tank associated with Building 4093. The leach field was located approximately 100 feet south of Building 4093.[421]

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4093 area is Class 1 because of the building's previous site use, known radiological use, and previous incident reports.

Recommended Locations for Soil/Sediment Sampling: Plate 1 and Figure 2.2 provide a convenient reference for the following recommendations.

Extensive soil sampling is recommended in the Building 4093 area. Building 4093 served as the AE-6 and L-85 reactor facility. Consequently, potential radioactive material migration via surface water flow or airborne release from this facility may affect the Building 4093 area. Previous characterization studies for the Building 4093 area were focused on delineating the extent of contamination to standards that were applicable at the time. Therefore, additional characterization is recommended for the Building 4093 area. This includes the following Building 4093 areas:

- The location of the sanitary leach field. Building 4093 was connected to a sanitary leach field that was removed in 1999.[422] If radioactive materials were released into the septic system, residual contamination above background values may exist in the materials surrounding the former leach field. The sampling should include the former location of the 4-inch diameter clay pipe supplying the leach field at a depth of approximately 4 feet below ground surface.[423] The leach field was reported to comprise 234 total linear feet, receiving flow from a 750-gallon septic tank associated with Building 4093. The leach field was located approximately 100 feet south of Building 4093.[424]

- The former location of the 4-inch vitrified clay pipe leading from the west corner of the building to the sanitary sewer. It is possible this line is part of the line that led to the former leach field. If radioactive materials were released into the septic system, residual contamination above background values may exist in the materials surrounding the former pipe.

[420] Rockwell International, *Area IV Radiological Characterization Survey, Final Report, Volume I*, A4CM-ZR-0011, August 15, 1996.
[421] MWH, *DOE Leach fields (Area IV AOC) RCRA Facility Investigation Report, Santa Susana Field Laboratory, Ventura County, California, Draft*, October 2003.
[422] Boeing Radiation Survey Reports, L-85 Facility Septic Tank Area, July and September 1999.
[423] Rockwell International, *Area IV Radiological Characterization Survey, Final Report, Volume I*, A4CM-ZR-0011, August 15, 1996.
[424] MWH, *DOE Leach fields (Area IV AOC) RCRA Facility Investigation Report, Santa Susana Field Laboratory, Ventura County, California, Draft*, October 2003.

- The drainage area on the northeast side of the building. Surface drainage extends from the northeast side of the building next to the retaining wall to southeast and then flows southwest toward the paved area southwest of the building.[425] If radioactive materials were released to surface at or around Building 4093, residual contamination above background values may exist in the soils surrounding the surface drainage areas within the Building 4093 area.

- The east side of the building where gamma radiation was found to be 1,000 mr/hr on the east side of the building directly opposite the core. In order to determine the need for access restrictions in the area surrounding Building 4093, a radiation survey of the perimeter of the AE-6 reactor was conducted on August 13, 1970. The reactor was at a power level of 2 kW, and was operating with the shield doors on the east side open and a plastic Lucite rod, approximately 6 feet long, inserted in the one-inch diameter beam hole. Gamma radiation measured 1,000 mr/hr on the east side of the building directly opposite the core.[426] The research team has been unable to determine if the building operated with the shield doors open frequently. If the shield doors were opened frequently during reactor operations, it is possible that residual contamination above background values may exist on the east side of the former building.

- The location of the former 750-gallon septic tank. If radioactive materials were released into the septic system, residual contamination above background values may exist in materials surrounding the former septic tank.

2.2.5 Building 4123 Area

Note: To date, the research team has located limited historical documents relating to the construction and operation of Building 4123. As a result, the information provided below is limited.

Site Description: The Building 4123 area includes Building 4123 and the surrounding area. Located north of 12th Street, Building 4123 was a small above-ground concrete block structure constructed sometime between 1957 and 1962.[427] Surrounding buildings include Building 4073, discussed above, and Buildings 4643 and 4793, discussed below. Figures 2.2.5a through 2.2.5d provide a current photograph and the best available building-specific drawing(s) that the research team could find. Plate 1 presents a summary of all identified features for this site.

Building Features: Building 4123 was a small above-ground concrete block structure with two steel-lined concrete wells (6 feet deep and 2 feet wide) in the floor.[428] Additional information regarding the building features were not located.

Former Use(s): Constructed sometime between 1957 and 1962, Building 4123 was used for the temporary storage of radiological waste material associated with the operations of Building

[425] Atomics International, Santa Susana Facility Plot Plan, Drawing 303-GEN-C38, Sheet 4 of 14, June 4, 1964.
[426] Johnson, B.I., Internal Letter Re: Radiation Survey of the AE-6 Reactor, Building 093, August 13, 1970.
[427] Rockwell International, AI-ERDA-13159, "KEWB Facilities Decontamination and Disposition Final Report," February 25, 1976.
[428] Rockwell International, AI-ERDA-13159, "KEWB Facilities Decontamination and Disposition Final Report," February 25, 1976.

4073, the KEWB reactor building. This included the storage of uranyl sulfate and mixed fission products.[429,430]

The building was demolished in 1975 as part of the decontamination and disposition of KEWB facilities, and was completely removed, including foundations and storage pits. Prior to D&D, the building was surveyed and found free of contamination. Several small casks stored in the facility were sent to the RMHF for future use.[431] Information indicating how the storage pits were demolished and with what materials the storage pits were backfilled could not be located. On March 3, 1976, the ERDA released the land on which Building 4123 had been located for unrestricted use.[432]

Information from Interviewees: Interviewee 5 had extensive knowledge on the operations of the KEWB and Building 4123. Interviewee 5 served as the responsible engineer for the KEWB and was one of three operators that ran the reactor. The following are excerpts from that interview:

> When the fuel was drained out of the reactor it went into the below-grade drain tank. We also had precipitate material in the lines and we did some chemical flushing to try and recover the precipitate material. That process generated a lot of liquid that ended up getting stored in glass carboys. We would flush the pipes and drain the rinse into the carboy containers. The containers were stored outside Building 4123 across from the KEWB reactor building. Building 4123 had two underground cells or holes in the ground - two concrete-line holes in the ground. And over in that area is where we stored all those bottles of liquid. Did some of it leak out onto the ground? Probably some, I would guess, but probably not a signification amount…
>
> … Halfway through the KEWB program we changed the reactor vessel shape. We took the original 12-inch spherical vessel out and replaced it with a 12-inch cylindrical vessel. We cut the spherical vessel out and stored the reactor in Building 4123, which was a storage building designed for holding the reactor vessel. It was highly radioactive, highly contaminated. We all received significant radioactive exposures, getting our yearly dose just taking that spherical vessel out and moving it to storage…
>
> …The primary thing that went in Building 4123 was the first KEWB reactor. I'm sure some of that liquid that we drained out from flushing the pipes was probably stored inside as well, although most of it was stored outside the building. One thing I would look at is the underground part of Building 4123 because I don't know what they did with it in the D&D process. Building 4123 was not very big, maybe 8 feet by 8 feet or 8 feet by 10 feet. It was a small building. It was strictly a storage building and was built specifically to hold the first KEWB reactor when it was removed from the reactor building. There were two below-grade, concrete-lined cells. The cells were cylindrical and about 2 feet in diameter. Because the reactor was maybe a foot in diameter, the 2-foot diameter cells held the reactor vessel easily…

[429] Author unknown, *Vanowen and SSFL Operations 1959, Laboratory Status Reports*, undated.
[430] Rocketdyne Report, N001ER000017, "Nuclear Operations at Rockwell's Santa Susana Field Laboratory – A Factual Perspective," September 1991.
[431] Rockwell International, AI-ERDA-13159, "KEWB Facilities Decontamination and Disposition Final Report," February 25, 1976.
[432] Stamp, Stanley, Letter Re: "Decontamination and Disposition of ERDA Facilities," March 3, 1976.

> ...As I recall, we never had a spill outside the building, but I would check the area at Building 4123 where the glass carboy containers were stored outside.[433] I think it would be prudent to reexamine Building 4123...
>
> ...The carboys were stored temporarily at Building 4123, but eventually it was all sent to RMHF.
>
> At Building 4123, some carboys, the "hotter" ones, were probably stored in the building. But most were stored outside on an asphalt pad on the southern side of the building, near the road. I am not sure how long the bottles were stored here. That would be something log books would be able to tell you. The draining occurred before the spherical reactor vessel was removed, so it would have been sometime in the early- to mid-1959. I don't think you will see any residual contamination from this area, but it would be something to look at...

Radiological Incident Reports: There have been no incident reports associated with the operations in Building 4123 located to date.

Current Use: As indicated above, Building 4123 was demolished in 1975. The entire building, including foundations, was removed.[434] The ERDA released the land on which Building 4123 had been located and the surrounding area for unrestricted use in 1976.[435]

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): A chronology of radiological investigations at this building is as follows:

- In 1975, Rocketdyne performed a final radiological survey during D&D of the KEWB facilities, including Buildings 4073, 4123, 4643, and 4793, and published the results in a final D&D report in 1976.[436] According to the report, Rocketdyne surveyed Building 4123 and found the building to be free of contamination. The survey found that all remaining surfaces of Building 4072 were decontaminated to levels as low as reasonably achievable, and in all cases below the 1975 levels for future unrestricted use (removable contamination of 20 dpm/100 cm^2 α or 100 dpm/100 cm^2 β). The survey concluded that the site was free of radioactivity except for normal background.

- In July 1975, Rocketdyne performed a surface scan of the KEWB site, including Buildings 4073, 4123, 4643, and 4793, to validate that no radiological contamination remained.[437] The survey found no levels of beta-gamma surface contamination above the measured background (0.15 – 0.25 mrad/hr) in 1975.

[433] It is important to note the interviewee did not provide a specific location for where the glass carboy containers were stored outside of Building 4123.
[434] Rockwell International, AI-ERDA-13159, "KEWB Facilities Decontamination and Disposition Final Report," February 25, 1976.
[435] Stamp, Stanley, Letter Re: "Decontamination and Disposition of ERDA Facilities," March 3, 1976.
[436] Rockwell International, AI-ERDA-13159, "KEWB Facilities Decontamination and Disposition Final Report," February 25, 1976.
[437] Letter from R.K. Owen (Rockwell International) to R.J. Tuttle, "Radiation Survey – T073 (KEWB) Site," July 17, 1975.

- In May 1983, Argonne National Laboratories performed a post remediation radiological survey to verify that the site was free of radioactivity except for normal background.[438] The survey performed a surface scan to determine the ambient gamma exposure rate and low-level radiation level. Also soil samples were collected and analyzed for gamma radiation and uranium. The survey found no measurements above 1983 background levels. Argonne National Laboratories determined that background is relatively high (40 μR/hr and 8,000 cts/min) due to the "shine" from nearby Buildings 4021 and 4022. The report did not provide any sources for this summary of background levels. The survey concluded that the site could be released for unrestricted use.

- In August 1988, Rocketdyne performed a surface scan between the KEWB facilities and the RMHF measuring ambient gamma exposure rate to ensure no contamination existed as a result of radioactive materials movement.[439] The mean exposure rate was 17.4 ± 0.96 μR/hr (–0.2 ± 0.96 μR/hr when corrected for background). And background was measured as 17.0 μR/hr. The acceptable limit was 5.0 μR/hr above background. As a result, the survey results were below the 1988 acceptable limits. The findings are inconsistent with the findings of the Argonne National Laboratories report that determined background levels to be 40 μR/hr. The August 1988 report did not provide any comparison of findings with previous reports to provide any reasons for the discrepancy.[440]

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Locations: Building 4123 included two steel-lined concrete wells (6 feet deep and 2 feet wide) in the floor that were used for the temporary storage of radiological waste material associated with the operations of Building 4073.[441] As indicated above, the research team did not locate any information to indicate how the wells were treated during the D&D of KEWB facilities. It was noted the building was completely removed, including foundations.[442]

Aerial Photographs: Aerial photographs do not show any disturbances near Building 4123, with the exception of a water pipeline that crosses near the site from 12th Street to Building 4003. The presence of Building 4123 is difficult to discern in early photographs (1957 through 1965); however, the building is visible in 1967 aerial photographs. The building appears to remain in 1972, but is no longer visible in 1978 photographs.[443]

[438] Argonne National Laboratory Report, no document number, "Surplus Facilities Management Program, Interim Post Remedial Action Survey Report for Kinetic Experiment Water Boiler (KEWB) Facility, Santa Susana Field Laboratory, Rockwell International, Canoga Park, California," May 1983.
[439] ETEC Document, GEN-ZR-0009, "Radiological Survey of the T513 Parking Lot; Old R/A Laundry Area; Plot 333; and Areas Between the SRE to RMHF, and KEWB to RMHF," August 26, 1988.
[440] Argonne National Laboratory, "Surplus Facilities Management Program, Interim Post Remedial Action Survey Report for Kinetic Experiment Water Boiler (KEWB) Facility, Santa Susana Field Laboratory, Rockwell International, Canoga Park, California," May 1983.
[441] Rockwell International, AI-ERDA-13159, "KEWB Facilities Decontamination and Disposition Final Report," February 25, 1976.
[442] Rockwell International, AI-ERDA-13159, "KEWB Facilities Decontamination and Disposition Final Report," February 25, 1976.
[443] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.

Radionuclides of Concern: Reactor fuel for the KEWB reactor was U-235 dissolved as uranyl sulfate in solution. Based on radiological investigations and historical documents, the radionuclides of concern include Co-60, Cs-137, Eu-152, Eu-154, Eu-155, Mn-54, Pb-210, Ra-226, Sr-90, U-235 and U-238.[444] All radionuclides of concern listed are included in the August 2009 Final Field Sampling Plan for the Santa Susana Field Laboratory radiological background study. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Drainage at the site is to the south-southwest to a "paved ditch" adjacent to a dirt road.[445] The Building 4093 leach field was located east of Building 4123.

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4123 area is Class 1 because of the buildings purpose as a temporary radioactive waste storage facility, the location of the building within ETEC, and its proximity to Building 4073.

Recommended Locations for Soil/Sediment Sampling: Plate 1 and Figure 2.2 provide a convenient reference for the following recommendations.

Due to the storage of the first KEWB reactor and the storage of radioactive materials at and around Building 4123, there is a possibility of elevated radionuclide concentrations in soil. Therefore, additional characterization is recommended for the Building 4123 area. This includes the following Building 4123 areas:

It is recommended that sampling at the Building 4123 area be included in the Building 4073 sampling plan.

- The former Building 4123 footprint. As indicated by an interviewee, Building 4123 had two concrete-lined holes in the ground that were used to store containers containing radioactive fuel and the original 12-inch spherical reactor vessel. It was highly radioactive, highly contaminated. The primary thing that went in Building 4123 was the first KEWB reactor. Additionally, the interviewee indicated that the "hotter" carboys were probably stored in Building 4123. As a result of these storage operations, it is possible residual contamination above background values may exist in the materials surrounding the former Building 4123 footprint.

- The outside storage area located south of the building where carboys containing radioactive material were stored prior to being transported to the RMHF. According to an interviewee with knowledge of the KEWB reactor operations, the carboys were stored temporarily outside on an asphalt pad on the southern side of the building, near the road. The interviewee indicated that leaks would have been possible during these storage activities. As a result, it is possible residual contamination above background values may exist in the materials surrounding the former outside storage area.

[444] Rocketdyne Report, N001ER000017, "Nuclear Operations at Rockwell's Santa Susana Field Laboratory – A Factual Perspective," September 1991.
[445] Atomics International, Drawing 303-00C-C2, *Misc. Paving, Patching & Drainage Improvements – KEWB*, Date illegible, circa 1969. HDMSE00457545.

2.2.6 Building 4453 Area

Site Description: Located approximately 165 feet southeast of Building 4093, the L-85 reactor, the Building 4453 area comprises Building 4453 and the land surrounding it located on 11th Street. Building 4453 was constructed in approximately 1958 and consisted of a steel frame covered in sheet metal.[446] Buildings 4093, 4083/4103, and 4074 are located northwest of Building 4453 and have been discussed above. Figures 2.2.6a through 2.2.6c provide a current photograph and the best available building-specific drawing(s) that the research team could find. Plate 1 presents a summary of all identified features for this site.

Building Features: Very little information has been located regarding the building features of Building 4453. As indicated above, Building 4453 consisted of a steel frame covered in sheet metal. The building appears to have been a single room. A 1986 inspection of the L-85 reactor by the NRC indicates that Building 4453 was used for measuring background for facilities associated with L-85 reactor operations. Background levels at Building 4453 were measured at 11.9 μR/hr. The building was reported to have a similar construction history as Building 4093, but had no history of non-sealed source radioactive material use.[447,448]

Former Use(s): Building 4453 was constructed between August 1957 and August 1959, and appears to have served as the fuel handling building for the L-85 reactor, Building 4093.[449] The fuel for the L-85 reactor consisted of uranyl sulfate. Ownership of Building 4093 was transferred from AEC to Rockwell in 1972, and the NRC licensed the facility on January 5, 1972 under license R-118 Docket No. 50-375. The documents do not provide information to indicate Building 4453 was included in the license. It should be noted; however, that the license allowed the storage of 200 grams of U-235 within a metal safe in Building 4093. "Fissile materials, other than the fuel solution in the reactor and what is stored in the metal safe, must be stored in approved safe-geometry containers in an array no more reactive than authorized for the containers." Documents do not provide the location of these storage containers. It is possible these materials were stored in Building 4453.[450]

In 1984, the building is listed as a neutron radiography storage building.[451] Documents relating to the dismantling of Building 4453 could not be located; however, a February 1987 radiation survey for license termination noted that Building 4453 was being used as a storeroom. According to an April 1987 Site Consolidation Assessment, Building 4453 was going to be used to store tools and materials from Building 4064.[452,453] Building 4093 was released for

[446] Atomics International Document, AI-70-73, *Safety Analysis Report for L-85 Nuclear Examination Reactor*, November 25, 1970.
[447] Rocketdyne Report N001SSR140087, *Radiation Survey for Release for Unrestricted Use – L-85 Reactor Facility*, March 6, 1986.
[448] Garcia, E.M, NRC Rockwell International Research Reactor L-85 Inspection, December 2, 1986.
[449] Rocketdyne Report N001SSR140087, "Radiation Survey for Release for Unrestricted Use – L-85 Reactor Facility," March 6, 1986.
[450] Skoholt, Donald, *North American Rockwell Corporatio, Docket No. 50-375, Facility License No R-118*, January 5, 1972.
[451] Olson, P, et. al, GEN-ZR-0002, *CERCLA Program Phase II – Site Characterization*, May 29, 1987.
[452] Energy Technology Engineering Center, *Site Consolidation Assessment*, April 16, 1987.
[453] It is important to note that HGL did not locate any references to Building 4453 in the documents cited by the May 2005 HSA, particularly those relating to the NRC license assigned to the L-85 reactor.

unrestricted use by NRC and the NRC license terminated March 19, 1987. The research team assumes Building 4453 was also released at this time.[454,455]

Information from Interviewees: There have been no interviews with persons familiar with the operations at Building 4453 to date.

Radiological Incident Reports: There have been no incident reports associated with the operations in Building 4453 located to date.

Current Use: The building was demolished sometime between October 1988 and June 1995, although the exact date of demolition is unknown. The concrete foundation of the building remains present at the site today.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): A chronology of radiological investigations at this building is as follows:

- In 1985, Rocketdyne conducted a final radiological survey, releasing the final report in March 1986. (The survey included buildings 4073, 4074, 4083, 4084, 4093, 4453 and 4453). Because non-sealed radioactive materials were not reported to have been used in Building 4453, the survey applied reduced sampling with a 1-square meter sample being measured from every other 9-square meter grid, rather than every 3-square meter grid.[456]

  Average contamination measurements were taken with an alpha (Ludlum Model 43-1 or equivalent) or beta (Ludlum, Model 44-9 or equivalent) probe. The survey included a reduced inspection plan after a 100% floor survey conducted before and after the floor tile was removed found no radioactive contamination. The maximum average alpha detected was 17.2 dpm/100 cm^2 (limit is 5,000 dpm/100 cm^2) and the maximum average beta detected was 1,987 dpm/100 cm^2 (limit is 5,000 dpm/100 cm^2). The results were reported in the report as a summary of survey results for Buildings 4083, 4074, and 4453. As a result, the same results apply to all three buildings; however, it is uncertain whether these results are a true reflection of the conditions at Building 4453.

  According to the report, the limits for the release for unconditional use of Building 4453 were taken from the U.S. Nuclear Regulatory Commission Regulatory Guide 1.86 and the U.S. Nuclear Regulatory Commission Dismantling Order, Docket No. 50-375. The report indicated that these criteria were in agreement with the guidance found in the January 1985 version of the American National Standards Institute/Health Physics Society Standard ANSI N13.12, and in the DECON-1 document issued by the State of California in 1977.

  The maximum average ambient exposure rate for three buildings including Building 4453 was originally found to be 23.1 μR/hr (limit is 18.9 μR/hr). It is important to note the

[454] Remley, M.E., Summary Report of Ambient Exposure Rate Measurements at the L-85 Research Reactor Facility After Repair of Concrete Floor, February 1987.
[455] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005.
[456] Rocketdyne, N001SSR140087, "Radiation Survey for Release for Unrestricted Use – L-85 Reactor Facility," March 6, 1986.

findings were the average of the three buildings. The report does not provide the findings of each building individually. The report summarized that the ambient exposure rates over the limit were attributed to the nearby RMHF and were reported to not represent residual contamination. Additionally, the survey found that measured radiation levels were below acceptable limits, making the site acceptable for unrestricted use.

- A December 2, 1986, Nuclear Regulatory Commission inspection report states that Building 4453 was used by Rocketdyne to determine background levels for comparison with surveys being conducted at Building 4093. According to the report, the background levels measured by Rocketdyne at Building 4453 were 11.9 μR/hr.[457]

Radiological Use Authorizations: None.

Former Radiological Burial or Disposal Locations: None.

Aerial Photographs: There are no disturbances surrounding Building 4453 between August 1959 when the building first appears and October 1988 when the building is last visible in aerial photographs. Aerial photographs after 1988 show a concrete foundation to still be present at the Building 4453 location.[458]

Radionuclides of Concern: Building 4453 was located outside the restricted area surrounding the L-85 reactor and was reported to have had no history of non-sealed source radioactive materials use.[459] However, documents indicate the building served as the fuel handing facility for Building 4093. Accordingly, the contaminants of concern are Co-60, Cs-137, Eu-152, Eu-154, Sr-90, U-238 and U-235. All radionuclides of concern listed are included in the August 2009 Final Field Sampling Plan for the Santa Susana Field Laboratory radiological background study. Table 3.3 presents a summary of contaminants of concern.[460]

Drainage Pathways: the research team has not located any drainage pathways in the area at or surrounding Building 4453.

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4453 area is Class 1.

Recommended Locations for Soil/Sediment Sampling: Plate 1 and Figure 2.2 provide a convenient reference for the following recommendations.

Because the building is stated to have served as a fuel handling facility for Building 4093, there is a possibility of there being elevated radionuclide concentrations in soil. Therefore, additional characterization is recommended for the Building 4453 area. This includes the following Building 4453 areas:

[457] Garcia, E.M., Nuclear Regulatory Commission Inspection, Rockwell International Research Reactor L-85, March 13, 1987.
[458] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[459] Murphy, G.L., Confirmatory Radiological Survey of the L-85 Reactor Facility, Final Report, December 1986.
[460] Rocketdyne Report N001SSR140087, "Radiation Survey for Release for Unrestricted Use – L-85 Reactor Facility," March 6, 1986.

- The former Building 4453 footprint. The building was demolished sometime between October 1988 and June 1995. The concrete foundation of the building remains present at the site today. Because the exact nature of the operations of the building as a fuel handling facility is unknown, it is possible residual contamination above background values may exist at and near the Building 4453 footprint.

2.2.7 Site 4633 Area

Note: Documents relating to the construction and operation of Site 4633 are limited.

Site Description: The Site 4633 area was located northeast of Building 4083/4103 and included Site 4633 and the surrounding area. The building was reported to have been constructed prior to 1962. Plate 1 presents a summary of all identified features for this site.

Building Features: No information was located.

Former Use(s): According to a June 1978 plot plan of the SSFL, Site 4633 served as the reactor cooling water pad. The research team has been unable to locate any information regarding the operations associated with Site 4633. Site 4633 was demolished in the late 1980s.[461]

Information from Interviewees: There have been no interviews with persons familiar with Site 4633 operations to date.

Radiological Incident Reports: There have been no incident reports associated with the operations at Site 4633 identified to date.

Current Use: Site 4633 was demolished in the late 1980s. Based on available information, the dimensions of the excavation made during building demolition are unknown.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): Radiological surveys specific to Site 4633 have not been conducted; however, studies have been conducted at Building 4083/4103. The results of those surveys are presented in Section 2.2.3, above.

Radiological Use Authorizations: None.

Former Radiological Burial or Disposal Locations: None.

Aerial Photographs: Aerial photographs do not show enough detail to see the structure referred to as Site 4633. The only notable features near Site 4633 include a water pipeline that crosses the site from 12th Street to Building 4003.[462]

Radionuclides of Concern: There have been no radionuclides of concern identified at the Site 4633 area.

[461] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries,* May 2005.
[462] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.

Drainage Pathways: The research team did not locate any information regarding the drainage pathways at Site 4633.

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Site 4633 area is Class 1 because there is so little information known about Site 4633.

Recommended Locations for Soil/Sediment Sampling: Plate 1 and Figure 2.2 provide a convenient reference for the following recommendations.

Because there is such limited information on the use and operations of Site 4633, as well as the site's proximity to Building 4093, there is a possibility of elevated radionuclide concentrations in soil. Therefore, additional characterization is recommended for the Site 4633 area. This includes the following Site 4633 areas:

- The Site 4633 footprint. Because the exact nature of the operations of Site 4633 is unknown, it is possible residual contamination above background values may exist at and near the Site 4633 footprint.

2.2.8 Building 4643

Note: Limited documents relating to the construction and operation of Building 4643 have been located.

Site Description: The Building 4643 area comprises Building 4643 and the surrounding area. Other buildings in the vicinity were part of the KEWB reactor facility and included Buildings 4073 and 4123, discussed above, and Building 4793, discussed below. No as-built drawings were located for Building 4643. Figures 2.2.8a through 2.2.8d provide a current photograph and the best available building-specific drawing(s) that the research team could find. Plate 1 presents a summary of all identified features for this site.

Building Features: Building 4643 was a small mechanical building with a 60-foot exhaust stack that had a 2,000-cubic foot per minute blower system. The building was connected to a 300-gallon underground storage tank that was connected to Building 4073 and held radioactive gases released from the core for a half-life period prior to expelling the exhaust to the atmosphere.[463,464] Other materials within the building included filters, filter bank housing, power lines, fire detection equipment, gas lines, vacuum pump, electrical panels, and blower and drive motor.[465]

Former Use(s): Constructed in the early 1960s, Building 4643 was an exhaust building that provided ventilation for the KEWB reactor building. The building was demolished in 1975. During demolition a contamination survey of Building 4643 and the associated equipment indicated that the floor of the exhaust building was contaminated with removable beta contamination levels of up to 600 dpm/100 cm^2. The exhaust blower and filter plenum were also

[463] Rockwell International, AI-ERDA-13159, "KEWB Facilities Decontamination and Disposition Final Report," February 25, 1976.
[464] Atomics International, Document NAA-SR-7300 Special, "Evaluation of the Atomics International Nuclear Development Field Laboratory as a Location for Reactor Facilities," May 25, 1962.
[465] Atomics International, FDP-704-990-002, *Dismantling Plan for KEWB Facility (Bldgs 073,123 and 793)*, October 17, 1974.

contaminated and were removed and sent to the RMHF for disposal. After the floor was decontaminated by wiping with a caustic solvent, the building was resurveyed and found to be within the "as low as practicable" limits set forth in 1975. The building was released to the salvage contractor who demolished and removed the remaining structure, including the 60-foot exhaust stack, as well as the tanks and their associated fill and drain lines. The D&D report does not provide information to indicate how the structure and exhaust stack were disposed or if they were included in the material that was used as backfill material during the regarding of the KEWB facility. It also does not provide information to indicate the dimensions of the excavation made during building demolition.[466] ERDA released the land on which Building 4643 was located for unrestricted use on March 3, 1976.[467]

Information from Interviewees: Interviewee 5 had extensive knowledge on the operations of the KEWB facility. Interviewee 5 served as the responsible engineer for the KEWB and was one of three operators that ran the reactor. The following are excerpts from that interview:

> There were radioactive gases and liquids associated with KEWB. The KEWB did generate fission gases. The fission gases were held in an underground storage tank and then vented up a stack after a decay period. The only contamination that might still remain from that would be in the underground storage tank. I don't know what the status of the underground storage tank is after D&D. I don't know if the tank was dug out during the D&D process or not. We had fission gases that were generated and sent to the underground tank. Then we had argon-41 that was generated in the reactor vault, but this was not held in the underground tank, it was just vented up the stack. We would have to ventilate the room anytime we had to do work in the reactor room because of the radioactive argon gas. The fission gases were held in the underground tank and decayed for a while and then slowly bled out the stack.

Radiological Incident Reports: There have been no incident reports resulting from operations in Building 4643 identified to date.

Current Use: Building 4643 was demolished in 1975 and released for unrestricted use in March 1976.[468] Aerial photographs do not show any activities in this area.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): A chronology of radiological investigations near this building is as follows:

- In July 1975, Rocketdyne performed surface scans of the KEWB site to validate that no radiological contamination remained. The survey found no levels of beta-gamma surface contamination above the measured background in 1975 (0.15 – 0.25 mrem/hr). The survey concluded that there was no radiation above 1975 background levels observed away from the site.[469]

- In 1976, Rocketdyne performed a final radiological survey of the KEWB building and support buildings, including Building 4643, during decontamination and disposition of the facility. A contamination survey of Building 4643, and the associated equipment

[466] Rockwell International, AI-ERDA-13159, "KEWB Facilities Decontamination and Disposition Final Report," February 25, 1976.
[467] Stamp, Stanley, Letter Re: "Decontamination and Disposition of ERDA Facilities," March 3, 1976.
[468] Stamp, Stanley, Letter Re: "Decontamination and Disposition of ERDA Facilities," March 3, 1976.
[469] Owen, R.K., Letter Re: "Radiation Survey – T073 (KEWB) Site," July 17, 1975.

indicated that the floor of the exhaust building was contaminated with removable contamination levels of up to 600 dpm/100 cm2 beta. The exhaust blower and filter plenum were also contaminated. During disposition, the exhaust blower and filter plenum were removed and sent to the RMHF for disposal. Rocketdyne personnel decontaminated the floor by wiping it with a caustic solvent and then resurveyed the building. The smear samples indicated contamination of less than 30 dpm/100 cm2 beta and less than 5 dpm/100 cm2 alpha. The building was completely demolished, including the removal of all concrete footings and pads. The report included a final survey of the entire KEWB area following grading activities. The survey found that all remaining surfaces were decontaminated to levels as low as reasonably achievable; in all cases below the 1976 levels for future unrestricted use (removable contamination of 20 dpm/100 cm^2 α or 100 dpm/100 cm^2 β). The survey concluded that the site was free of radioactivity except for normal background.[470]

- In May 1983, Argonne National Laboratories performed a post remediation radiological survey to verify that the KEWB site was free of radioactivity except for normal background. The survey performed a surface scan to determine the ambient gamma exposure rate and low-level radiation level. Soil samples were collected and analyzed for gamma radiation and uranium. The soil samples were taken at four locations around the perimeter of the site. Additionally, nine bore holes were drilled to depths of up to twelve feet, and sampled in sequential one-foot increments. The report did not include any figures to show the locations of the soil samples or bore holes. The report also did not include any analytical data or sampling results.

  The survey found no measurements above background in May 1983. According to Argonne National Laboratories, background was reported to be relatively high (40 μR/h and 8,000 cts/min) due to the shine from nearby Buildings 4021 and 4022. The report stated that the results of the analyses of soil samples revealed no radionuclide concentration above background levels. The survey concluded that the site could be released for unrestricted use.[471]

- On August 1988, Rocketdyne performed a surface scan of the terrain between the KEWB facilities and the RMHF measuring ambient gamma exposure rates to ensure that no contamination existed as a result of radioactive materials movement. The mean ambient gamma radiation detected was 17.4 ± 0.96 μR/hr, with background being 17.0 μR/hr. The acceptable limit, according to the report, was determined to be 5.0 μR/hr above background, meaning the survey results found no contamination above 1988 background levels.[472] The findings are inconsistent with the findings of the Argonne National Laboratories report that determined background levels to be 40 μR/hr. The August 1988

[470] Rockwell International, AI-ERDA-13159, "KEWB Facilities Decontamination and Disposition Final Report," February 25, 1976.
[471] Argonne National Laboratory, "Surplus Facilities Management Program, Interim Post Remedial Action Survey Report for Kinetic Experiment Water Boiler (KEWB) Facility, Santa Susana Field Laboratory, Rockwell International, Canoga Park, California," May 1983.
[472] ETEC, GEN-ZR-0009, "Radiological Survey of the T513 Parking Lot; Old R/A Laundry Area; Plot 333; and Areas Between the SRE to RMHF, and KEWB to RMHF," August 26, 1988.

report did not provide any comparison of findings with previous reports to provide any reasons for the discrepancy.[473]

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Locations: There have been no radiological burial or disposal locations identified during the course of Building 4643 operations; however, it is important to note that asphalt and concrete from D&D activities were used as backfill at the site in 1975. While the concrete was decontaminated to levels that were "as low as practicable," it is uncertain whether these levels are in compliance with the requirements of SB-990.

Aerial Photographs: It is difficult to discern any features related to Building 4643 in aerial photographs.[474]

Radionuclides of Concern: Reactor fuel for the KEWB reactor was U-235 dissolved as uranyl sulfate in solution. As a result, the radionuclides of concern include Co-60, Cs-137, Eu-152, Eu-154, Sr-90, U-238 and U-235.[475,476] All radionuclides of concern listed are included in the August 2009 Final Field Sampling Plan for the Santa Susana Field Laboratory radiological background study. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Drainage at Building 4643 is south-southwest toward a drainage ditch located adjacent to the former dirt road leading to the site. A 2-inch drain line also extends from this area to areas south-southwest.

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4643 area is Class 1 as a result of the use of the building as an exhaust stack for radioactive gases, known contamination, and proximity to Building 4073.

Recommended Locations for Soil/Sediment Sampling: Plate 1 and Figure 2.2 provide a convenient reference for the following recommendations.

Due to the potential of radioactive material migration via surface water flow or airborne release from Buildings 4073 and 4643, there is a possibility of elevated radionuclide concentrations in soil. Therefore, additional characterization is recommended for the Building 4643 area. This includes the following Building 4643 areas:

It is recommended that sampling at the Building 4643 area be included in the Building 4073 sampling plan.

- The former Building 4643 footprint. During demolition, a contamination survey of Building 4643 and the associated equipment indicated that the floor of the exhaust

[473] Argonne National Laboratory, "Surplus Facilities Management Program, Interim Post Remedial Action Survey Report for Kinetic Experiment Water Boiler (KEWB) Facility, Santa Susana Field Laboratory, Rockwell International, Canoga Park, California," May 1983.
[474] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[475] It is important to note that Ar-41 is not included in the listing of radionuclides of concern as a result of its short half-life of 109 minutes.
[476] Rocketdyne Report, N001ER000017, "Nuclear Operations at Rockwell's Santa Susana Field Laboratory – A Factual Perspective," September 1991.

building was contaminated with removable beta contamination levels of up to 600 dpm/100 cm^2. The exhaust blower and filter plenum were also contaminated and were removed and sent to the RMHF for disposal. During the course of building demolition, it is possible residual contamination above background values may exist at the former building location.

- The gas line from the 300-gallon storage tank to the former building. The building was connected to a 300-gallon underground storage tank that was connected to Building 4073 and held radioactive gases released from the core for a half-life period prior to expelling the exhaust to the atmosphere.[477,478] The removal of the pipe or the passage of radioactive gasses through the pipe may have caused possible residual contamination above background values along the gas line.

- As outlined in the sampling recommendations for Building 4073, the ditch adjacent to the former dirt road should be sampled. The ditch leads to 12th Street where the flow of drainage proceeds southeast along 12th Street to G Street and continues southwest to 17th Street.[479] If radioactive materials were released the ground surface near Building 4073, residual contamination above background values may exist in the materials surrounding the ditch.

2.2.9 Building 4793

Note: Limited documents relating to the construction and operation of Building 4793 have been located.

Site Description: The Building 4793 area is located within the KEWB facility area, east of Building 4073, and includes Building 4793 and the surrounding area. Building 4793 was a small above-ground mechanical building located east of the KEWB reactor building.[480] Figures 2.2.9a through 2.2.9d provide a current photograph and the best available building-specific drawing(s) that the research team could find. Plate 1 presents a summary of all identified features for this site.

Building Features: D&D documents describe the building as a sheet-steel electrical control building. The building contained the electrical panels, air conditioner, and heater. A pit was located in the floor of this building where most of the electrical conduits to the reactor room terminate.[481,482]

[477] Rockwell International, AI-ERDA-13159, "KEWB Facilities Decontamination and Disposition Final Report," February 25, 1976.
[478] Atomics International, Document NAA-SR-7300 Special, "Evaluation of the Atomics International Nuclear Development Field Laboratory as a Location for Reactor Facilities," May 25, 1962.
[479] Atomics International, Drawing 303-00C-C2, "Misc. Paving, Patching & Drainage Improvements – KEWB," Date illegible, circa 1969. HDMSE00457545.
[480] Rockwell International, AI-ERDA-13159, "KEWB Facilities Decontamination and Disposition Final Report," February 25, 1976.
[481] Atomics International, Document NAA-SR-7300 Special, "Evaluation of the Atomics International Nuclear Development Field Laboratory as a Location for Reactor Facilities," May 25, 1962.
[482] Rockwell International, AI-ERDA-13159, "KEWB Facilities Decontamination and Disposition Final Report," February 25, 1976.

Former Use(s): Building 4793 housed the heating and air conditioning systems for the KEWB reactor building and was constructed in the early 1950s. The building was demolished in 1975. During D&D operations, the building was surveyed and found to be free of contamination. The underground electrical wiring to and from the building was removed by the salvage contractor. The building was unbolted from the foundation and removed from the site and sent to the salvage yard. The concrete pad was demolished and removed.[483] The land on which Building 4793 was located was released for unrestricted use March 3, 1976, by the ERDA.[484]

Information from Interviewees: None to date.

Radiological Incident Reports: There have been no incident reports relating to the operations of Building 4793 identified to date.

Current Use: Building 4793 was demolished in 1975 and the building's footprint has been released for unrestricted use since 1976.[485] Based on available information, the dimensions of the excavation made during building demolition are unknown.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): A chronology of radiological investigations in the vicinity of this building is as follows:

- In 1975, Rocketdyne performed a final radiological survey of the KEWB building and support buildings, including Building 4793, during D&D of the facility. Rocketdyne surveyed Building 4793 and found the building to be free of contamination. Following the survey, the salvage contractors removed the underground electrical wiring to and from the building. Rocketdyne maintenance personnel removed the building from the site and sent it to the "salvage yard." The report indicates the concrete pad was demolished and removed but does not indicate who conducted the removal. The survey of the area after demolition found that all remaining surfaces were decontaminated to levels as low as reasonably achievable; in all cases below the levels for future unrestricted use (removable contamination of 20 dpm/100 cm^2 α or 100 dpm/100 cm^2 β). The survey concluded that the entire KEWB site was free of radioactivity except for normal background.[486]

- In July 1975, Rocketdyne performed a surface scan of the KEWB site, including Building 4793, following demolition to confirm that no radiological contamination remained.[487] The survey found no levels of beta-gamma surface contamination above the measured background (0.15 – 0.25 mrad/hr). According to the report, survey results were below 1975 background limits and were, as a result, below acceptable limits.

- In May 1983, Argonne National Laboratories performed a post remediation radiological survey to verify that the KEWB site, including Building 4793, was free of radioactivity

[483] Rockwell International, AI-ERDA-13159, "KEWB Facilities Decontamination and Disposition Final Report," February 25, 1976.
[484] Stamp, Stanley, Letter Re: "Decontamination and Disposition of ERDA Facilities," March 3, 1976.
[485] Stamp, Stanley, Letter Re: "Decontamination and Disposition of ERDA Facilities," March 3, 1976.
[486] Rockwell International, AI-ERDA-13159, "KEWB Facilities Decontamination and Disposition Final Report," February 25, 1976.
[487] Letter from R.K. Owen (Rockwell International) to R.J. Tuttle, "Radiation Survey T073 (KEWB) Site," July 17, 1975.

except for normal background. The survey performed a surface scan to determine the ambient gamma exposure rate and low-level radiation levels. Soil samples were collected and analyzed for gamma radiation and uranium. The soil samples were taken at four locations around the perimeter of the site. Additionally, nine bore holes were drilled to depths of up to twelve feet, and sampled in sequential one-foot increments. The report did not include any figures to show the locations of the soil samples or bore holes. The report also did not include any analytical data or sampling results.

The survey found no measurements above background. According to Argonne National Laboratories, background was reportedly relatively high (40 μR/hr and 8,000 cts/min) due to the "shine" from nearby Buildings 4021 and 4022. The report stated that the results of the analyses of soil samples revealed no radionuclide concentration above background levels. The survey concluded that the site could be released for unrestricted use.[488]

- On August 1988, Rocketdyne performed a surface scan of the terrain between the KEWB facilities and the RMHF measuring ambient gamma exposure rates to ensure that no contamination existed as a result of radioactive materials movement. The mean ambient gamma radiation detected was 17.4 ± 0.96 μR/hr, with background being 17.0 μR/hr. The acceptable limit, according to the report, was determined to be 5.0 μR/hr above background, meaning the survey results found no contamination above 1988 background levels.[489] The findings are in contract with the Argonne National Laboratories report that determined background levels to be 40 μR/hr.[490]

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Locations: There have been no radiological burial or disposal locations identified during the course of Building 4793 operations; however, it is important to note that asphalt and concrete from D&D activities of this building and Building 4073 were used as backfill at the site in 1975. While the concrete was decontaminated to levels that were "as low as practicable," it is uncertain whether these levels are in compliance with the requirements of SB-990.

Aerial Photographs: Aerial photographs do not show any disturbances near Building 4793, with the exception of a water pipeline that crosses near the site from 12th Street to Building 4003. The presence of Building 4793 is difficult to discern in the aerial photographs, as a result, the research team was unable to confirm the time of construction or demolition.[491]

Radionuclides of Concern: There have been no indications of use of radionuclides in Building 4793; however, because the building is associated with the operations of the KEWB reactor, the

[488] Argonne National Laboratory, "Surplus Facilities Management Program, Interim Post Remedial Action Survey Report for Kinetic Experiment Water Boiler (KEWB) Facility, Santa Susana Field Laboratory, Rockwell International, Canoga Park, California," May 1983.
[489] ETEC, GEN-ZR-0009, "Radiological Survey of the T513 Parking Lot; Old R/A Laundry Area; Plot 333; and Areas Between the SRE to RMHF, and KEWB to RMHF," August 26, 1988.
[490] Argonne National Laboratory, "Surplus Facilities Management Program, Interim Post Remedial Action Survey Report for Kinetic Experiment Water Boiler (KEWB) Facility, Santa Susana Field Laboratory, Rockwell International, Canoga Park, California," May 1983.
[491] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.

radionuclides of possible concern include Co-60, Cs-137, Eu-152, Eu-154, Sr-90, U-238 and U-235.[492] All radionuclides of concern listed are included in the August 2009 Final Field Sampling Plan for the Santa Susana Field Laboratory radiological background study. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Drainage at the Building 4793 area appears to be south, southwest.[493]

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4793 area is Class 1 because of the building's proximity to Building 4073.

Recommended Locations for Soil/Sediment Sampling: Plate 1 and Figure 2.2 provide a convenient reference for the following recommendations.

Due to the potential of radioactive material migration via surface water flow or airborne release from Buildings 4073 and 4643, additional characterization is recommended for the Building 4793 area. This includes the following Building 4606 areas:

It is recommended that sampling at the Building 4793 area be included in the Building 4073 sampling plan.

- The former Building 4793 footprint. Because the demolition of Building 4793 occurred concurrently with Building 4073 demolition activities and rubble from both structures was used as backfill material, it is possible residual contamination above background values may exist at the former Building 4793 location.

- As outlined in the sampling recommendations for Building 4073, the ditch adjacent to the former dirt road should be sampled. The ditch leads to 12th Street where the flow of drainage proceeds southeast along 12th Street to G Street and continues southwest to 17th Street.[494] If radioactive materials were released the ground surface near Building 4073, residual contamination above background values may exist in the materials surrounding the ditch.

2.3 GROUP 3

The Group 3 index map is presented in Figure 2.3. Following Figure 2.3, the site photograph and layout drawings for each building area within HSA-5A Group 3 are presented. HSA-5A Group 3 includes three building areas including Building 4030/4035 and Building 4641.

2.3.1 Building 4030/4035 Area

Site Description: The Building 4030/4035 area includes Building 4030, Building 4035, and the surrounding area. Building 4030/4035 was in the north-eastern section of ETEC on 10th Street, off the west side of G Street and had a total enclosed area of 2,311 square feet. Also on 10th Street, Building 4641 shared a fenced area with Building 4030 that was used as a palletized

[492] Rocketdyne Report, N001ER000017, *Nuclear Operations at Rockwell's Santa Susana Field Laboratory – A Factual Perspective*, September 1991.
[493] Atomics International, Santa Susana Facility Plot Plan, Drawing 303-GEN-C38, Sheet 4 of 14, June 4, 1964.
[494] Atomics International, Drawing 303-00C-C2, "Misc. Paving, Patching & Drainage Improvements – KEWB," Date illegible, circa 1969. HDMSE00457545.

material holding area in the early 1960s and may have held drums containing mixed fission products.[495,496] Drawings indicate the building had an associated leach field that was likely used until 1961 to 1962, when the building was connected to the newly-built Area III site-wide sewage system.[497] Figures 2.3.1a through 2.3.1d provide a current photograph and the best available building-specific drawing(s) that the research team could find. Plate 1 presents a summary of all identified features for this site.

Building Features: Building 4030 was constructed in 1958 for research with a small accelerator neutron source. The building included two connected sections, each with steel framing, siding and roof. The western portion of Building 4030 was constructed at a right angle to the front office section. The front section of Building 4030 was known as Building 4035 before the rear section was added, and the two buildings were combined to form Building 4030.[498] The rear section of Building 4030 was configured to house a Van de Graaf accelerator that provided an adjustable energy proton beam to bombard a tritium target to produce neutrons. A Van de Graaf accelerator was also located in Building 4009 in Subarea HSA-8. An outside concrete wall was constructed to the north and east sides of the rear section of the building to provide shielding for the proton beams.[499] The building included restrooms so that the facility provided a complete self-contained accelerator test installation.[500] The building had an associated leach field that was likely used until 1961 to 1962, when the building was connected to the newly-built Area III site-wide sewage system.[501] Additionally, the building is serviced by electrical substation 4064.[502] A fenced-in asphalt area between Buildings 4030 and 4641 was used as a palletized material holding area. According to a 1988 survey, some drums containing mixed fission products may have been stored in this area.[503]

Former Use(s): During the course of its operation, Building 4030 has been referred to as the AE-6 counting room and workshop, the AE-6 office annex (former Building 4035), the particle accelerator facility, the site purchasing office, and traffic and warehousing. Building 4030 was constructed in 1958 for research with a small accelerator neutron source. A Van de Graff accelerator was moved into the facility in 1960 and operated through 1964 in support of the SNAP program: The accelerator provided a proton beam of up to tens of microamperes in current, with continuously adjustable energies from a few hundred KeV up to a maximum of

[495] ETEC Document, GEN-ZR-0007, "Radiological Survey of Shipping /Receiving and Old Accelerator Area-Buildings T641 and T030," August 19, 1988.
[496] Rocketdyne Report, 030-AR-0002, "Decontamination and Decommissioning (D&D) of Building T030," November 13, 1997.
[497] The May 2005 HSA lists the following document as the source document for the information regarding the leachefield; however, HGL was unable to locate this information within this document: ORISE Document 96/C-4, "Verification Survey of the Interim Storage Facility; Buildings T030, T641, and T013; an Area Northwest of Buildings T019, T013, T012, and T059; and a Storage Yard West of Buildings T626 and T038, SSFL, Rockwell International, Ventura County, California," Vitkus, T. J., and T. L. Bright, February 1996.
[498] Rocketdyne Report, 030-AR-0002, "Decontamination and Decommissioning (D&D) of Building T030," November 13, 1997.
[499] ETEC Document, GEN-ZR-0007, "Radiological Survey of Shipping /Receiving and Old Accelerator Area-Buildings T641 and T030," August 19, 1988.
[500] Rocketdyne Report, 030-AR-0002, "Decontamination and Decommissioning (D&D) of Building T030," November 13, 1997.
[501] Atomics International, Drawing 303-GEN-C17, Central Sewage System, Plan & Topography, August 27, 1959. Not an "As-built" drawing.
[502] Energy Technology Engineering Center, *Site Consolidation Assessment*, April 16, 1987.
[503] Rocketdyne Report, 030-AR-0002, "Decontamination and Decommissioning (D&D) of Building T030," November 13, 1997.

about 1 MeV. The particle beam was well-focused with a diameter of a few millimeters. Neutrons were generated using a tritium target via the H-3(p,n)He-3 reaction. Five-gallon cans of borated water were used for neutron shielding around the accelerator to thermalize and capture neutrons.[504,505] As indicated above, the reactor operated through 1964, at which time the facility was reportedly decommissioned, although documents relating to this decommissioning could not be located.

Following its use, the Van de Graaf accelerator was mothballed and remained in the building until 1966. A 1966 smear survey of the accelerator detected significant tritium contamination. The results of this survey are provided in the summary of previous radiological investigations, below. According to the 1997 decontamination and decommissioning report for Building 4030, Atomics International resurveyed the building following the removal of the accelerator and no residual contamination was found. The report does not indicate how the building was resurveyed or provide the survey results.[506] It is important to note that disposition of the accelerator could not be determined.

In 1965, Building 4030 was converted to an office. Beginning in 1972, the building was used as a purchasing office for the site and for traffic and warehousing.[507,508,509] According to a 1988 Use Agreement, DOE provided approval to the Rockwell Rocketdyne Division's request to relocate the SSFL shipping and receiving function to government-owned Buildings 4641 and 4030. The buildings, at the time, were under the cognizance of the DOE. The use agreement appears to have been in effect from April 1, 1988, through September 30, 1988.[510,511] The building was utilized as an office area until 1995.

Information from Interviewees: Interviewee 196 worked at the SSFL from 1959 to 1981 and again from 1991 to 1995 and stated:

> The only tritium I know about at the site was a particle source for an accelerator was in building 4035 or perhaps 4030. I've talked to the guy who was in charge of that accelerator, DGH. As I recall he didn't know what happened to the source. It was a small source.

Radiological Incident Reports: There are no incident reports associated with Building 4030. However, on June 20, 1989, a box of radioactive materials was removed from "T641/T030." The material, 13 mCi of Be-7, had been shipped from the DeSoto Facility in a Type A box. An

[504] ETEC Document, GEN-ZR-0007, "Radiological Survey of Shipping /Receiving and Old Accelerator Area-Buildings T641 and T030," August 19, 1988.
[505] Rocketdyne Report, 030-AR-0002, "Decontamination and Decommissioning (D&D) of Building T030," November 13, 1997.
[506] Rocketdyne Report, 030-AR-0002, "Decontamination and Decommissioning (D&D) of Building T030," November 13, 1997.
[507] ETEC Document, GEN-ZR-0007, "Radiological Survey of Shipping /Receiving and Old Accelerator Area-Buildings T641 and T030," August 19, 1988.
[508] Rocketdyne Report, 030-AR-0002, "Decontamination and Decommissioning (D&D) of Building T030," November 13, 1997.
[509] Mooers, A.R., Atomics International Internal Letter Re: Tritium Smear Survey, Building 030 Van de Graaff Accelerator, March 29, 1966.
[510] Schelin, Earl, Letter Re: Use Agreement for Relocation of Shipping & Receiving to Buildings 641 and 030, March 21, 1988.
[511] Additional information regarding this use agreement could not be located.

external survey of the surface for contamination and external radiation found no contamination (A0581).[512]

Current Use: DOE released the facility for unrestricted use on December 22, 1997.[513] DHS concurred with the release of the facility for unrestricted use on January 15, 1999.[514] According to the 2005 HSA, Building 4030 was demolished in 1999 and the site was paved.[515] Based on available information, the dimensions of the excavation made during building demolition are unknown.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): A chronology of radiological investigations at this building is as follows:

- On March 29, 1966, personnel conducted a tritium smear survey on Building 4030 and associated equipment. Two of the samples contained sufficient contamination to saturate the gas proportional counter utilized in measuring tritium contamination. According to the report, the activity of the samples was "estimated" by covering each sample with a clean piece of sample paper with an 1/8-inch diameter hole at its center. As a result, the tritium beta particles from the sample area outside the 1/8-inch diameter hole were shielded and only a 1/8-inch diameter area of the sample was counting. This produced a count rate of approximately 75,000 dpm. As recorded, assuming an equal distribution of the contamination over the total area of the sample, a ratio of count rate to the area was established and the total sample count rate was calculated by extrapolating to the total area of the 1-inch diameter sample. The following are the results of five sample locations with the most severe estimated contamination.

1966 Building 4030 Tritium Contamination Levels

Location	Activity (dpm/100 cm^2)
Plate below target holder	~1×10^5
Tritium target storage can	~1×10^5
Lower cooling hose	~1×10^5
Target holder (sides and front)	~3.6×10^6
Target holder (rear)	~3.6×10^6

The report recommended that the areas of severe contamination be decontaminated to an "acceptable" level but did not define the "acceptable" level.[516]

- In 1988, Rocketdyne performed a survey to clarify and identify areas at SSFL requiring further radiological inspection or remediation. The survey treated the building, Building 4641, and the surrounding area as a single sample lot for characterization and interpretation. As a result, the results presented here include data from Building 4641, discussed below. For the purposes of the survey, ETEC personnel superimposed 6-meter square grids over the terrain and building areas. One ambient gamma exposure rate

[512] Rowles, Jim, Internal Letter Re: Radiation Safety Incident Report, SSFL T641, June 20, 1989.
[513] Joma, Hannibal, Letter Re: Release of Facilities for Unrestricted Non-Radiologic Use, December 22, 1997.
[514] Wong, Gerald, DHS/RHB, Untitled letter, January 15, 1999.
[515] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 - Area IV Site Summaries*, May 2005.
[516] Mooers, A.R., Atomics International Internal Letter Re: Tritium Smear Survey, Building 030 Van de Graaff Accelerator, March 29, 1966.

measurement was made 1 meter from the surface in each 36-square meter area, resulting in approximately 114 measurements being acquired. In addition to the ambient gamma exposure rate measurements, the survey also included beta surveys of the accelerator room and outside paved area (palletized-container storage area). The survey also included surface soil sampling near the west and north sides of Building 4030. Ten samples were collected at random and were analyzed for tritium by U.S. Testing Inc.

The survey indicated that the large concrete block wall built as a shield outside the north wall of Building 4030 was not activated during building operations. The only suspect radionuclide was tritium, which was used as the target for producing neutrons. Radiological contamination quantities were compared against unrestricted-use acceptable contamination prescribed by DOE 5400.1, below.[517]

Building 4030 1988 Maximum Acceptable Contamination Limits

Criteria	Alpha (dpm/100 cm^2)	Beta (dpm/100 cm^2)
Total Surface, averaged over 1 m^2	5,000	5,000
Maximum Surface, in 1 m^2	15,000	15,000
Removable Surface, over 100 cm^2	1,000	1,000
Ambient Gamma Exposure Rate	5 μR/hr over background	
Soil Activity Concentration	21 pCi/g 31 pCi/g	100 pCi/g
Water Activity Concentration	$1x10^{-4}$ μCi/mL	$1x10^{-5}$ μCi/mL

The average ambient gamma radiation measured for the entire data set of 114 measurements was 12.7 μR/hr with the limit being 5 μR/hr above background. Background was determined to be between 14 and 15.6 μR/hr based on 1988 measurements of the areas surrounding the "Incinerator Road" and the Building 4309 area. There was no detectable activity of beta radiation. The average tritium activity concentration in soil was 5.31 pCi/l with the maximum acceptable contamination being 366 pCi/l, meaning the survey results were below the 1988 acceptable limits.

It is important to note that according to the report, Rocketdyne experienced difficulty in assessing the radiological condition of "a clean facility based on an acceptance requirement relative to 'background'". The report indicated a large variabiligy of gamma exposure rated depending on whether measurement were taken indoors, outdoors, or near a large sandstone outcropping. Accounting for the variables and deviations, and subtracting a value that represents "natural" background gamma radiation at SSFL, Rocketdyne determined the area to be clean of any residual radioactive contamination.[518]

[517] DOE 5400.1 is a November 9, 1988, order from the U.S. Department of Energy pertaining to the general environmental protection program. The purpose of the order is to "establish environmental protection program requirements, authorities, and responsibilities for [DOE] operations for assuring compliance with applicable Federal, State, and local environmental protection laws and regulations, Executive orders, and internal Department policies. The Order more specifically defines environmental protection requirements that are generally established in DOE 5480.1B."

[518] ETEC Document, GEN-ZR-0007, "Radiological Survey of Shipping /Receiving and Old Accelerator Area-Buildings T641 and T030," August 19, 1988.

- ORISE conducted an independent verification survey for Building 4030/4035 in 1995. Surface scans for alpha, beta and gamma activity and single-point direct measurements for total alpha and total beta activity were performed on floors, walls, equipment and outside soil. These levels were compared to the guidelines specified in DOE 5400.1 as presented in the table above. Total alpha surface activity was found to be less than 55 dpm/100 cm^2, while total beta surface activity was found to be less than 1,400 dpm/100 cm^2. One sample of total tritium activity exceeded the average guideline for beta-gamma emitters (6,600 dpm/100 cm^2), and ORISE recommended additional sampling be performed in this area.[519]

- In 1996, Rocketdyne performed a Final Comprehensive Radiological Survey designed to measure total or removable surface activity and provide additional sampling for tritium activity in the accelerator area. Walls, floors and ceilings were surveyed for total and removable alpha and beta activity and maximum alpha and beta activity. Floors were surveyed for ambient gamma readings in μR/hr at 1 meter. The total alpha and beta limits were both 5,000 dpm/100 cm^2. The removable alpha and beta limits were both 1,000 dpm/100 cm^2. The removable tritium limit was 10,000 dpm/100 cm^2, and the ambient gamma limit was less than 5.0 μR/hr at 1 meter from surface. All survey results were below the 1996 acceptable limits.[520]

- DHS performed verification sampling in 1996 and 1998 to support concurrence of release for unrestricted use. According to a March 1996 letter, the release of Building 4030/4035 by DHS was put on hold as a result of DOE's recommendation that Rocketdyne resurvey the building.[521]

- In November 1997, Rocketdyne reported the decontamination and decommissioning activities at Buildings 4030 and 4641 in a single report. The report provides a summary of previous survey and decommissioning activities. According to the report, the Van de Graaf Accelerator was removed from Building 4030 in 1966. In 1996, Rocketdyne removed approximately 2,311 square feet of asbestos floor tile that was disposed of as non-radioactive hazardous waste. The document does not provide information regarding the final removal of Building 4030.[522]

- In March 2007, Cabrera Services completed the results of a final status survey on post-HSA sites, including Building 4030/4035. The purpose of the survey was to determine final status for areas where radionuclide concentrations were found to be below their respective derived concentration guideline level. The scope of the survey included surface soil to a depth of 0.5 feet below ground surface. Additionally, two subsurface soil samples were collected to support the assumption that contamination was restricted to the first 0.5 feet below ground surface. None of the samples reported radionuclide concentrations above their respective 2007 DCGLs, and, as a result, Cabrera

[519] ORISE Document 96/C-4, "Verification Survey of the Interim Storage Facility; Buildings T030, T641, and T013; an Area Northwest of Buildings T019, T013, T012, and T059; and a Storage Yard West of Buildings T626 and T038, SSFL, Rockwell International, Ventura County, California," Vitkus, T. J., and T. L. Bright, February 1996.
[520] Rocketdyne Report, 030-AR-0001, "Final Radiological Survey Report for Building T030," January 22, 1997.
[521] Montes, Michael, Letter Re: Buildings 030, 019, and 654, March 29, 1996.
[522] Rocketdyne Report, 030-AR-0002, "Decontamination and Decommissioning (D&D) of Building T030," November 13, 1997.

recommended Building 4030 for unrestricted release. The DCGLs were derived, radionuclide-specific activity concentrations within a survey unit corresponding to the release criterion and are summarized in the table below.[523]

DCGLs for Radionuclides of Concern

Constituent	Residential Soil Concentration (pCi/g)	
	Boeing DCGL [1]	EPA PRG 10-4 Risk Level [2]
Americium-241	**5.44** [3]	187
Cobalt-60	**1.94**	4
Cesium-134	**3.33**	16
Cesium-137	9.2	**6**
Europium-152	4.5	**4**
Europium-154	**4.1**	5
Tritium	31,900	**228**
Manganese-54	**6.1**	69
Plutonium-238	**37.2**	297
Plutonium-239	**33.9**	259
Plutonium-240	**33.9**	-
Plutonium-241	**230**	40,600
Strontium-90	36	**23**
Thorium-228	**5**	15
Thorium-232	**5**	**5**
Uranium-234	**30**	401
Uranium-235	30	**20**
Uranium-238	**35**	74

[1] Boeing, Approved Sitewide Release Criteria for Remediation of Radiological Facilities at the SSFL, 1998

[2] Source: Based on EPA preliminary remediation guides (PRGs) for residential soil at a 10-4 risk level. OSWER 9355.01-83A. "Distribution of OSWER Radionuclide Preliminary Remediation Goals (PRGs) Superfund Electronic Calculator." February 7, 2002. http://epa-prgs.ornl.gov/radionuclides. Data retrieved October 26, 2006.

[3] More restrictive standard for each constituent is bolded and shaded.

Radiological Use Authorizations: The research team has not located any use authorizations for the use of radiological materials at the building.[524]

Former Radiological Burial or Disposal Locations: None found.

Aerial Photographs: In 1957, the future location of Building 4030 is being developed. There is evidence of fill being placed in the surrounding area. By 1959, the building is visible and in 1962 the building has been expanded to include the Building 4035 portion of the building. A parking lot is present south of the building in 1959 and 1962 where Building 4641 will eventually be constructed. In 2005 the building is no longer present. The aerial photograph

[523] Cabrera Services, Inc., *Final Status Survey Report: Final Status Survey Post Historical Site Assessment Sites, Block 1*, March 2007.

[524] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005.

interpretation indicated that outdoor storage and possible stains were visible in 2002 and ground scarring and dark-toned material were visible in 2003.[525]

Radionuclides of Concern: Regulated radiological materials were managed at Building 4030.[526] The van de Graaf accelerator produced neutrons by the $H^3(p,n)He^3$ nuclear reaction. The potential contaminant of concern is tritium. Activation of building materials was negligible because drums of borated water were used around the target to thermalize and capture neutrons.[527] All radionuclides of concern listed are included in the August 2009 Final Field Sampling Plan for the Santa Susana Field Laboratory radiological background study. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: As indicated above, the building had an associated leach field that was likely used until 1961 to 1962, when the building was connected to the newly-built Area III site-wide sewage system.[528] The associated leach field was not located during decontamination and demolition. During the October 2003 RCRA Facility Investigation Report on Area IV leach field sites, the Building 4030 leach field is identified as comprising approximately 90 total linear feet, receiving flow from a 1,000-gallon septic tank. On a facility map, the leach field was located approximately 300 feet southwest of Building 4030; however, the existence of the leach field could not be confirmed during the RFI.[529] In 1995, disturbed ground is visible south-southwest of Building 4641 along 11th Street at the presumed location of the leach field. The disturbed ground is vegetated by 2005.

Otherwise drainage at the site is to the south on the west side of the building and to the northeast on the east side of the building.[530]

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4030 area is Class 1 based on previous site activities.

Recommended Locations for Soil/Sediment Sampling: Plate 1 and Figure 2.2 provide a convenient reference for the following recommendations.
Due to the possible storage of drums containing mixed fission products, tritium contamination, and the building's operations, additional characterization is recommended for the Building 4030/4035 area. This includes the following Building 4030/4035 areas:

- Outdoor storage and possible stains were visible in 2002 aerial photographs and ground scarring and dark-toned material were visible in 2003. It is recommended these locations

[525] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[526] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 - Area IV Site Summaries*, May 2005.
[527] ETEC Document, GEN-ZR-0007, "Radiological Survey of Shipping /Receiving and Old Accelerator Area-Buildings T641 and T030," August 19, 1988.
[528] The May 2005 HSA lists the following document as the source document for the information regarding the leachefield; however, HGL was unable to locate this information within this document: ORISE Document 96/C-4, "Verification Survey of the Interim Storage Facility; Buildings T030, T641, and T013; an Area Northwest of Buildings T019, T013, T012, and T059; and a Storage Yard West of Buildings T626 and T038, SSFL, Rockwell International, Ventura County, California," Vitkus, T. J., and T. L. Bright, February 1996.
[529] MWH, *DOE Leach Fields (Area IV AOC) RCRA Facility Investigation Report, Santa Susana Field Laboratory, Ventura County, California*, October 2003.
[530] Atomics International, Santa Susana Facility Plot Plan, Drawing 303-GEN-C38, Sheet 4 of 14, June 4, 1964.

be sampled due to the unknown nature of the storage activities. Residual contamination bay be above background values in this area as a result of storage activities.

- The possible leach field for Building 4030 should be further researched and evaluated for possible sampling. To date, historical documents for Building 4030 do not provide information on the leach field location. The possible location of the leach field should be investigated further through geophysical techniques and targeted sampling strategy.

- The drainage area on the east and west sides of the building should be evaluated. If radiological materials were released into the environment, residual contamination may be above background values in the area.

- The location of the former concrete shield wall on the north side of the building should be evaluated by sampling to ensure that no radioactivity from operations remain at the former shield wall.

- The sanitary sewer lines located along the western side of the Building 4030. If radioactive materials were released into the sanitary sewer system, residual contamination may exist in the materials surrounding the sewer lines.

- The Building 4030/4035 footprint, specifically the former location of the accelerator should be evaluated as a result of the elevated levels of tritium contamination in relation to the operation of the accelerator. Based on the operations in this area of the building, residual contamination above background values may be present in this area.

2.3.2 Building 4046 Area

Note: To date, the research team has been unable to locate documents relating to the construction and operation of Building 4046.

Site Description: The Building 4046 area includes Building 4046 and the surrounding area, excluding Buildings 4030/4035 and 4641. Building 4046 was located west of Building 4030/4035 (discussed above) and northwest of Building 4641 (discussed below). A sidewalk joined Building 4046 to Building 4453, a fuel handling facility. [531] Figures 2.3.2a provides a current photograph of the former Building 4046 location. Plate 1 presents a summary of all identified features for this site.

Building Features: No information was located.

Former Use(s): Building 4046 was constructed in approximately 1977 and, reportedly, did not handle radiological materials.[532] The building is identified in industrial planning maps as a material office annex owned by Rockwell International; however, additional information regarding the building operations could not be located. [533]

[531] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[532] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries,* May 2005.
[533] SSFL Area IV, ETEC Industrial Planning Maps, 1962-1992.

Information from Interviewees: None to date.

Radiological Incident Reports: There have been no incidents identified associated with operations at Building 4046.

Current Use: Building 4046 appears to have been demolished prior to 1980.[534] Based on available information, the dimensions of the excavation made during building demolition are unknown.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): There have been no radiological surveys specific to Building 4046 conducted to date; however, radiological investigations have occurred at and surrounding Buildings 4030/4035 and 4641.

Radiological Use Authorizations: None.

Former Radiological Burial or Disposal Locations: None found.

Aerial Photographs: The area that includes and surrounds Building 4046 is vegetated in most of the aerial photographs. The building appears in the 1978 aerial photographs and by 1980 has been removed and the area is partially re-vegetated.[535]

Radionuclides of Concern: None found.

Drainage Pathways: No drainage pathways associated with Building 4046 have been located, although, generally, as identified in 1964, the drainage in the vicinity of the future building show the drainage to flow south, southeast.[536]

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4046 area is Class 2 because of the unknown nature of the building's use and operation, as well as the building's proximity to Building 4030/4035 and Building 4641.

Recommended Locations for Soil/Sediment Sampling: Plate 1 and Figure 2.3 provide a convenient reference for the following recommendations.

Due to the limited information available regarding the construction, operation, and demolition of Building 4046, additional characterization is recommended for the Building 4046 area. This includes the footprint of Building 4046, as well as the areas south-southeast of the building to coincide with the approximate drainage from Building 4030/4035 prior to Building 4046 being constructed.

2.3.3 Building 4641 Area

Site Description: The Building 4641 area is located south of Building 4030/4035 and comprises Building 4641 and the surrounding area. Building 4641 was constructed in 1964 as a shipping and receiving facility. A fenced area between Buildings 4030/4035 and 4641 was used as a

[534] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[535] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[536] Atomics International, Santa Susana Facility Plot Plan, Drawing 303-GEN-C38, Sheet 4 of 14, June 4, 1964.

palletized material holding area. South and west of the building are outcroppings of Chatsworth sandstone formation.[537] Building 4030/4035 located north of Building 4641 originally served as the AE-6 counting room and workshop, and was discussed previously. Building 4046 was located at the northwest corner of Building 4641 for a short period of time in the late 1970s and is discussed above, also. No as-built drawings depicting the building floor plan were located for Building 4641. Figures 2.3.3a through 2.3.3d provide a current photograph and the best available building-specific drawing(s) that the research team could find. Plate 1 presents a summary of all identified features for this site.

Building Features: Building 4641 was located south of Building 4030. The building had 7,680 square feet of storage space, 240 square feet of office space, and a loading dock for shipping and receiving.[538]

Former Use(s): Building 4641 was constructed in 1964 to be used for shipping and receiving. Building 4641 served as a transfer point for all SSFL incoming and outgoing shipments. Through 1985, this included radioactive materials. Non-radioactive materials were stored in the warehouse. Radioactive and nuclear shipments reportedly were only handled on the outdoor dock; they were never stored in the warehouse. Additionally, the storage area may have been used to store drums containing mixed fission products. Radioactive materials included individual gamma-graphic sources, radioactive laundry and shipping casks. All radioactive materials being shipped or received were always completely containerized and packaged. Containers were not opened in the area of Building 4641. The building had a radiation detector alarm system in the dock, and the alarm system was never triggered.[539]

In 1985, Building 4641 was designated as an on-site, internal moving and transport facility, and radioactive materials handling at the building ceased.[540] According to a 1988 Use Agreement, DOE provided approval to Rockwell's Rocketdyne Division to relocate the SSFL shipping and receiving function to government-owned Buildings 4641 and 4030. The buildings, at the time, were under the cognizance of the DOE. The use agreement appears to have been in effect from April 1, 1988, through September 30, 1988.[541,542] Building 4641 was demolished in 2004.[543]

Information from Interviewees: None to date.

Radiological Incident Reports: There has been one incident associated with Building 4641 that could have resulted in a release to the environment. The following table provides information

[537] ORISE Document 96/C-4, "Verification Survey of the Interim Storage Facility; Buildings T030, T641, and T013; an Area Northwest of Buildings T019, T013, T012, and T059; and a Storage Yard West of Buildings T626 and T038, SSFL, Rockwell International, Ventura County, California," Vitkus, T. J., and T. L. Bright, November 1995.
[538] ORISE Document 96/C-4, "Verification Survey of the Interim Storage Facility; Buildings T030, T641, and T013; an Area Northwest of Buildings T019, T013, T012, and T059; and a Storage Yard West of Buildings T626 and T038, SSFL, Rockwell International, Ventura County, California," Vitkus, T. J., and T. L. Bright, November 1995.
[539] ETEC Document, GEN-ZR-0007, "Radiological Survey of Shipping/Receiving and Old Accelerator Area-Buildings T641 and T030," August 19, 1988.
[540] ETEC Document, GEN-ZR-0007, "Radiological Survey of Shipping/Receiving and Old Accelerator Area-Buildings T641 and T030," August 19, 1988.
[541] Schelin, Earl, Letter Re: Use Agreement for Relocation of Shipping & Receiving to Buildings 641 and 030, March 21, 1988.
[542] Additional information regarding this use agreement could not be located.
[543] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries,* May 2005.

presented in an incidents database provided by Boeing. Summaries of the incident reports are provided following the table, when available.

Building 4641 Incident Report Summary

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A0581	6/20/1989	Building 4641, Traffic SSFL	Be-7	Radioactive material arrived at SSFL Traffic without any labels or control.

- On June 20, 1989, 13 mCi of solid Be-7 arrived at the facility in a box without any labels or controls, in violation of State of California regulations. The incident was summarized as "a loss of control and security required of radioactive materials." There were no releases to the environment as a result of this incident (A0581).[544]

Current Use: Building 4641 was demolished in 2004.[545] According to December 18, 2003, letter from Boeing to the Ventura County Air Pollution Control District, the superstructure, concrete foundation, utilities, and asphalt surrounding the building were removed in accordance with the Ventura County Building Codes. Following demolition, the area was graded for proper drainage and returned to "green field conditions". The letter does not define "green field conditions."[546] Based on available information, the dimensions of the excavation made during building demolition are unknown.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): A chronology of radiological investigations at this building is as follows:

- In 1988, Rocketdyne performed a survey to clarify and identify areas at SSFL requiring further radiological inspection or remediation. The survey treated the building, Building 4030, and the surrounding area as a single sample lot for characterization and interpretation. As a result, the results presented here include data from Building 4030, discussed above. For the purposes of the survey, ETEC personnel superimposed 6-meter square grids over the terrain and building areas. One ambient gamma exposure rate measurement was made 1 meter from the surface in each 36-square meter area, resulting in approximately 114 measurements being acquired. In addition to the ambient gamma exposure rate measurements, the survey also included beta surveys of the accelerator room and outside paved area (palletized-container storage area). The survey also included surface soil sampling near the west and north sides of Building 4030, but did not include any soil samples near or around Building 4641.

  Radiological contamination quantities were compared against unrestricted-use acceptable contamination prescribed by DOE 5400.1, below.[547]

[544] Rowles, Jim, Internal Letter Re: Radiation Safety Incident Report, SSFL T641, June 20, 1989.
[545] Pomatto, G., Letter Re: Contract DE-AC03-99SF21530 GFY04 Performance Incentive Fee Achievements, November 17, 2004.
[546] Ludwig, Barbara, Letter Re: Demolish Buildings 4487& 4641, December 18, 2003.
[547] DOE 5400.1 is a November 9, 1988, order from the U.S. Department of Energy pertaining to the general environmental protection program. The purpose of the order is to "establish environmental protection program requirements, authorities, and responsibilities for [DOE] operations for assuring compliance with applicable Federal, State, and local environmental protection laws and regulations, Executive orders, and internal Department policies.

Building 4641 1988 Maximum Acceptable Contamination Limits

Criteria	Alpha (dpm/100 cm^2)	Beta (dpm/100 cm^2)
Total Surface, averaged over 1 m^2	5,000	5,000
Maximum Surface, in 1 m^2	15,000	15,000
Removable Surface, over 100 cm^2	1,000	1,000
Ambient Gamma Exposure Rate	5 µR/hr over background	
Soil Activity Concentration	21 pCi/g 31 pCi/g	100 pCi/g
Water Activity Concentration	$1x10^{-4}$ µCi/mL	$1x10^{-5}$ µCi/mL

The average ambient gamma radiation measured for the entire data set of 114 measurements was 12.7 µR/hr with the limit being 5 µR/hr above background. Background was determined to be between 14 and 15.6 µR/hr based on 1988 measurements of the areas surrounding the "Incinerator Road" and the Building 4309 area. There was no detectable activity of beta radiation.

It is important to note that according to the report. Rocketdyne experienced difficulty in assessing the radiological condition of "a clean facility based on an acceptance requirement relative to 'background'". The report indicated a large variabiligy of gamma exposure rated depending on whether measurement were taken indoors, outdoors, or near a large sandstone outcropping. Accounting for the variables and deviations, and subtracting a value that represents "natural" background gamma radiation at SSFL, Rocketdyne determined the area to be clean of any residual radioactive contamination.[548]

- In 1995, ORISE performed an independent verification survey for Building 4641. Surface scans for alpha, beta and gamma activity and single-point direct measurements for total alpha and total beta activities were performed on the loading dock. In addition, 25 single-point direct measurements for total alpha and total beta activity were preformed on floors, walls, equipment, and pavement.

  Surface activity levels were less than 100 dpm/100 cm^2 for total alpha and less than 1,400 dpm/100 cm^2 for total beta on the loading dock. These levels were compared to the guidelines specified in DOE 5400.1 presented in the table above and were considered radiologically clean. Exposure rate measurements were performed at 1 meter above the surface of the loading dock using a proportional ionization counter and ranged from 10 to 12 µR/hr. The background exposure rate was 8 µR/hr. The report summarizing the verification survey results showed that surface activity levels, exposure rates, and/or radionuclide concentration levels in soil were less than the above guidelines for release to unrestricted use.[549]

The Order more specifically defines environmental protection requirements that are generally established in DOE 5480.1B."

[548] ETEC Document, GEN-ZR-0007, "Radiological Survey of Shipping /Receiving and Old Accelerator Area-Buildings T641 and T030," August 19, 1988.

[549] ORISE Document 96/C-4, "Verification Survey of the Interim Storage Facility; Buildings T030, T641, and T013; an Area Northwest of Buildings T019, T013, T012, and T059; and a Storage Yard West of Buildings T626 and T038, SSFL, Rockwell International, Ventura County, California," Vitkus, T. J., and T. L. Bright, November 1995.

Radiological Use Authorizations: The research team did not locate any use authorizations associated with the operations in Building 4641.

Former Radiological Burial or Disposal Locations: No former radiological burial or disposal locations have been identified at or around Building 4641.

Aerial Photographs: In 1957, the Building 4641 area appears to be a fill area and by 1959 the area is a parking area. The parking area remains until sometime between 1962 and 1965 when Building 4641 is constructed. Outside storage begins to appear directly north of Building 4641 in 1967. Between 1972 and 1978, the building was expanded on the south side. A possible stain is visible in August 1986 on the north side of the building. In 1995, disturbed ground is visible south-southwest of the building along 11th Street at the approximate location of the Building 4030/4035 leach field. By 2005 the building has been removed and ground scarring is visible at the former building location. The disturbed ground visible in 1995 is vegetated by 2005.[550]

Radionuclides of Concern: As a result of the limited information regarding the types of radioactive and nuclear shipments handled on the outdoor dock, the research team has been unable to identify a list of radionuclides of concern specific to this building. As a result, it is recommended the building be evaluated for all radionuclides included in the August 2009 Final Field Sampling Plan. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: According to the May 2005 HSA, the Building 4030/4035 leach field was located in the vicinity of Building 4641 from approximately 1961 to 1962. However, attempts to locate the leach field have been unsuccessful. Drainage surrounding Building 4641 is to the south.

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4641 area is Class 2 based on previous site activities on the outdoor dock and the storage activities surrounding the building.

Recommended Locations for Soil/Sediment Sampling: Plate 1 and Figure 2.3 provide a convenient reference for the following recommendations.

Due to the use of the building as a shipping and receiving building, including radioactive material, additional characterization is recommended for the Building 4641 area. This includes the following Building 4641 areas:

- Outdoor storage directly north of Building 4641 and possible stains were visible in 1967 and 1986 aerial photographs. It is recommended these locations be sampled due to the unknown nature of the storage activities and the possibility that radioactive materials may have been stored in this location, resulting in the possibility that radionuclide concentrations in the soil will exceed background values .

- The former location of the outdoor dock should be evaluated as this is reported to have been the area of the building where radioactive materials were received.

[550] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.

2.4 GROUP 4

The Group 4 index map is presented in Figure 2.4. Following Figure 2.4, the site photograph and layout drawings for each building area within HSA-5A Group 4 are presented. HSA-5A Group 4 includes seven building areas including Building 4005 and Building 4042.

2.4.1 Building 4005 Area

Site Description: The Building 4005 area comprises Building 4005, substation Building 4705, two holding tanks and drain lines, and the land surrounding these two buildings located south of B Street and northeast of 17th Street. These buildings were located outside the boundaries of the U.S. Government-optioned land at the SSFL Site.[551] Building 4005 was constructed in 1958 for non-nuclear testing of thermodynamic characteristics of proposed coolants for the Organic Moderated Reactor Experiment and Piqua reactors.[552] Figures 2.4.1a through 2.4.1e provide a current photograph and the best available building-specific drawing(s) that the research team could find. Plate 1 presents a summary of all identified features for this site.

Building Features: Building 4005 was a tilt-up concrete structure with Butler aluminum siding and several windows. The structure was 80 feet long (running northwest to southeast) and 60 feet wide.[553] The building also included "a number of concrete pads" on the east end of the building that held equipment used in the Molten Salt Oxidation Project and filter plenums from the fuel fabrication project.[554] An underground storage tank installed in 1961 was located immediately southwest of Building 4005 for the storage of fuel oil to operate power generators during natural gas curtailment. The tank was excavated and removed on August 31, 1987.[555]

Building 4005 was divided into several portions, including a small administration area, change rooms, chemistry laboratories, storage rooms and a large high-bay area. Several concrete pads sat east of the building and held various equipments from the Molten Salt Oxidation project and the radioactive filter plenums. Building 4005 was connected to two underground radioactive liquid holding tanks by drain lines. The tanks were located approximately 60 feet northeast of the building. The drain lines extended from various laboratories and work areas within Building 4005 and were made of cast iron. The pipe joints and fittings were connected and sealed with oakum and lead. Portions of the exterior drain lines were located under two major equipment installations that included a large tank and support structure and a free-standing bag-house structure.[556,557]

Former Use(s): Building 4005, a "company-owned" facility used for Government programs, was constructed in 1958 for non-nuclear testing of thermodynamic characteristics of proposed

[551] Rutherford, P.D., *Exemption from Decommissioning Docket Process, Rocketdyne Building T005*, July 24, 1996
[552] Rockwell International, *Decontamination and Decommissioning (D&D) of the Uranium Carbide Fuel Facility - Building T005*, 005-AN-002, September 28, 1993.
[553] Rocketdyne, *Final Radiological Survey of Building 005*, 005-ZR-0001, September 21, 1993.
[554] ORISE, *Verification Survey of Buildings 005, 023, and 064, Santa Susana Field Laboratory, Rockwell International, Ventura County, California*, 94/K-14, October 1994.
[555] Groundwater Resources Consultants, Inc., *Preliminary Site Assessment Work Plan, Tank 1, Building 005*, September 25, 1990. p. 2
[556] Rocketdyne, *Final Radiological Survey of Building 005*, 005-ZR-0001, September 21, 1993.
[557] Rockwell International, *Decontamination and Decommissioning (D&D) of the Uranium Carbide Fuel Facility – Building T005*, 005-AN-002, September 28, 1993. p. 23

coolants for the Organic Moderated Reactor Experiment and Piqua reactors. During the middle 1960s, Building 4005 was converted into a small-scale production facility, the Uranium Carbide Fuel facility, to study the operations associated with manufacturing reactor fuel assemblies out of uranium carbide for the Atomic Energy Commission (AEC) Heavy-Water Organic-Cooled Reactor.[558,559] The work was performed under the authority of the AEC's Chicago Operations Office, whose policy at the time exempted the operations in Building 4005 from licensure. In the pilot plant, uranium oxide was reacted with graphite to convert it to uranium carbide. The uranium carbide was cast into pellets, machined, and assembled into cladding tubes to make fuel assemblies. During this time approximately 700 UCx cylinders, 0.25 inches in diameter and 3 inches lone were fabricated. Highly enriched uranium (93.1 % by weight) metal was homogenized with 4.9 % by weight enriched uranium by induction melting and casting to produce 12.7 % by weight enriched uranium slugs. The uranium slugs were then synthesized by reacting uranium metal with graphite in an arc furnace. The cast slugs were then machined into cylinders. The facility operated for a period of nine months during 1966 and1967, first using depleted uranium, and later enriched uranium and was a radiological controlled access area. In 1967, equipment was removed and surfaces decontaminated to permit non-radiological use of the building.[560,561,562]

Beginning in 1972, Building 4005 was used as the Molten Salt Test Facility, a non-nuclear test facility consisting of the Molten Salt Test Bed and the Process Demonstration Unit (PDU).[563] The molten salt test facility, according to a 1992 environmental monitoring program plan, was a general purpose molten salt combustion pilot plant constructed in 1973 in Building 4005 to permit investigation of new processes using engineering scale equipment. Tests were completed at the facility in July 1986. During the facility's use, approximately 25 test campaigns were conducted for a total of approximately 1,000 hours of operation. Testing was completed under contract to the DOE, the EPA, and the Department of the Navy, in addition to Rockwell-funded independent research and development projects.[564]

According to the 1992 environmental monitoring program plan, the molten salt gasification plant (or the PDU) was designed and operated by Rockwell for DOE to demonstrate the technical feasibility of producing sulfur-free, low-Btu product gas by partial combustion of Illinois No. 6 coal in a sparged bed of molten, sodium carbonate salt. "Make-up salt," together with coal, was continuously fed to a refractory lined combustion vessel, and a small streat of the molten salt bed was continuously removed and water quenched to control the concentration of absorbed sulfur

[558] It is important to note that the 1988 "Executive Summary of the DOE SSFL Site Radiological Survey" by Rocketdyne indicates the uranium carbide fuel fabrication facility operated in Building 4005 from the late 1950s to 1969. Historical documents of the building's use during this time period could not be located to verify the dates of operation.

[559] Rockwell International, *Environment, Safety, and Health Long Range Plan II*, N001PMP000008, September 13, 1988.

[560] Rockwell International, *Decontamination and Decommissioning of the Uranium Carbide Fuel Facility – Building T005*, 005-AN-002, September 28, 1993.

[561] Rocketdyne, *Final Radiological Survey of Building 005*, 005-ZR-0001, September 21, 1993.

[562] Rockwell International, *Nuclear Operations at Rockwell's Santa Susana Field Laboratory – A Factual Perspective*, N001ER000017, December 20, 1989, p. 19

[563] Rockwell International, *Decontamination and Decommissioning of the Uranium Carbide Fuel Facility Building T005*, 005-AN-002, September 28, 1993.

[564] Rockwell International, *Environmental Monitoring Program Plan, Santa Susana Field Laboratory, Area IV*, ER-AN-0006, September 30, 1992.

and ash. The product gas was ducted out of the vessel to an aqueous particulate scrubber/cooler and then burned in a waste gas incinerator.

The quenched salt, which contained sulfur and ash from the coal, formed a "green liquor" similar to that formed in a Kraft paper mill. This liquor (2 to 3 gallon per minute stream) was filtered and processed to regenerate sodium carbonate for recycle to the gasifier. According to 1992 plan, these operations were first started in November 1978 and operated for a total of nine test runs until final shutdown in June 1981. The total operating time was approximately 1,500 hours at an average coal feed rate of 0.25 tons per hour. Following testing, the aqueous plant equipment was flushed with clean water to remove "green liquor" and salt residues. All bulk quantities of sodium carbonate and coal were disposed of off-site; however, the document does not indicate where. In 1991, an unidentified commercial demolition company completed disposal of all plant equipment and foundations and returned the site to its "original" condition.[565] This occupied a few offices, while the remaining offices served as storage and tool cribs.[566]

In addition to the above, in 1982, Building 4005 also contained a low NOx-SOx burner at the north edge of the building to determine the possibility of burning high-sulfur coal with reduced emissions of NOx and sulfur dioxide. Rockwell operated the unit intermittently until 1988 with a total of 48 test runs completed between 1982 and 1988. According to the 1992 environmental monitoring program plan, the "site" had been partially remediated by removing bulk quantities of coal and fly ash.[567]

According to a 1988 long range plan, Building 4005 had been "partly decontaminated" to permit restricted use. The plan stated that additional decontamination was required for unrestricted use. This decontamination included the removal of the contaminated exhaust system and liquid radioactive waste tank.[568] In 1993, according to project progress reports, Rockwell International completed the removal of the Building 4005 filter plenum and exhaust ducting. The material was size-reduced for packaging and shipment.[569]

Information from Interviewees: A number of interviewees were knowledgeable about operations at Building 4005. Interviewee 254 worked in Building 4005 doing heat transfer studies with loops. The following provides excerpts from the Interviewee 254 interview:

> I first handled radioactive material in about 1965 when I worked in Building 5. We had been doing heat transfer studies with loops using non-radioactive materials. Then we received radiologically-contaminated organic material for use in our loops in Building 5. That was my first encounter with radioactive materials...

[565] Rockwell International, *Environmental Monitoring Program Plan, Santa Susana Field Laboratory, Area IV*, ER-AN-0006, September 30, 1992.
[566] ETEC, *Radiological Survey of Building T005*, GEN-ZR-0003, November 16, 1987. p. 9
[567] Rockwell International, *Environmental Monitoring Program Plan, Santa Susana Field Laboratory, Area IV*, ER-AN-0006, September 30, 1992.
[568] Rockwell International, *Environment, Safety, and Health Long Range Plan II*, N001PMP000008, September 13, 1988.
[569] Gaylord, G., Energy Technology Engineering Center Project Progress Report, Accounting Period For First Quarter FY93, January 26, 1993.

> ...When I first started working with radiological material in Building 5 we had safety procedures to follow... You had to clean the area when you were done and put radioactive waste in RA (radioactive) disposal containers...
>
> ...The level of radiation was so low in Building 5 that time limits for exposure were not in place yet. Most of the contamination in Building 5 was alpha contamination so it wouldn't penetrate very far.

Interviewee 255 worked for Atomics International from 1967 to 1985 as an atomic reactor inspector and certified x-ray technician. According to Interviewee 255:

> I worked in Building 4005 and we made fuel rods for a reactor. That building has been cleaned up and used for other purposes since then. I don't think there were any problems in Building 4005. We didn't manufacture a lot of fuel up there...
>
> ... When we were manufacturing fuel in Building 4005, there were two or three times we had to evacuate the building because some of the monitor alarms went off...
>
> ... As far as specific radionuclide sources, we built uranium fuel rods in Building 4005 for an offsite reactor. The building was cleaned up completely and used for other tests afterward, but I wasn't involved then because I had moved to ETEC/LMEC.

Later, when the focus of Building 4005 operations shifted to coal gasification, Interviewee 78 provided the following information:

> Building 5 had a coal gasification system that we ran around the clock. Coal was converted to a low butane gas by putting the coal in a vessel of molten salt. One day the molten salt vessel blew up. The vessel was under pressure and a 36-inch blind flange malfunctioned. Molten salt was spewing all over the place and going into the drainage system... after the explosion following the flange blow out, nasty crap was coming out of there and running into the street in front of the building. We were putting sand bags out to keep it on the street. The stuff eventually froze up again. We got it shut down.

Interviewee 277 appears to describe a similar incident in his description of the operations at Building 4005 and the PDU as follows:

> At Building 5 there was the Molten Salt Test Facility (MSTF), I think but I'm not sure, and the Process Demonstration Unit (PDU). I worked at both. The PDU was built and we had 20-25 mechanics there who were getting the unit ready to function. The unit was built by an outside contractor and we did testing and checked everything out. I worked with Kentucky coal and Pennsylvania coal and worked with coke which was a more refined coal – it was very fine and air bubbles would come out of it like a volcano. The vessels ran at 1900 degrees and were lined with ceramic bricks at the bottom and the coal bed was like lava. When cooled there was a by-product we called "green liquor" that would eat the leather off of your boots. If you got it on your hands it would start to burn and you would have to wash it off.
>
> There was a spill of the green liquor that when down the 17th Street drainage. I was working off site back east deconning at the Frankfurt Arsenal when I was asked to come back to help with the green liquor spill. The cause of the spill was that the pumps weren't working and the stuff overflowed into Silvernale pond. It turns out that one of the

> technicians was smoking cigars with plastic tips and throwing the butts into the area that was being pumped out and these plastic cigar tips jammed up in the pumps.

Interviewee 411 began working at the SSFL property in 1985 and indicated the use of Building 4005 as possible storage of radioactive materials, as indicated below; however, information stating such storage activities in Building 4005 could not be located in available historical documents.

> I was responsible for overseeing shipment of radiological materials off the mountain. I didn't actually have anything to do with how radiological materials were handled, we just managed the paperwork for the shipments. We had to check their radiological readings before we put them on a truck for transport. We made sure they met the requirements for acceptable levels of radiation. I made the arrangements for all the shipments and thus I knew where everything that was shipped was going. All radioactive materials that were shipped were shipped off-site; nothing stayed at the SSFL. There were some materials that we stored temporarily until there was a sufficient quantity to ship - I think the building we used for that was Building 5 - where we stored things until we had enough to ship. I really can't remember. Everything was stored inside a building.

Radiological Incident Reports: There have been several incidents associated with Building 4005 that could have resulted in a release to the environment. The following table provides information presented in an incidents database provided by Boeing. Summaries of the incident reports are provided following the table, when available.

Building 4005 Incident Report Summary

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A0494	12/17/1959	Low bay	Not applicable	Employee did not wear prescribed protective clothing in a controlled area.
A0473	6/3/1960	High bay	S-35	HBR and kerosene caught fire.
A0430	8/15/1960	HBR Low Bay	Not applicable	Hot OMRE coolant spilled in hood burning employee.
A0603*	12/31/1966	UC Conv. Room	Uranium Carbide	Failed coolant line in UC conversion room.
A0606	1/30/1967	Building 5 Pad	Uranium Carbide	Fire in roto cone duct work on service pad.
A0605	2/13/1967	Room 115	Uranium Carbide	Fire reported in duct between "Queen City" and scrubber.
A0649	7/8/1967	UCPFF	Uranium	A small fire occurred in the large particle collection tank.
A0215	8/8/1991	North Pad	Depleted Uranium	Contaminated oil dripped from radioactive exhaust duct to pad.

*Incident file name A0603 does not appear to be an incident report. Rather, the document is an internal letter dated January 5, 1967, with the subject "Radiation Safety Unit Weekly Highlights for Week Ending December 31, 1966." A portion of this letter has been redacted and it is possible the referenced incident description has been redacted and, as a result, cannot be summarized.

- On December 17, 1959, an employee was observed working the South Low Bay lab of Building 4005 without a "red line" lab coat or film badge in two separate instances (A0494).[570]

- On June 3, 1960, while high boiler residue was being drained from the impurities loop system, a fire broke out within its enclosure. The incident report indicated the fire occurred in the north high bay of the building. Smears of the outside surfaces of the enclosure and nose swipes at the time of the incident determined no detectable contamination. On June 6, 1960, the Building 4005 Health Physicist surveyed the entire area and found contamination of 80 dpm/100 cm^2 inside the enclosure on burned areas. According to the report, the highest radiation intensity, also on the burned areas, was approximately 0.9 mR/hr. The nature and quantity of the material could not be deciphered from the scanned document (? Gallons of 30% high boiler residue containing mainly S-35 and C-14?) (A0473).[571]

- On August 15, 1960, an employee was filtering treated "OMRE" coolant in a hood in the south low bay of Building 4005. The employee used a vacuum procedure in an attempt to improve the filtration. During this procedure, some of the liquid spilled onto the protective cotton gloves, seared through the gloved, and caused a second degree burn. The incident report stated that no contamination was detected on the skin (A0430).[572]

- On January 30, 1967, a uranium fire occurred in a retention tank of a vacuum system. Tank ducting was burned through, allowing a release of contaminated smoke to the building. According to the radiation safety unit weekly newsletter summarizing the incident, no large-scale dispersal of contamination and no personnel exposure occurred as a result of the fire. Samples of the residue removed from the tanks following the fire were submitted for analysis; however, the results of this analysis was not provided in the documentation relating to this incident (A0606).[573]

- A February 23, 1967, radiation safety unit weekly newsletter stated that on February 13, 1967, a small fire occurred in a metal exhaust duct connecting a grinder with an air scrubber. A small amount of uranium carbide material had collected in an elbow of the duct and was ignited by a hot chip. No unfiltered release occurred, and damage was limited to burning of the paint on the surface of the duct. The newsletter states at the end of the same paragraph that "a total of 700 gallons of radioactive liquid effluent with a concentration of 3.7×10^{-7} uc/cc were released from tank #4 to the surface drain." (A0605)[574]

- According to a radiation safety unit weekly newsletter for the week ending on July 8, 1967, an inspection of Building 4005 resulted in the discovery that an undiscovered fire occurred in the large particle collection tank resulting in the blistering and peeling of the

[570] Atomics International, Notice of [Illegible] Infraction, A0494, December 18, 1959.
[571] Warren, J.W., *A0473, Building 4005 North High Bay*, July 1, 1960.
[572] Warren, J.W., A0430, Radiological Safety Incident Report, Bldg 005 Low Bay, August 15, 1960.
[573]. Unknown, Internal Letter Regarding "Radiation Safety Unit Weekly Newsletter for Period Ending February 4, 1967," February 9, 1967.
[574] Unknown, Internal Letter Regarding "Radiation Safety Unit Weekly Newsletter for Period Ending February 13, 1967," February 23, 1967.

facility vacuum system. The inspection determined that no release to the atmosphere resulted (A0649).[575]

- On August 8, 1991, personnel conducting a facility surveillance inspection observed an oil spill on the concrete pad under the radioactive exhaust duct. The area was surveyed with a GM beta-gamma probe that measured 8,000 dpm/100 cm2 beta-gamma. All removable contamination was bagged and removed from the area. The spill was painted and identified as fixed contamination. The exhaust duct was decontaminated at the suspect area and contained with tape and plastic. A "smear swipe" of the spill was collected and analyzed. Analysis determined that the material was depleted uranium with a total activity of approximately 2nCi ($2x10^{-9}$ Ci). The total activity of the spill was approximately 4 nCi, below the radioactive material labeling limit for natural uranium of 100 µCi (A0215).[576]

Current Use: The research team did not locate specific information regarding the demolition of Building 4005. However, according to the 1997 annual site environmental report, Building 4005 was demolished in 1997.[577] Based on available information, the dimensions of the excavation made during building demolition are unknown.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): A chronology of radiological investigations at this building is as follows:

- As indicated above, following the fuel fabrication program in 1967, the building was decontaminated to permit non-radiological use of Building 4005. According to Report 005-AN-0002, all associated project equipment was removed from the building. The wall between rooms 105 and 112 was removed to allow use of the high bay for storage and "other appropriate activities." The floor tile, wall baseboards and coving were removed from Rooms 105, 112, 116, 111, 111A, 115, and 108, and radioactive material exhaust outlets were cut and capped. Additionally, "some" of the radioactive liquid drain lines were removed. Surveys conducted on the underlying floor and exhaust ducts ensured no contamination remained, and ensured no loose contamination spread to surrounding areas. During the late 1970s, both underground radioactive liquid holdup tanks were removed and disposed as low-level radioactive waste. The excavated areas were backfilled and resurfaced with asphalt paving. The radioactive liquid drain lines from the building to the holdup tanks were capped and left in place.[578]

- Additional decontamination activities occurred in 1987 at Building 4005 and included the decontamination of Rooms 108 and 106, decontamination of the walls and floors of Rooms 115, 107, 111, 110, 116, 110A, and the hallways, removal of four radioactive-contaminated exhaust ventilation drops, and removal of radioactive drain lines in the floors of Rooms 107, 111, 110, 108, 116, 115, 110A, and hallways. Decontamination

[575] Alexander, R.E., Internal Letter Regarding "Radiation Safety Unit Weekly Newsletter for Period Ending July 8, 1967," July 13, 1967.
[576] Wallace, J.H., Radiological Safety Report A0215, August 12, 1991.
[577] Rocketdyne Division, *Rocketdyne Propulsion and Power DOE Operations Annual Site Environmental Report 1997*, A4CM-ZR-0012, November 1998. p.44
[578] Rockwell International, *Decontamination and Decommissioning (D&D) of the Uranium Carbide Fuel Facility - Building T005*, 005-AN-002, September 28, 1993.

efforts were to also include the removal of the radioactive exhaust ducting, radioactive filter plenums, and the underground radioactive liquid drain lines located outside the building; however, these tasks were not completed at the time. The decontaminated areas were surveyed and the results of this survey are presented below.[579]

- In 1987, Rocketdyne performed a characterization survey to confirm that residual contamination remained in ventilation systems and drain lines. The survey showed that several areas were contaminated at levels above 1987 DOE release limits: room 113, room 110E, four remaining radioactive exhaust ducts and both radioactive exhaust filter plenums. The maximum beta level detected in the rooms was 107.954 dpm/100 cm^2 (acceptable limit 1,000 dpm/100 cm^2), while the maximum alpha level detected was 2.467 dpm/100 cm^2 (acceptable limit 1,000 dpm/100 cm^2). The maximum beta level in the exhaust ducts measured 6.302 dpm/100 cm^2. Additionally, a radiation survey of the outside concrete equipment pads and the gutter leading from Building 4005 to south of G Street were also surveyed and were found to be "free of radioactive material contamination."[580]

- Prior to decontamination and decommissioning activities, Rocketdyne performed surveillance and maintenance activities at Building 4005. In April 1991, during surveillance, it was determined that Building 4005 required a number of repairs to maintain exhaust ducting containment. According to the April 1991 progress report, the doors and other openings into the large and the small filter plenums were sealed with a silicon caulking sealant. Original makeup air penetrations into the deactivated exhaust system were sealed off using sheet metal coverings, and the roof of the large filter plenum was cleaned of accumulated debris. The progress report did not provide any information regarding survey results at Building 4005.[581]

  As documented in an August 1991 project progress report, during routine inspection of the Building 4005 contaminated ventilation system in August 1991, personnel noticed a substance leaking from what appeared to be a "pinhole in a section of ducting." the substance was surveyed and found to be radioactively contaminated. The material was cleaned up, the leak sealed, and an occurrence report was issued.[582] The progress report does not provide any details to indicate the volume of material removed, the activity of the material, or the disposal of the material.

- In 1993, Rocketdyne conducted additional decontamination activities to release the building and surrounding grounds for unrestricted use. This included the removal and disposal of radioactive-contaminated exhaust ducting, radioactive exhaust filter plenums and previously left in place underground radioactive liquid waste drain lines at the northeast corner of the building. Surveys were conducted and documented to ensure "all detectable [radioactive] materials contamination above background levels were removed

[579] Rockwell International, *Decontamination and Decommissioning (D&D) of the Uranium Carbide Fuel Facility – Building T005*, 005-AN-002, September 28, 1993. p. 8
[580] ETEC, *Radiological Survey of Building T005*, GEN-ZR-0003, November 16, 1987.
[581] Gaylord, G., Energy Technology Engineering Center, Project Progress Report, Accounting Period for April 1991, April 1991.
[582] Gaylord, G., Energy Technology Engineering Center, Project Progress Report, Accounting Period for August 1991, August 1991.

from the facility site." The report did not provide the background levels used; however, they were likely the same as those presented in the table below. The radioactive-contaminated waste generated during removal was packaged and disposed of as low level radioactive waste at the Hanford Disposal Site in Hanford, Washington. A summary of the exterior radioactive drain line removal project is provided below:[583]

- According to Report 005-AN-0002, the remaining exterior underground radioactive liquid waste drain lines were located off the northwest corner of Building 4005. Extending approximately 60 feet from various laboratories and work areas within Building 4005 to the two previously removed holding tanks, the drain lines comprised three 2-inch, one 3-inch, and two 4-inch diameter lines. The drain lines were approximately 40 feet in length. As indicated above, two major equipment installations were located above the drain lines. The bag house structure was lifted and relocated and the tank and support structure were left in place.

  Personnel removed the surface concrete and asphalt paving above the drains lines with saws, jack hammers, bob cat ram, and backhoe. Removed concrete, asphalt paving and soil were surveyed for radioactivity and hazardous materials and were found to be free of "hazardous materials." The report does not specify if the removed material was also found to be free of radioactivity. The drain line pipe sections were removed from the excavations and placed in a Radioactive Material Management Area (RMMA) where the pipe joints were separated and the lead seals were removed.[584] Approximately 80 pounds of lead seals were found to be free of radioactivity and were packaged and processed from the RMMA. The drain pipe was reduced in size by an unknown method, surveyed and packaged for disposal as low level radioactive waste. According to the report, "a few sections of drain pipe were embedded in concrete support foundations. In these instances, the drain pipe interiors were surveyed, found to be free of [radioactivity] or hazardous materials contamination and the pipe left embedded in the concrete."

  In addition to the above, soil samples were taken from the bottom areas of the excavations for testing. The area adjacent to the wall of the "underground pit that contained the two holdup tanks previously removed" was also excavated deeper to expose soil near the base of the pit. Samples taken here were analyzed to confirm no contamination resulting from the removal of the tanks. Analysis found no radioactivity or hazardous materials contamination. The excavations were then backfilled and paved with concrete.[585]

- Report 005-ZR-0001 reported the calculated radioactive waste shipped from the building's final D&D procedures to be Th-231 (0.053 mCi), U-235 (0.035 mCi), Th-234 (0.108 mCi), Pa-234m (0.108 mCi), U-234 (0.923 mCi), and U-238 (0.108 mCi). This

[583] Rockwell International, *Decontamination and Decommissioning (D&D) of the Uranium Carbide Fuel Facility – Building T005*, 005-AN-002, September 28, 1993. p. 9
[584] The report did not provide the location of the radioactive material management area used for these removed materials.
[585] Rockwell International, *Decontamination and Decommissioning (D&D) of the Uranium Carbide Fuel Facility – Building T005*, 005-AN-002, September 28, 1993. p. 23-24

waste included interior and exterior radioactive ducting, two radioactive filter plenums, and the remaining exterior radioactive drain lines.[586]

- Rocketdyne performed a final survey in September 1993 to demonstrate regulatory compliance for releasing the Buildings 4005, 4009, and its adjacent yards without radiological restrictions. The survey divided the interior and exterior into eight areas or sample lots. Each sample lot was surveyed for total alpha and beta, removable alpha and beta, and ambient gamma exposure. The survey found that Building 4005 and adjacent yards were acceptably free of contamination in 1993 and recommended that the facility be released for unrestricted use. The following table presents the contamination limit criteria for Building 4005 in 1993.[587,588]

Building 4005 1993 Contamination Limit Criteria

Parameter	Limit			
Allowable Total	**Radionuclides**	**Average**	**Maximum**	**Removable**
Residual Surface Contamination for Alpha and Beta (dpm/100 cm^2)	U, U-235, U-238, and associated decay product, alpha emitters	≤5,000	≤15,000	≤1,000
Surface Contamination for Gamma Exposure Rate	≤5 UR/hr above background at 1 meter interior and exterior			
Soil Contamination Limits for Uranium	U-234 <23.17 pCi/g U-235 <5.54 pCi/g U-238 < 24.55 pCi/g			
Soil Contamination Limits for Thorium	Th-234 <23.17 pCi/g			

Source: Rocketdyne, *Final Radiological Survey of Building 005*, 005-ZR-0001, September 21, 1993.

- ORISE performed a verification survey in 1994. The ORISE survey included document reviews, visual inspection, and independent measurement and sampling of the interior of the building, as well as exterior areas. Surface activity levels in Building 4005 were compared to the residual uranium radioactive material guidelines specified in DOE Order 5400.5 and were found to meet the DOE 1994 requirements for release to unrestricted use.[589] In October 1994, the radioactive material and management area designation was removed by DOE from Building 4005.[590]

- The California Department of Health Services (DHS) Radiologic Health Branch released Building 4005 for unrestricted use on March 22, 1995.[591]

- The 2001 site environmental report indicates five septic tanks and leach fields, located at Buildings 4005, 4011, 4100, 4373, and 4535, were excavated. The report indicates that

[586] Rocketdyne, *Final Radiological Survey of Building 005*, 005-ZR-0001, September 21, 1993. p.16
[587] Rocketdyne, *Final Radiological Survey of Building 005*, 005-ZR-0001, September 21, 1993.
[588] Rocketdyne, *Building 005 Final Survey Procedure*, 005-SP-0001, December 9, 1992.
[589] ORISE, *Verification Survey of Buildings 005, 023, and 064, Santa Susana Field Laboratory, Rockwell International, Ventura County, California*, 94/K-14, October 1994.
[590] Rocketdyne Division, *Annual Site Environmental Report, Santa Susana Field Laboratory and De Soto Sites 1994*, RI/RD95-153, September 1995.
[591] Rocketdyne Division, *Annual Site Environmental Report, Santa Susana Field Laboratory and De Soto Sites 1995*, RI/RD96-140, July 1996. p. 10

soil samples taken at Building 4005 at various stages of the excavation found Eu-152 at maximum concentrations of 2.84 pCi/g; however, it was determined that concentrations were below the site-wide release limit of 4.5 pCi/g for Eu-152.[592]

Radiological Use Authorizations: On April 8, 1976, a Rockwell International internal letter granted approval for the use of radioactive materials under Authorization No. 101 for the use of Mn-54 (with minor associated activation products) in Buildings 4005 and 4006 for the "decontamination of sodium components."[593] On April 8, 1977, Authorization No. 101A renewed Authorization No. 101 until April 8, 1978.[594] The research team did not find any additional information to indicate the authorization was renewed or cancelled after April 8, 1978. The research team has also not located any information regarding the actual use of Mn-54 within Building 4005.

To date, no use authorizations or licenses have been located for the use of U-234, U-235, or U-238 in Building 4005; however, an April 5, 1995, memorandum from the DHS/RHB indicated that Amendment No. 90 to License #0015-70, dated March 22, 1995, specifically released Building 4005.[595] According to 1996 correspondence from Rocketdyne to DOE, the building, while being used to develop fabrication techniques for enriched uranium carbide fuel, was operated by Atomics International as a license-exempt operation under the authority of the AEC Chicago Operations Office.[596]

Former Radiological Burial or Disposal Locations: As indicated above, Building 4005 was connected to two underground radioactive liquid holding tanks by drain lines. The tanks were located approximately 60 feet northeast of the building. The drain lines extended from various laboratories and work areas within Building 4005 and were made of cast iron. The pipe joints and fittings were connected and sealed with oakum and lead. Portions of the exterior drain lines were located under two major equipment installations that included a large tank and support structure and a free-standing bag-house structure.[597,598]

Aerial Photographs: The aerial photographs of the Building 4005 area show the area to be highly industrialized with outside storage and staining visible throughout the building's operation. The March 2010 Environmental Photographic Interpretation Center Draft Report identifies the area, including Building 4005, as solid waste management unit 7.10, the former coal gasification PDU (FCG PDU). The FCG PDU, located on the eastern side of 17th street appears to be a processing area (PA-3) that is active by 1959 and included the addition of buildings by 1965. By 2005, all structures have been removed from this location. The processing area (PA-3) is characterized by the presence of storage tanks, overhead pipelines, a smokestack, open storage areas, stains and ground scars. From 1978 to approximately 1990 a

[592] Boeing, *Site Environmental Report for Calendar Year 2001, DOE Operations at the Boeing Company Rocketdyne Propulsion & Power*, RD02-148, September 2002.
[593] Tuttle, R.J., *Authorization for Use of Radioactive Materials or Radiation Producing Devices, Authorization No. 101*, April 8, 1976.
[594] Tuttle, R.J., *Authorization for Use of Radioactive Materials or Radiation Producing Devices, Authorization No. 101*, April 8, 1976.
[595] Kapel, Ben R., Memorandum regarding Building 4005 and Amendment 90 to License 0015-70, April 5, 1995.
[596] Rutherford, P.D., Exemption from Decommissioning Docket Process, Rocketdyne Building T005, July 24, 1996
[597] Rocketdyne, *Final Radiological Survey of Building 005*, 005-ZR-0001, September 21, 1993.
[598] Rockwell International, *Decontamination and Decommissioning (D&D) of the Uranium Carbide Fuel Facility – Building T005*, 005-AN-002, September 28, 1993. p. 23

probable conveyor connected the processing area to a coal storage area to the south (see Parking Lot 4501). A drainage channel carried runoff from the processing area into impoundment IM-5, located south of the intersection of G and 17th Street in 1965 and 1967.[599]

Radionuclides of Concern: As the Uranium Carbide Fuel facility, Building 4005 was used to react uranium oxide with graphite to convert it to uranium carbide. The uranium carbide was cast into pellets, machined, and assembled into cladding tubes to make fuel assemblies. The facility operated for a period of nine months during 1966 and 1967, using depleted uranium and enriched uranium.[600,601,602] Drain lines, duct work, walls and floor were found to be contaminated with natural and enriched uranium (U-238, U-234, and U-235) and fission products (C-14, Mn-54, S-35, Th-231, Th-234, P-32, Fe-59, and Co-60).[603,604] Protactinium-234m (Pa-234m) is excluded from the list of radionuclides of concern as a result of its short half life of 1.17 minutes. All radionuclides of concern listed are included in the August 2009 Final Field Sampling Plan for the Santa Susana Field Laboratory radiological background study. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Surface drainage is to the southwest of the facility. Building 4005 was surrounded by open-grated catch basins that directed drainage from the building south along 17th Street through an open outfall south of G Street and through a field to "R-2A Pond." A sump located within the building emptied into the same subsurface network of open-grated catch basins. During the 1992 Building 4005 D&D Operations Plan, it was discovered that six underground drain lines ran from the Northeast corner of Building 4005 to a below-grade radioactive holdup tank area. The two tanks "had been previously removed and the area was backfilled with soil."[605]

Also a sump is depicted in 1969 facility drawings just east of the southeast corner of the building.[606] The 1993 final radiological survey of Building 4005 identifies this sump as a cooling tower sump.[607] Additional information regarding this sump could not be located.

Radiological Contamination Potential: Class 1 because of prior history as use as uranium carbide fuel facility, known site contamination, reported incidents, and unknown building demolition operations.

Recommended Locations for Soil/Sediment Sampling: Plate 1 and Figure 2.4 provide a convenient reference for the following recommendations.

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[599] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[600] Rockwell International, *Decontamination and Decommissioning of the Uranium Carbide Fuel Facility Building T005*, 005-AN-002, September 28, 1993.
[601] Rocketdyne, *Final Radiological Survey of Building 005*, 005-ZR-0001, September 21, 1993.
[602] Rockwell International, *Nuclear Operations at Rockwell's Santa Susana Field Laboratory – A Factual Perspective*, N001ER000017, December 20, 1989. p. 19
[603] Rocketdyne, *Final Radiological Survey of Building 005*, 005-ZR-0001, September 21, 1993.
[604] Unknown Author, *Laboratory Status Report, Building 005*, circa 1959, 3 pages.
[605] Rocketdyne, *Final Radiological Survey of Building 005*, 005-ZR-0001, September 21, 1993.
[606] Atomics International, Santa Susana Facility Plot Plan, 303-GEN.-C40, May 1969.
[607] Rocketdyne, *Final Radiological Survey of Building 005*, 005-ZR-0001, September 21, 1993. p.14

Extensive soil sampling is recommended in the Building 4005 area. As discussed above, there were several radiological incidents at Building 4005 and documented evidence of radiological releases. Significant information is lacking regarding the excavation activities at Building 4005. In addition, previous characterization studies for the Building 4005 area were focused on delineating the extent of contamination to standards that were applicable at the time. Therefore, additional characterization is recommended for the Building 4005 area. This includes the following Building 4005 areas and appurtenances:

- Former radioactive gas holdup tank locations exterior and northeast of the Building 4005 footprint. The known radioactive waste holdup tank may have left residual contamination above background values in the area. Additionally, drain lines contained in concrete may still be present at site.[608,609]

- 17th Street drainage channel to G Street located west of former Building 4005 location. If radioactive materials were released from Building 4005 and drained into the drainage channel area, residual contamination above background values may exist to the west of the building.

- The storm drain and former location of the 8-inch surface trough surrounding former building location. If radioactive materials were released into the storm drain and surface trough, residual contamination above background values may exist in the materials surrounding the storm drains.

- Sewer lines located northwest and northeast of the Building 4005 footprint. If radioactive materials were released into the sewer system, residual contamination above background values may exist in the materials surrounding the sewer lines.

- Sump located just east of the southeast corner of the building. Identified as a cooling tower sump, historical information could not be located regarding the sump operations. As a result, it is possible residual contamination above background values may exist at the former sump location.

2.4.2 Building 4042 Area

Site Description: Located along B Street, south of 12th Street and west of G Street, the Building 4042 area includes Building 4042, substation Building 4742, and the surrounding area. Constructed in 1963, Building 4042 was a 4,269-square-foot structure with steel sides and a steel roof.[610,611] Building 4042 is located opposite Buildings 4023 and 4032 along 12th Street. Buildings 4023 and 4032 were discussed above. Figures 2.4.2a through 2.4.2c provide a current photograph and the best available building-specific drawing(s) that the research team could find. Plate 1 presents a summary of all identified features for this site.

[608] Rocketdyne, *Final Radiological Survey of Building 005*, 005-ZR-0001, September 21, 1993.
[609] Rockwell International, *Decontamination and Decommissioning (D&D) of the Uranium Carbide Fuel Facility – Building T005*, 005-AN-002, September 28, 1993. p. 23
[610] ETEC Document, GEN-ZR-0013, "Radiological Survey of Buildings T049, T042, T027, T032, and T025," August 26, 1988.
[611] ETEC, *Site Consolidation Assessment*, April 16, 1987.

Building Features: Limited information regarding the building features of Building 4042 could be located. The building contained 4,117 square feet of laboratory space and had 38-foot ceilings. According to a 1988 plot plan of the building, the building included three trenches. Drainage from these trenches could not be determined.[612] Special features of the building included a lithium hydride casting furnace. The building also had other environmental chambers for testing in inert and vacuum environments. Building 4042 also contained facilities used for the development of an alcohol cleaning process for the removal of sodium from large components.[613]

Former Use(s): Constructed in 1963, Building 4042 is identified as a SNAP program thermal and structure test facility. It is identified as a non-nuclear test and support facility. The SNAP Shield Casting Facility was used as a general test and lithium hydride shield fabrication building in support of the SNAP program. The facility was also used for sodium aerosol and related technology tests.[614] After support work for SNAP tests ceased, Building 4042 was used for testing liquid metal systems, also known as LMFBR Development Testing.[615]

On February 14, 1973, the AEC, SNAP Project Office, granted Atomics International permission to use Building 4042 and the associated equipment for loading UO_2 into a "lower axial blanket shield." The permission letter does not provide the amount of UO_2 used; however, the use authorization authorized 15,000 pounds of uranium in the form of UO_2 powder. Permission was granted with the understanding that the work would not interfere with the SNAP Program closeout and the equipment and building would be cleaned of any UO_2 deposited during the operation.[616,617] Additional information regarding these operations could not be located.

A 1986 plan of long range D&D of facilities at the SSFL identifies hazardous waste as being present at the site, but no radiological waste.[618] A December 20, 1989 report titled "Nuclear Operations at Rockwell's Santa Susana Field Laboratory–A Factual Perspective" identifies Building 4042 as having contained a radioactive test loop.[619] The 1987 Site Consolidation Assessment indicated the building was used for cleaning of small sodium components in the LMFBR test program. Additionally, equipment from LiH shield test and development was being stored in the building. The possible future uses of the building were identified as the assembly and disassembly and cleaning of sodium components and subscale sodium pump for the DFBR program.[620]

Information from Interviewees: None to date.

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[612] ETEC Document, GEN-ZR-0013, "Radiological Survey of Buildings T049, T042, T027, T032, and T025," August 26, 1988.
[613] ETEC, *Site Consolidation Assessment*, April 16, 1987.
[614] ETEC Document, GEN-ZR-0013, "Radiological Survey of Buildings T049, T042, T027, T032, and T025," August 26, 1988.
[615] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005.
[616] Stamp, S.R., Letter Re: Temporary Use of Building 4042 at Santa Susana, February 14, 1973.
[617] Rockwell International Document, Use Authorization 62, February 6, 1973.
[618] Tessier, M.J., Letter Re: Long Range D&D Plan for NE Contaminated Facilities, October 24, 1986.
[619] Rockwell International, N001ER000017, *Nuclear Operations at Rockwell's Santa Susana Field Laboratory – A Factual Perspective*, December 20, 1989.
[620] ETEC, *Site Consolidation Assessment*, April 16, 1987. p. 13.

Radiological Incident Reports: The research team has not identified any incident reports associated with radiological operations at Building 4042.[621]

Current Use: Building 4042 was demolished between 2002 and 2005.[622] The statement of work indicated that the building structures, including all equipment and fixtures, should be demolished or dismantled and removed from the SSFL. The concrete slab foundations were to be removed, as well as the asphalt aprons surrounding the building. The sewer system for bathrooms was to be removed to "logical points of disconnect."[623] Based on available information, the dimensions of the excavation made during building demolition are unknown.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): The following is a summary of the August 1988 radiological survey conducted at Building 4042:

- As part of the DOE SSFL Site Survey, Building 4042 was surveyed to determine if any residual activity was accidentally left behind as a result of operations in support of the SNAP program. Measurements, including exposure rate measurements, were made in Building 4042. The maximum gamma radiation detected was 4.4 μR/hr. (corrected for background and statistically tested against an acceptance limit of 5 μR/hr). The average gamma radiation measured 0.1 μR/hr. Based on the median value of exposure rate measurements in the vicinity of Building 4042, the ambient background value for gamma was determined to be 7.1 μR/hr in 1988.[624]

  The maximum total-average alpha measured 12.6 dpm/100 cm^2 (statistically tested against an acceptance limit of 5,000 dpm/100 cm^2), where the average total-average alpha measured 4.0 dpm/100 cm^2. The maximum removable alpha measured 5.9 dpm/100 cm^2 (statistically tested against an acceptance limit of 1,000 dpm/100 cm^2). The average removable alpha measured 0.5 dpm/100 cm^2. The maximum total-average beta measured 1,200 dpm/100 cm^2 (statistically tested against an acceptance limit of 5,000 dpm/100 cm^2), and the average total-average beta measured 775 dpm/100 cm^2. Based on the results of the survey of Building 4042, the conclusion was made that this area passed the criteria for unrestricted use at that time.[625,626]

Radiological Use Authorizations: Use Authorization 62 was obtained for a period of one year, from February 6, 1973, to February 6, 1974. The authorization was for 15,000 pounds of uranium in the form of UO_2 powder for the Lower Axial Blanket Shielding Experiment.[627,628] It is unclear whether this experiment was ever conducted.

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[621] An incident involving mercury occurred at Building 4024 on February 24, 1965, but did not involve any radioactive materials.
[622] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[623] Unknown, Job B (B4039, B4032, and B4042) Statement of Work, March 3, 2003. HDMSP00038237.
[624] ETEC Document, GEN-ZR-0013, "Radiological Survey of Buildings T049, T042, T027, T032, and T025," August 26, 1988.
[625] ETEC Document, GEN-ZR-0013, "Radiological Survey of Buildings T049, T042, T027, T032, and T025," August 26, 1988.
[626] ETEC DOCUMENT, GEN-ZR-0015, "Executive Summary of the DOE SSFL Site Radiological Survey," October 10, 1988. Pg 19
[627] ETEC Document, GEN-ZR-0013, "Radiological Survey of Buildings T049, T042, T027, T032, and T025," August 26, 1988.
[628] Rockwell International Document, Use Authorization 62, February 6, 1973.

Former Radiological Burial or Disposal Locations: None.

Aerial Photographs: The Building 4042 area is vegetated until the 1965 aerial photograph when the building has been constructed and is in use. In 1967, the substation Building 4742 is visible on a concrete pad at the southwest corner of the building. An additional concrete pad is located at the southeast corner of the building. Possible overhead pipes appear to connect Building 4042 to Building 4023 across 12th Street in 1978. In addition, a possible horizontal tank is visible at the southeast corner of the building, and two probable horizontal tanks are located south of Building 4042. A possible liquid collection area is located between the two concrete pads located south of the building. In 1980, the two horizontal tanks are clearly visible and the possible liquid collection area is still present between the two concrete pads. Also, a structure appears to be visible on the concrete pad at the southeast corner of the building; however, the structure is not identifiable. The possible horizontal tank at the southeast corner of the building is not visible in 1980. In 1988, the two horizontal tanks remain present, but the possible liquid collection area is no longer visible; however, in 1995, the aerial photographs show a vegetated depressed area in the location of the former possible liquid collection area. The building is no longer visible in aerial photographs after 2002 and in 2005, a large ground scar remains where Building 4042 was previously located.[629]

Radionuclides of Concern: Possible radionuclides at Building 4042 include U-235 and U-238.[630] All radionuclides of concern listed are included in the August 2009 Final Field Sampling Plan for the Santa Susana Field Laboratory radiological background study. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: According to aerial photographs, a possible liquid collection area was located between two concrete pads located south of Building 4042. In addition, a plot plan of Building 4042 shows the presence of three trenches within the building; however, the purpose or the outfall of these trenches remains unknown. The building was surrounded on the east and west with drain lines and an emergency shower was located east of the building.[631]

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4042 area is Class 1 due to its location within ETEC, the possible unconfirmed use of uranium in the building, the unknown nature of the materials that entered the trenches located within the building, and the presence of standing water south of the building.

Recommended Locations for Soil/Sediment Sampling: Plate 1 and Figure 2.4 provide a convenient reference for the following recommendations.

Soil sampling is recommended in the Building 4042 area. Information is lacking regarding the excavation activities at Building 4042. In addition, previous characterization studies for the Building 4042 area were focused on delineating the extent of contamination to standards that were applicable at the time. Therefore, additional characterization is recommended for the Building 4042 area. This includes the following Building 4042 areas and appurtenances:

[629] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[630] ETEC Document, GEN-ZR-0013, "Radiological Survey of Buildings T049, T042, T027, T032, and T025," August 26, 1988.
[631] Atomics International, Santa Susana Facility Plot Plan, Drawing 303-GEN-C38, Sheet 4 of 14, June 4, 1964.

- The possible liquid collection area located between two concrete pads located south of Building 4042 should be evaluated. In 1978, aerial photographs show the presence of an unknown liquid between the two concrete pads located south of the building. In 1988, the possible liquid collection area is no longer visible; however, in 1995, the aerial photographs show a vegetated depressed area in the location of the former possible liquid collection area. Should radioactive material have flowed to this area, it possible residual contamination above background values may exist in the depressed area south of Building 4042.

- The sanitary sewer lines located west of Building 4042. Three trenches were located within Building 4042. Drainage from the trenches could not be determined; however, it is possible the effluent from the trenches flowed to the sanitary sewer lines. If radioactive materials were released into the sewer system, residual contamination above background values may exist in the materials surrounding the sewer lines.

- The drain lines located west and east of the building, as well as the emergency shower. As with the sanitary sewer lines, if the trenches within Building 4042 flowed to the drains located on the east and west side of the building, it is possible if radioactive materials were released, residual contamination above background values may exist to the east of the building.

2.4.3 Building 4048

Note: To date, the research team has been unable to locate documents relating to the construction and operation of Building 4048.

Site Description: The Building 4048 area includes Building 4048 and the surrounding area. Building 4048 was a small structure located southeast of Building 4005.[632] Figure 2.4.3a provides a current photograph of the former Building 4048 location. Plate 1 presents a summary of all identified features for this site.

Building Features: No information was located.

Former Use(s): Building 4048 appears to have been constructed in approximately 1978 and was constructed as a Government-owned facility. The building is identified in a 1978 industrial planning map as the plant development unit (PDU) instrumentation building.[633] As indicated above, according to a 1992 environmental monitoring program plan, the PDU was designed and operated by Rockwell for DOE to demonstrate the technical feasibility of producing sulfur-free, low-Btu product gas by partial combustion of Illinois No. 6 coal in a sparged bed of molten, sodium carbonate salt. These operations are described in detail above for Building 4005. Source documents do not provide additional information to identify the operations of Building 4048 in support of the PDU; however, it should be noted that the PDU was a non-radioactive facility that operated from November 1978 to June 1981.[634]

[632] SSFL Area IV, ETEC Industrial Planning Maps, 1962-1992.
[633] SSFL Area IV, ETEC Industrial Planning Maps, 1962-1992.
[634] Rockwell International, *Environmental Monitoring Program Plan, Santa Susana Field Laboratory, Area IV*, ER-AN-0006, September 30, 1992.

Information from Interviewees: None to date.

Radiological Incident Reports: There have been no radiological incident reports located associated with the operations in Building 4048.

Current Use: Building 4048 is no longer depicted in industrial planning maps after the middle 1990s and is no longer visible in aerial photographs in 1995.[635] According to a 1992 environmental monitoring program plan an unidentified commercial demolition company completed disposal of all plant equipment and foundations in 1991 and returned the site to its "original" condition.[636] The program plan does not define "original" condition. Based on available information, the dimensions of the excavation made during building demolition are unknown.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): There have been no radiological surveys conducted at Building 4048, to date; however, the area surrounding adjacent Building 4005 has been assessed. The results of these investigations are summarized above.

Radiological Use Authorizations: None.

Former Radiological Burial or Disposal Locations: None.

Aerial Photographs: Very little detail can be seen in aerial photographs at or near Building 4048. The building is located within an industrial or processing area with numerous open storage areas, overhead pipes, stains, and storage tanks.[637]

Radionuclides of Concern: As indicated above, the PDU was a non-nuclear facility at the SSFL that operated from November 1978 to June 1981.[638] The research team has not identified any radionuclide use at Building 4048.

Drainage Pathways: According to the aerial photograph interpretation, a drainage channel carried runoff from the area into an impoundment located south of the intersection of G and 17th Streets in 1965 and 1967.

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4048 area is Class 1 because of its location within ETEC and proximity to Building 4005.

Recommended Locations for Soil/Sediment Sampling: Plate 1 and Figure 2.4 provide a convenient reference for the following recommendation.

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[635] SSFL Area IV, ETEC Industrial Planning Maps, 1962-1992.
[636] Rockwell International, *Environmental Monitoring Program Plan, Santa Susana Field Laboratory, Area IV*, ER-AN-0006, September 30, 1992.
[637] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[638] Rockwell International, *Environmental Monitoring Program Plan, Santa Susana Field Laboratory, Area IV*, ER-AN-0006, September 30, 1992.

It is recommended that Building 4048 be included in the sampling plan for Building 4005. As discussed above, there is limited information available regarding the operations of Building 4048. Given the building's proximity to Building 4005 and the drainage pathways in the area, it is recommended the former Building 4048 footprint be evaluated for contamination.

2.4.4 Building 4049 Area

Site Description: Located south of B Street and northwest of Building 4005, the Building 4049 area includes Building 4049, an adjacent structure, and the surrounding area. Building 4049 was constructed around 1959. Figures 2.4.4a through 2.4.4c provide a current photograph and the best available building-specific drawing(s) that the research team could find. Plate 1 presents a summary of all identified features for this site.

Building Features: Building 4049 was an 800-square-foot structure with concrete walls, a concrete slab floor and a concrete foundation. The ceiling height was 10.5 feet with a 2-ton jib crane.[639]

Former Use(s): Building 4049 was constructed in 1959 as a hydraulic test facility control center for an outdoor vertical test stand. According to a 1988 radiological survey of the building, the building was not associated with the SNAP program. The outdoor test stand was used for tests with terphenyl organics and finned sintered-aluminum-product cladding materials, sodium-water reaction tests, and a variety of sodium and NaK hydraulic tests. From 1968 to 1977, Building 4049 was used as a control center for Piqua Test Loops. In 1977, Building 4049 was designated as a control and test center for the PDU coal gasification process.[640] An undated table listing buildings that generate waste at the SSFL site indicates that Building 4049 also served as a computer services building.[641] By 1988, according to the August 1988 radiological survey, the building was abandoned.[642]

Information from Interviewees: Interviewee 101 began working at the SSFL in 1986 and provided information on inactive facilities including Building 4049. Of Building 4049, interviewee 101 stated the following:

> There were several inactive buildings on site, some of which were under my management. One involved a lithium hydride shield, developed in building 049 in the 1950s, which was designed to protect people in space from neutrons near a reactor. When the project ended decades earlier, much expensive equipment remained idle in the building. There were many other project specific buildings, government funded, that were very expensive yet were inactive.

Radiological Incident Reports: There have been several incidents associated with Building 4049 that could have resulted in a release to the environment. The following table provides

[639] ETEC Document, GEN-ZR-0013, "Radiological Survey of Buildings T049, T042, T027, T032, and T025," August 26, 1988.
[640] ETEC Document, GEN-ZR-0013, "Radiological Survey of Buildings T049, T042, T027, T032, and T025," August 26, 1988.
[641] Unknown, Table of SSF Waste Generators, Undated.
[642] ETEC Document, GEN-ZR-0013, "Radiological Survey of Buildings T049, T042, T027, T032, and T025," August 26, 1988.

information presented in an incidents database provided by Boeing. Summaries of the incident reports are provided following the table, when available.

Building 4049 Incident Report Summary

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A0425	3/31/1960	Support Lab	Activation Corrosion Products*	"Empty" pipe opened in clean lab contaminated employee with H.B.R.
A0479	4/1/1960	Building 4049 HBR	Activation Corrosion Products*	Employee contaminated clothing while working around open HBR pipe.
A0476	4/17/1960	Building 4049	None Identified	Vacuum surge tank sprayed on employees' personal clothing.
A0358	4/27/1960	Pad SS	None identified	HBR was sprayed on employee when it was opened.

* Activation corrosion products have been defined as typically comprising Co-60, Mn-54, Ni-59, Ni-63, and Fe-55.

- On March 31, 1960, a pipe containing high boiler residue was opened, with high boiler residue spilling onto someone's shoes and pant legs. Activated corrosion product (ACP) contamination levels were recorded at 500 dpm/100 cm^2. These ACPs have been defined by Boeing as typically comprising Co-60, Mn-54, Ni-59, Ni-63, and Fe-55 (A0425).[643]

- An incident occurred on April 1, 1960, during which an employee came in contact with an open pipe containing high boiler residue. According to the incident report, there were high boiler residue spots on his undershirt and work shirt. A smear of his skin showed no skin contamination and the shirt and undershirt showed no detectable contamination (A0479).[644]

- On April 19, 1960, machine oil from the vacuum surge tank sprayed an employee's shirt. The shirt was surveyed and smeared and found to contain no detectable contamination or radiation. The shirt was returned to the employee (A0476).[645]

- On April 27, 1960, an employee opened the high boiler residue line and had high boiler residue spray on the employee's shows, pants, and shirts. The articles of clothing were surveyed and smeared, and following cleaning, there was no contamination detected. The incident report did not indicate the contamination levels detected prior to cleaning, if any (A0358).[646]

Current Use: Building 4049 was demolished in 1999.[647] Based on available information, the dimensions of the excavation made during building demolition are unknown.

[643] Warren, J.W., Internal Letter Re: Radiological Safety Incident Report,A0425, April 22, 1960.
[644] Warren, J.W., Internal Letter Re: Radiological Safety Incident Report A0479, May 19, 1960.
[645] Warren, J.W., Internal Letter Re: Radiological Safety Incident Report A0476, May 19. 1960.
[646] Warren, J.W., Internal Letter Re: Radiological Safety Incident Report, Building 049 Pad-SS, April 27, 1960.
[647] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries,* May 2005 referencing Boeing Document, EID-04366, "Removal of DOE Buildings, Demo Pak A," May 18, 1999. p. 5.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): The following is a summary of the August 1988 radiological survey conducted at Building 4049:

- Building 4049 was included as part of the 1988 DOE SSFL Site Survey to determine whether any residual activity remained as a result of operations at Building 4005, which was known to be contaminated in certain locations. Building 4049 was located within the fence-line boundary of Building 4005, which was known to be contaminated in certain locations. The radiological survey of Building 4049 concluded that the inside ambient exposure rate was 9.3 +/- 1.02 μR/hr (gross). This was much less than the average local outside background of 15.3 μR/hr (gross). According to the report, therefore the 1988 acceptable gamma exposure limit of 5 μR/hr (net) was met.

  The maximum total alpha contamination measured 17.5 dpm/100 cm^2 (statistically tested against an acceptance limit of 5,000 dpm/100 cm^2). The maximum total beta contamination measured 1,080 dpm/100 cm^2 (statistically tested against an acceptance limit of 5,000 dpm/100 cm^2). The maximum removable alpha contamination was found to be 1.7 dpm/100 cm^2 (statistically tested against an acceptance limit of 1,000 dpm/100 cm^2), and the maximum removable beta contamination measured 7.1 dpm/100 cm^2 (statistically tested against an acceptance limit of 1,000 dpm/100 cm^2). Based on these results, Building 4049 was judged to be free of contamination and available for unrestricted use.[648]

Radiological Use Authorizations: The research team did not locate any use authorizations for Building 4049.

Former Radiological Burial or Disposal Locations: None found.

Aerial Photographs: Aerial photographs show undeveloped land until the 1959 photograph when Building 4049 and the area surrounding it have been developed. In 1959, a drainage channel is visible leading south-southwest toward 17th Street and then along 17th Street toward a liquid-filled impoundment in Area III. The 1959 aerial photographs also show a possible storage tank, possible overhead pipes, and stains surrounding the buildings. In 1962, overhead pipes and open storage areas have been identified and a possible storage tank remains present.[649]

Radionuclides of Concern: An undated laboratory status report identified burning high boiler residue contamination at Building 4049, including the following radionuclides: C-14, S-35, P-32, Fe-59, and Co-60.[650] Activation corrosion products have also been identified as radionuclides of concern in past incident reports. According to correspondence with Boeing, activation corrosion products at the SSFL include, at a minimum, Co-60, Mn-54, Ni-59, Ni-63, and Fe-55. As a result, these are included in the list of radionuclides of concern associated with Building 4049 operations. All radionuclides of concern listed are included in the August 2009 Final Field Sampling Plan for the Santa Susana Field Laboratory radiological background study. Table 3.3 presents a summary of contaminants of concern.

[648] ETEC Document, GEN-ZR-0013, "Radiological Survey of Buildings T049, T042, T027, T032, and T025," August 26, 1988.
[649] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[650] Unknown Author, "Laboratory Status Report, Building 049," circa 1959, 1 page.

Drainage Pathways: In 1959, a drainage channel is visible leading south-southwest toward 17th Street and then along 17th Street toward a liquid-filled impoundment in Area III. A Building 4005 surface drainage map shows "inactive DOE PDU gasifier drains" leading from Building 4049 to an open-grated catch basin located adjacent to 17th Street that leads south through a "field" to what is identified as the "R-2A Pond."[651]

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4049 area is Class 1 because of previous incident reports, the location of the building within ETEC, and stains and open storage surrounding building in aerial photographs.

Recommended Locations for Soil/Sediment Sampling: Plate 1 and Figure 2.4 provide a convenient reference for the following recommendations.

Soil sampling is recommended in the Building 4049 area. As discussed above, there were several radiological incidents at Building 4049 involving high boiler residue and documented evidence of radiological releases. Significant information is lacking regarding the excavation activities at Building 4049.

In addition, previous characterization studies for the Building 4049 area were focused on delineating the extent of contamination to standards that were applicable at the time. Therefore, additional characterization is recommended for the Building 4049 area. This includes the following Building 4049 areas and appurtenances:

- Areas of staining and open storage surrounding building. The nature of the storage activities surrounding the building is unknown. Additionally, information regarding operations that may have resulted in staining at and around the building during peak operations could not be located. As a result, if radioactive materials were released from this open storage, residual contamination above background values may exist to the south of the building.

- The drainage channel leading south-southwest toward 17th Street should be evaluated, and is included in the HSA-5B technical memorandum. In 1959 aerial photographs the drainage channel is visible. Subsequent photographs do not provide enough detail to determine whether the drainage channel remains throughout building operations. If radioactive materials were released from the open storage at the building, residual contamination above background values may have entered the drainage pathways around the building.

- The "inactive DOE PDU gasifier drains" leading from Building 4049 to an open-grated catch basin. The nature of the use of these drains is unknown. There is also limited information on the operation of the PDU in this area. Given the presence of open storage at the Building 4049, the "inactive DOE, PDU gasifier drains" should be evaluated to determine if residual contamination above background values entered the drains.

[651] Rocketdyne Report, 005-ZR-0001, "Final Radiological Survey of Building 005," September 21, 1993.

2.4.5 Building 4185 (1982-1983) Area

Note: Building 4185 is identified as a building feature on a 1983 Industrial Planning Map south of Building 4005; however, all available information indicates Building 4185 was located in the SRE complex. Aerial photographs from 1983 do not clearly show a building, and the research team could not locate any information about the building depicted in the 1983 Industrial Planning Map. As a result, operational summaries of this building are not available. The May 2005 HSA could not locate information relating to this building either.[652]

Site Description: The Building 4185 area comprises Building 4185, which was depicted on a 1983 Industrial Planning Map. The building, located near the southeast corner of Building 4005, is located within an industrialized area that includes Building 4005, Building 4048, Building 4049, Building 4705, and Building 4793 (1992). Aerial photographs show the area as being very active, and, as a result, structures are difficult to discern within the area. Figure 2.4.5a provides a current site photograph. Plate 1 presents a summary of all identified features for this site.

Building Features: No information was located.

Former Use(s): The operations of Building 4185, located south of Building 4005, have not been identified.

Information from Interviewees: None to date.

Radiological Incident Reports: There have been no incident reports associated with operations in Building 4185 located to date.

Current Use: Aerial photographs do not clearly show a building present in the area depicted in the 1983 Industrial Planning Map.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): There have been no radiological surveys identified in association with this Building 4185. However, numerous radiological investigations have been conducted in relation to the operations at Building 4005. See Section 2.4.1, above, for a description of these investigations.

Radiological Use Authorizations: None.

Former Radiological Burial or Disposal Locations: None.

Aerial Photographs: As indicated above, 1983 aerial photographs do not clearly identify a building present in the area depicted in the 1983 Industrial Planning Map. However, the area is very active in 1983.[653]

Radionuclides of Concern: None.

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[652] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005.
[653] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.

Drainage Pathways: In 1959, a drainage channel is visible leading south-southwest from Building 4049 toward 17th Street and then along 17th Street toward a liquid-filled impoundment in Area III. This drainage channel would have crossed through the Building 4185 area. A Building 4005 surface drainage map shows drains leading from Building 4049 to an open-grated catch basin located adjacent to 17th Street that leads south through a "field" to what is identified as the "R-2A Pond."[654,655]

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4185 area is Class 1 because of the location of the building within ETEC and its proximity to Building 4005, as well as the unknown nature of the building operations.

Recommended Locations for Soil/Sediment Sampling: Plate 1 and Figure 2.4 provide a convenient reference for the following recommendation.

It is recommended that Building 4185 be included in the sampling plan for Building 4005. As discussed above, there is limited information available regarding the operations of Building 4185. Given the building's proximity to Building 4005 and the drainage pathways in the area, it is recommended the former Building 4185 footprint be evaluated for contamination.

2.4.6 Parking Lot 4501 Area

Site Description: The Parking Lot 4501 Area comprises Parking Lot 4501 and time clock Building 4823. This area is located at the corner of G Street and 17th Street. Parking Lot 4501 was constructed between August 1957 and August 1959.[656] Figures 2.4.6a and 2.4.6c provide a current photograph and the best available building-specific drawing(s) that the research team could find. Plate 1 presents a summary of all identified features for this site.

Building Features: There are no building features to report for Parking Lot 4501. Building 4823 was located on the west side of the parking lot and served as a time clock.

Former Use(s): Parking Lot 4501 appears to have been mainly used for its intended purpose; however, a 1987 Industrial Planning Map refers to this area as "Coal Storage" and beginning in May 1978 aerial photographs show dark mounded material that appears to be coal at this location until 1995 when the site has been cleared.[657] The coal storage would have been in support of the Molten Salt Test Bed and the Process Demonstration Unit (PDU).[658] The molten salt test facility, according to a 1992 environmental monitoring program plan, was a general purpose molten salt combustion pilot plant constructed in 1973 in Building 4005 to permit investigation of new processes using engineering scale equipment. The molten salt gasification plant (or the PDU) was designed and operated by Rockwell for DOE to demonstrate the technical feasibility of producing sulfur-free, low-Btu product gas by partial combustion of Illinois No. 6 coal in a sparged bed of molten, sodium carbonate salt. The total operating time from November 1978 to

[654] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[655] Rocketdyne Report, 005-ZR-0001, "Final Radiological Survey of Building 005," September 21, 1993.
[656] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[657] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[658] Rockwell International, *Decontamination and Decommissioning of the Uranium Carbide Fuel Facility Building T005*, 005-AN-002, September 28, 1993.

June 1981 was approximately 1,500 hours at an average coal feed rate of 0.25 tons per hour.[659] As a result, Parking Lot 4501 would have provided adequate coal storage for these operations.

Information from Interviewees: None to date.

Radiological Incident Reports: There have been no incident reports associated with Building 4501 located to date.

Current Use: According to the May 2005 HSA, Parking Lot 4501 is used as a storage yard; however 2005 aerial photographs appear to indicate the area of the paved parking lot is no longer present and appears to be partially re-vegetated.[660]

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): None.

Radiological Use Authorizations: None.

Former Radiological Burial or Disposal Locations: No formal burial or disposal locations have been identified at or around Parking Lot 4501.

Aerial Photographs: Parking Lot 4501 first appears in aerial photographs in August 1959. Drainage channels are visible on the western boundary of the parking lot adjacent to 17th Street. These drainage channels originate from the area surrounding Building 4005, discussed above. Beginning in May 1978, a probable coal storage bin is located at the northeast half of the parking lot, and a probable conveyor connects the parking lot to an industrialized area east of Building 4005 associated with the PDU. Outside storage is visible on the southwest half of the parking lot. In 1980, a coal storage bin is no longer visible and there are three probable coal storage piles. A stain is located in the center of Parking Lot 4501. The conveyor remains present and a probable horizontal tank is located at the former location of the time clock building. Numerous other small structures appear to be present and a possible pipeline is located at the northeast corner of the former parking lot.

By 1983, the area includes areas of dark toned material and possible staining is visible on the northeast half of the site. The conveyor and possible horizontal tank remain. The areas use continues to be for coal storage in 1988. A number of small structures or outside storage are also located at the area and the possible horizontal tank appears to be a vertical tank. The site has been cleared significantly by 1995. There is no longer any dark toned material or coal storage, the conveyor is longer present, and the area is mostly free of any outside storage. The vertical tank is no longer present; however a new vertical tank appears on the southern portion of the parking lot area. A drainage channel and pipeline run northeast-southwest along between the Parking Lot 4501 area and G Street. In 2005, the site is mostly vegetated with an area of ground scarring in the central portion of the former parking lot.[661]

Radionuclides of Concern: None.

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[659] Rockwell International, *Environmental Monitoring Program Plan, Santa Susana Field Laboratory, Area IV*, ER-AN-0006, September 30, 1992.
[660] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005.
[661] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.

Drainage Pathways: Two drainage channels appear to surround this area. The western boundary of Parking Lot 4501 is bordered by the Building 4005 drainage channel that originates from Building 4005 and runs to Pond 2A. Another drainage channel appears to be present along the southern boundary of Parking Lot 4501 between the parking lot and G Street following the installation of unknown pipelines along G Street.[662]

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Parking Lot 4501 area is Class 2 because of the use of heavy industrial use of the parking lot from 1978 to 1995, and the potential of radioactive material migration via surface water flow or airborne release from Building 4005.

Recommended Locations for Soil/Sediment Sampling: Plate 1 and Figure 2.4 provide a convenient reference for the following recommendations.

Due to the potential of radioactive material migration via surface water flow or airborne release from Building 4005 and the lack of site investigation, additional characterization is recommended for the Parking Lot 4501 area.

- The perimeter of the former Parking Lot 4501. Parking lots are generally constructed to have drainage flow to the perimeter of the structure. As a result, should radioactive materials have drained from facilities to the north to the parking lot, or should any of the industrial activities at the parking lot included radioactive materials, residual contamination above background values may exist along the perimeter of the former Parking Lot 4501.

- The drainage channel and unknown pipelines located along G Street. Should radioactive materials have drained from facilities northeast of the parking lot to the drainage channel along G Street, residual contamination above background values may exist within the drainage channel.

- The Building 4005 drainage channel along 17th Street that is adjacent to the Parking Lot 4501 area. Should radioactive materials have drained from facilities north of the parking lot, namely Building 4005, to the drainage channel along 17th Street, residual contamination above background values may exist within the drainage channel.

2.4.7 Parking Lot 4536 Area

Site Description: The Parking Lot 4536 area includes Parking Lot 4536, time clock Building 4836, and guard shack Building 4636, as well as the surrounding area to the intersection of 12th and G Streets. Parking Lot 4536 was constructed between 1962 and 1965. Figures 2.4.7a and 2.4.7c provide a current photograph and the best available building-specific drawing(s) that the research team could find. Plate 1 presents a summary of all identified features for this site.

Building Layout: There are no building features to report for Parking Lot 4536. Buildings 4836 and 4636 were located at the northeast corner of the parking lot and served as a time clock and guard shack, respectively.

[662] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.

Former Use(s): Parking Lot 4536 appears to have been mainly used for its intended purpose of serving personnel working in the SNAP facility until approximately 1978. In 1978, the parking lot is also used for outside storage of non-radiological equipment. These storage activities increase until 2005 when the parking lot was removed.[663,664]

Information from Interviewees: None to date.

Radiological Incident Reports: There have been no incident reports associated with operations at Parking Lot 4536 identified to date.

Current Use: June 2005 aerial photographs show the area to have been cleared of all storage materials and the pavement has been removed.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): Radiological surveys specific to Parking Lot 4536 have not been conducted; however the parking lot was included in the Area IV Radiological Characterization Survey, conducted in 1994 and 1995.

The Area IV Radiological Characterization Survey was designed to locate and characterize any previously unknown areas of elevated radioactivity in Area IV. The study measured background to be 15.6 mR/hr with an acceptable limit less than 5 mR/hr above background. The survey found the area to be below the then-acceptable limits.[665]

Radiological Use Authorizations: None.

Former Radiological Burial or Disposal Locations: None.

Aerial Photographs: As indicated above, Parking Lot 4536 was constructed between 1962 and 1965. Prior to its appearance in 1965, the area is vegetated with no notable features. The parking lot appears to be used for its intended purpose until 1978 when outside storage is visible on the west half of the parking lot. Storage crates appear at the northwest corner of the parking lot in 1980. Outside storage remains visible, and relatively unchanged in 1980, 1983 and 1988. However, in 1988, dark toned material is also visible on the east half of the parking lot. In 1995, the west half of parking lot continues to have some outside storage and possible standing liquid is visible along the western boundary and staining in the southwest corner. Staining and dark-toned mounded material is visible on the east side of the parking lot. The only thing remaining at the site in 2005 is ground scarring, likely a result from demolition activities.[666]

Radionuclides of Concern: None.

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[663] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005.
[664] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[665] Rocketdyne, Document A4CM-ZR-0011, Rev. A, Area IV Radiological Characterization Survey, August 15, 1996.
[666] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.

Drainage Pathways: Aerial photographs from 1983, 1988, and 1995 show a pipeline along the southern boundary of the parking lot. Drainage around the site appears to follow this pipeline from the northeast to the southwest.

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Parking Lot 4536 area is Class 2 because of the presence of storage operations for a number of years in the area.

Recommended Locations for Soil/Sediment Sampling: Plate 1 and Figure 2.4 provide a convenient reference for the following recommendations.

Due to the potential of radioactive material migration via surface water flow or airborne release from buildings northwest of the parking lot, including Building 4023, and the lack of site investigation, additional characterization is recommended for the Parking Lot 4536 area.

- The perimeter of the former Parking Lot 4536. Parking lots are generally constructed to have drainage flow to the perimeter of the structure. As a result, should radioactive materials have drained from facilities to the north to the parking lot, or should any of the industrial activities at the parking lot included radioactive materials, residual contamination above background values may exist along the perimeter of the former Parking Lot 4536.

- The outside storage areas located at Parking Lot 4536. Should radioactive materials have been contained in the storage containers at Parking Lot 4536, residual contamination above background values may exist at the former Parking Lot 4536 area.

2.5 GROUP 5

The Group 5 index map is presented in Figure 2.5. Following Figure 2.5, the site photograph and layout drawings for each building area within HSA-5A Group 5 are presented. HSA-5A Group 5 includes one building area, Building 4029, the radiation measurement facility.

2.5.1 Building 4029 Area

Site Description: The Building 4029 area includes Building 4029 and the surrounding area. Building 4029, the radiation measurement facility, is a single open bay, Butler-type building with a steel frame, corrugated metal siding and roofing. An undated photograph shows the presence of a drum and/or barrel storage area south of Building 4029. Figures 2.5.1a through 2.5.1i provide a current photograph and the best available building-specific drawing(s) that the research team could find. Plate 1 presents a summary of all identified features for this site.

Building Features: Building 4029 measured 20 by 40 feet with a 12-foot eave. The ceilings and walls are insulated with fiberglass mat. The floors were originally tiled with asphalt tiles that were subsequently removed. Following removal of the tiles, the floor remained bare concrete slab. Ventilation is provided by an exhaust blower through two absolute filters. Three below-grade enclosures were constructed to hold radioactive calibration sources: a 10-foot deep, 12-inch diameter concrete well with three separate galvanized pipe casings for source storage, a 10-foot deep concrete and lead well with a 4-foot above-grade section (14 feet total) with

galvanized pipe casing for instrument calibration, and a 3- by 3-foot concrete pit two feet deep for source storage.[667,668]

Building 4029 has also been referred as the old calibration facility, the hazardous waste storage facility, and the hazardous waste management facility.

Former Use(s): Constructed between 1962 and 1965, Building 4029 was originally constructed to store radioactive source materials, including PoBe, PuBe, Co-60, Ra-226, and Cs-137, for instrument calibration.[669] The table below shows the calibration sources used at Building 4029, the source strength, and the date the source strength was measured.

Calibration Sources Used at Building 4029

Source	Source Strength (mCi)	Date
1 - Ra-226*	24.8	1960
2 - Ra-226	132	1960
3 – Ra-226	930	1960
4 - Co-60	Unknown	Not Applicable
5 – PoBe	Unknown	Not Applicable
6 – PuBe	Unknown	Not Applicable
7 – Cs-137	5310	September 1963
8 – Cs-137	5260	September 1963

Source: ETEC Document, 029-AR-0001, "Final D&D Report for Building T029," March 28, 1996.
*A March 1964 incident resulted in the release of Ra-226 from this source capsule at Building 4029. This incident is discussed in detail below.

Ra-226, Cs-137, and Co-60 were used to calibrate gamma-sensitive instruments, while PoBe and PuBe were used to calibrate neutron-sensitive equipment. Based on information contained in the 1996 D&D report, the Ra-226 sources were replaced with two Cs-137 sources and were not used in the facility concurrently. The encapsulated Co-60 source was used in the early 1960s and was used on a limited basis. It was removed from the facility in about 1965.[670,671,672]

The PoBe and PuBe neutron sources were fully encapsulated and stored in a small concrete pit in the northeast corner of the building, approximately 3- by 3-foot wide and 2 feet deep. The pit was also used to store gamma sources in lead pigs when not in use. The neutron storage facility was dismantled in 1964 or 1965. All materials were handled and stored in encapsulated form and leak tests were performed every six months. All radioactive source materials were removed

[667] ETEC Document, 029-AR-0001, "Final D&D Report for Building T029," March 28, 1996.
[668] ETEC Document, GEN-ZR-0006, "Radiological Survey of the Old Calibration Facility – Building T029," August 19, 1988.
[669] ETEC Document, 029-AR-0001, "Final D&D Report for Building T029," March 28, 1996.
[670] ETEC Document, GEN-ZR-0006, "Radiological Survey of the Old Calibration Facility – Building T029," August 19, 1988.
[671] ETEC Document, 029-AR-0001, "Final D&D Report for Building T029," March 28, 1996.
[672] Rockwell International, Document N001DWP000024, "Radiological Decontamination of Building 029," July 31, 1989.

by April 29, 1974, and transferred to another facility, and Building 4029 was partially decommissioned.[673,674,675,676]

Beginning in 1974, Building 4029 was later incorporated into the Hazardous Waste Management Facility (HWMF) as a storage area along with Building 4133, which served as a treatment facility. The HWMF was for the management of reactive metal waste, including Na, NaK, Li, and LiH_2, and functioned to convert waste metallic sodium into sodium hydroxide. During a June 1989 DHS inspection of the SSFL Site, DHS reported Rockwell and Rocketdyne received a state permit on December 30, 1983, for a sodium waste storage area at Building 4029. According to a 1988 DOE memorandum, ten cold traps containing sodium, a reactive hazardous waste, were being stored in an unpermitted storage area. The memorandum indicated the traps were stored outside the Building 4029-permitted storage area. While it was stated the sodium was contained and would not cause an environmental problem, the storage outside of Building 4029 was a violation of the RCRA storage regulations. As a result, ETEC was in the process of developing sawing techniques to cut the traps so that they could be oxidized at the burn facility.[677,678,679,680]

The 1997 Annual Site Environmental Report indicated the facility received a renewed RCRA Part B permit (CAD0000629972 [3-3-TS-002]) to operate the facility from the California Department of Toxic Substances Control in 1993. In 1997, the facility was reported to be in final closure; however, according to the 1998 Annual Site Environmental Report, the facility entered final closure in 1998 and a closure plan was submitted to DTSC in January 1999.[681,682,683684]

Following an independent verification survey, DOE determined Building 4029 satisfied the requirements for release without radiological restrictions on February 5, 1993.[685] DHS

[673] Rockwell Health and Safety, Letter, "Transfer of Radioactive Sources from T029," from J. D. Moore (Rockwell Health and Safety) to W. F. Heine, May 1, 1974.
[674] ETEC Document, GEN-ZR-0006, "Radiological Survey of the Old Calibration Facility – Building T029," August 19, 1988.
[675] ETEC Document, 029-AR-0001, "Final D&D Report for Building T029," March 28, 1996.
[676] Rockwell International, Document N001DWP000024, "Radiological Decontamination of Building 029," July 31, 1989.
[677] ETEC Document, GEN-ZR-0006, "Radiological Survey of the Old Calibration Facility – Building T029," August 19, 1988.
[678] The Boeing Company, *Rocketdyne Propulsion and Power DOE Operations Annual Site Environmental Report 1997*, A4CM-ZR-0012, November 23, 1998.
[679] The Boeing Company, *Rocketdyne Propulsion and Power DOE Operations Annual Site Environmental Report 1998*, RD99-115, September 22, 1999.
[680] Scott, Randal, Memorandum Re: Survey Status Report, July 5, 1988.
[681] ETEC Document, GEN-ZR-0006, "Radiological Survey of the Old Calibration Facility – Building T029," August 19, 1988.
[682] The Boeing Company, *Rocketdyne Propulsion and Power DOE Operations Annual Site Environmental Report 1997*, A4CM-ZR-0012, November 23, 1998.
[683] The Boeing Company, *Rocketdyne Propulsion and Power DOE Operations Annual Site Environmental Report 1998*, RD99-115, September 22, 1999.
[684] DOE, "Environmental Assessment for Cleanup and Closure of the Energy Technology Engineering Center, Final," March 2003.
[685] ORISE, Letter, "Type A Verification of Building T029, Santa Susana Field Laboratory, Rockwell International, Canoga Park, California," from T. Vitkus (ORISE) to A. Kluk, February 5, 1993.

concurred that Building 4029 met the approved standards for unrestricted release on December 21, 1995.[686] DOE released Building 4029 without radiological restrictions on April 21, 1997.[687]

In 1996, a D&D report documented the work performed to remove residual radioactive contamination from a relatively inaccessible area of Building 4029. All below-grade enclosures were removed and disposed of as low level waste, the exhaust system was removed for reuse, and the excavations were backfilled to allow for continued use of the facility. Details regarding this removal effort are provided below.[688]

Information from Interviewees: None to date.

Radiological Incident Reports: There have been several incidents associated with Building 4029 that could have resulted in a release to the environment. The following table provides information presented in an incidents database provided by Boeing.

Building 4029 Incident Report Summary

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A0029	11/11/1963	SSFL & DS131	Co-60	Investigation of discrepancies in quarterly radioactive by-product material.
A0032	3/24/1964	Source well	Ra-226	Leaking calibration source contaminated facility and personnel.
A0367	6/24/1965	Calibration Facility	Ra-226	Alarm failed when source failed to return to safe storage.
A0577	11/20/1970	Calibration Facility	Cs-137	Calibration source encapsulation failed during use.

- On November 11, 1963, a health and safety supervisor was notified that six radioactive sources were reported missing from the Quarterly Radioactive By-Product Material Inventory for the third quarter of 1963. The June 30, 1963, inventory listed the following sources as being present in Building 4029: one 5.01 mC Ra-226 source, one 0.177 mC Ra-226 source, two 1.0 mC Co-60 sources, one 0.1 mC Co-60 source, and one Sb-125 source. The inventory, however, was found to be incorrect. All the sources were eventually accounted for with the exception of the 0.1 mC Co-60 source, which was believed to have been disposed of from the waste disposal shed (Building 131, Headquarters) a year earlier. The incident report does not provide any indication that a release occurred as a result of this incident (A0029).[689]

- On March 24, 1964, a leaking calibration source contaminated the building and personnel with 24.8 mCi Ra-226. According to the incident report, the source was one of three containing 24.8 mCi of Ra-226 as a bromide salt. The other sources contain 132 mCi and 930 mCi of Ra-226 in the bromide chemical form as well. All three sources were

[686] Wong, Gerald, DHS Letter regarding release of Building T029, T028, and OCY, January 2, 1996.
[687] Liddle, Roger, DOE, Letter Re: release of Facilities for Unrestricted Non-Radiologic Use," April 21, 1997.
[688] ETEC Document, 029-AR-0001, "Final D&D Report for Building T029," March 28, 1996.
[689] Badger, F.H., Internal Letter Re: Investigation of Reported Missing Radioactive Sources, January 8, 1964.

encapsulated in platinum iridium alloy of 1.0 mm wall thickness, except for the 930 mCi of Ra-226, which has a wall thickness of 1.5 mm of platinum alloy.

On March 24, 1964, a 24.8 mCi Ra-226 source capsule became detached from the nylon string and fell into the bottom of the source thimble. The 13-foot fall of the source capsule cracked the outer plastic encapsulation surrounding the inner capsule and released some loose Ra-226. The contamination was primarily confined to the source storage well and the source thimble. Three personnel were contaminated with alpha activity on their hands with 2,500 dpm maximum as determined by a portable alpha survey meter. The personnel were evacuated to the Building 4020 hot change room for decontamination. The area outside the source holder was found to be contaminated with "low level" removable alpha contamination. Decontamination of the facility reduced fixed and removable contamination below detectable levels with one exception at the source storage well at the floor level was 6 dpm/100 cm2 alpha.
According to the report, the source was believed to be at the bottom of the storage well as the gamma activity at the top of the North storage well was approximately 1.5 mR/hr. A high volume air sample showed normal background alpha activity of 2.5 x 10-11 uc/cm3.

On March 25, 1964, the source was recovered from the source well and was placed in a lead shipping container to await disposition (A0032).[690]

- On June 24, 1965, personnel failed to return a 132 mg Ra-226 source to its well following instrument calibration. Following the departure of the personnel, five Atomics International employees spent approximately 2.5 hours in the building installing a glove box and connecting it to the building's absolute filter system. The exposed source was discovered on June 25, 1965, by Health and Safety personnel who were present at the building to conduct a smear survey of a 55-gallon drum containing "a few kg of depleted UC." The source was returned to the well and the personnel who entered the building during the period of exposure were monitored (A0367).[691]

- On November 20, 1970, the encapsulation of a 4.6 Ci Cs-137 calibration source failed during use and dropped 10 feet to the bottom of the well, resulting in the source getting stuck in the storage well. It was estimated that the external radiation level of the source was 16 R/hr one foot away from the source (A0577).[692]

During a June 1989 DHS inspection of the SSFL Site, DHS reported Rockwell and Rocketdyne received a state permit on December 30, 1983 for a sodium waste storage area at Building 4029. The inspection also stated that "[Rockwell and Rocketdyne] failed to submit a written report to the Department (and EPA) within 15 days after determination of release of the radioactive materials at the sodium storage area (T029)." According to the report, the facility's Industrial Hygienist "mentioned that they had found radioactive contamination in the sodium storage area." However, no signs were posted indicating radioactive contamination.[693] The research team could

[690] Busick, D.D., Internal Letter Re: Report of Radioactive Contamination Incident of the Radiation Measurement Facility – Building 029, April 10, 1964.
[691] Wildanger, A.W., Incident Report Re: Radiation Measurement Facility, A0367, July 9, 1965.
[692] Owen, R.K., Internal Letter Re: Incident Report – Sealed Source Capsule Failure at T029, December 2, 1970.
[693] Motiafard, V., State of California, Department of Heath Services, Addendum Report, Rockwell International Corporation Rocketdyne Division, November 30, 1989.

not locate additional information regarding the contamination referenced by the Industrial Hygienist at Building 4029.

Current Use: The hazardous waste management facility, including Buildings 4133 and 4029 was scheduled to be demolished in 2007. Physical closure activities began on March 26, 2007; however, a stop work order was issued and Building 4029 was placed into "safe shutdown" pending the completion of an environmental impact study.[694,695] The research team assumes the building remains in "safe shutdown."

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): A chronology of radiological investigations at this building is as follows:

- Rocketdyne performed a Radiological Survey in 1988 measuring the gamma exposure rate of the building, surrounding area and entrance road to clarify and identify areas needing further radiological inspection or requiring remedial action. The Ra-226 source wells were surveyed for alpha contamination, and an area south of Building 4029 used for storing barrels in the early 1960s was also surveyed for residual radioactive material.

  The average gamma measurements were 14.4 ± 1.55 μR/hr (–0.84 ± 1.55 μR/hr corrected for background at the time). The measurements were below the 1988 DOE (20 μR/h above background) and NRC (5 μR/hr above background) limits. It was found that source wells were contaminated (2.800 α- dpm/100 cm^2) and it was recommended that they be remediated during the final decommissioning and demolition of the facility. The survey concluded that with the exception of the wells, the facility and surrounding areas, including the drum storage area, are "clean" of any residual radioactive contamination.[696]

- According to a 1989 Rockwell International factual perspective, the contaminated Ra-226 thimble was removed and disposed of in October 1989.[697] The information was referenced from Rocketdyne Report N704SRR990029.

- In 1993, ORISE performed a Type A verification of Building 4029. ORISE reviewed the decontamination and radiological survey report and supporting documentation and performed scans of the floor surfaces contiguous with the source well's former location. According to the report, the surface scans did not identify any locations of elevated direct radiation. ORISE determined the building satisfied the 1993 requirements for release without radiological restrictions.[698]

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[694] The Boeing Company, "Site Environment Report for Calendar Year 2007 DOE Operations at The Boeing Company Santa Susana Field Laboratory, Area IV," September 2008.
[695] DOE, Letter, "Response to Letter Dated, may 23, 2007, regarding Closure of Hazardous Waste Management Units in the Radioactive Materials Handling Facility (RMHF), Boeing, Santa Susana Field Laboratory, Simi Valley, California," from T. Johnson (ETEC) to N. Riley (Boeing), June 1, 2007.
[696] ETEC Document, GEN-ZR-0006, "Radiological Survey of the Old Calibration Facility – Building T029," August 19, 1988.
[697] Rockwell International, N001ER000017, "Nuclear Operations at Rockwell's Santa Susana Field Laboratory – A Factual Perspective," December 20, 1989. p. 45.
[698] ORISE, Letter, "Type A Verification of Building T029, Santa Susana Field Laboratory, Rockwell International, Canoga Park, California," from T. Vitkus (ORISE) to A. Kluk, February 5, 1993.

- DHS performed verification sampling in 1995 and found no residual contamination exceeding the limits for unrestricted release in January 1996. According to the survey summary, the survey results were all less than twice the 1995 background levels for the structure and surrounding area.[699][700]

- In 1996, the D&D report documented the work performed in 1989 to remove residual radioactive contamination from a relatively inaccessible area of Building 4029. This work included the excavation of the Ra-226 source storage well and the Ra-226 source holder, which were disposed of as low-level radioactive waste. A rectangular area of the floor surrounding the Ra-226 source storage well was excavated using concrete saws and jack-hammers. A backhoe was used to dredge the soil from the cut-up area. A vacuum cleaner removed the soil in the immediate vicinity of the 12-inch diameter casing. Once the casing was loosened from the soil ("with the inner contents of contaminated source thimble tubes still intact"), a sling was attached to the casing and a forklift moved the casing to the floor. The casing was covered with plastic bags, tagged as radioactive material and transported to the RMHF.

  At the RMHF, routine smear surveys on the surfaces of the thimbles showed "normal" background activity. Swabs from the interiors of the thimble tubes after the casing was excavated shows alpha-contaminated interiors, requiring the disposal of the casing as low-level radioactive waste. The casing was cut into two pieces and the concrete embedment was separated from the casing's three inner tubes. All components were packaged for disposal as low-level radioactive waste at an authorized site.

  Additionally, the work included the demolition of the housing used for the Co-60 source and disposal of the uncontaminated debris as nonradioactive waste. The storage well of the Co-60 source cell was partially excavated to a depth of approximately 2 feet below grade. The Co-60 structure was "eliminated to an extent that provides an obstruction-free floor-space for future storage of nonradioactive materials." The exhaust system outside the building was also removed, surveyed and determined to be "clean" for reuse. Smear surveys on the Co-60 source and exhaust system showed no activity above 1996 background levels.

  All excavated areas were refilled and resurfaced, although the D&D report does not provide information regarding the type of fill used or its origin. The volume of contaminated waste from the three source storage locations was approximately 40 cubic feet. An additional 60 cubic feet of contaminated waste was generated from areas adjacent to the storage locations and soil and asphalt.

  Rocketdyne took soil samples as part of the D&D effort. The survey found all radiation to be in "acceptable ranges" around 1996 background levels. Excavation sampling results for Pb-214 were 0.28 and 0.27 pCi/g compared to a background measurement of 0.84 pCi/g. Excavation sampling results for K-40 were 23.1 and 23.6 pCi/g compared to a background measurement of 22.2 pCi/g. Based on these measurements and the 1988

[699] Lupo, Roger, DHS, "Verification Survey of Building T029," September 14, 1995.
[700] Wong, Gerald, DHS Letter regarding release of Building T029, T028, and OCY, January 2, 1996.

radiological survey, the facility was released for unrestricted use and the excavated area was refilled.[701][702]

- EPA conducted an oversight verification survey in 2001 for alpha and beta contamination. The survey included scans for alpha and beta and fixed point measurements for alpha and beta. Six swipe samples were collected and dust samples were collected from two ventilation ducts. Swipe samples were analyzed for removable contamination and dust samples were analyzed for the presence of radium daughter products. The contaminant of concern for Building 4029 was Ra-226 on the floors and walls. Acceptable limits for the survey were consistent with NRC Regulatory Guide 1.86 (Ra-226 levels of 100 dpm/100 cm^2 average, 300 dpm/100 cm^2 maximum, and 20 dpm/100 cm^2 removable) and the proposed site wide release criteria in accordance with Area IV survey.[703] None of the field measurements indicated the presence of radionuclides above the 2001 acceptable limits. The EPA field measurements confirmed the conclusions reached by both Rocketdyne and ORISE.[704]

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Locations: No known disposal or burial locations have been identified at or near Building 4029. It is important to note, however, that barrels and drums were stored outside the building for a short period of time in the early 1960s. Surveys of the storage area found no detectable activity.[705] In 1989, a storage area was reported to be located near Building 4029 that contained a permitted long-term storage hazardous waste area. Reactive metals including sodium, potassium, sodium potassium, zirconium, and lithium metal were stored in "55-gallon drums (illegible). There were also apparently 20 'cold traps' containing reactive sodium metal stored outside Building 029." The area where the traps were stored was not within the permitted hazardous waste storage area.[706]

Aerial Photographs: Based on aerial photographs, Building 4029 was constructed between 1962 and 1965, which is inconsistent with information presented in the 2005 HSA. The 1962 aerial photographs do not show any construction activities in the vicinity of Building 4029; however, by 1965, the building is present. In 1980, four small containers are visible directly west of the building. They do not appear in subsequent photographs. Significant ground scarring that is located south-southwest of the building is visible in 1995 aerial photographs. The ground scar is no longer present in 2005.[707]

Radionuclides of Concern: Constructed in 1959, Building 4029 was originally constructed to store radioactive source materials, including Co-60, Ra-226, and Cs-137, for instrument

[701] Rockwell International, N704SRR990029, "Final Decontamination and Radiological Survey of Building T029," June 28, 1990.
[702] ETEC Document, 029-AR-0001, "Final D&D Report for Building T029," March 28, 1996.
[703] Rocketdyne Document, A4CM-ZR-0011, Rev. A, "Area IV Radiological Characterization Survey," August 15, 1996.
[704] Tetra Tech EM Inc., "Final Oversight Verification and Confirmation Radiological Survey Report for Buildings T-012, T-029, and T-363," December 20, 2002.
[705] ETEC Document, GEN-ZR-0006, "Radiological Survey of the Old Calibration Facility – Building T029," August 19, 1988.
[706] Schiffman, Joel, United Stated Department of Energy Environmental Survey Report, June 16, 1989.
[707] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.

calibration.[708][709] All radionuclides of concern listed are included in the August 2009 Final Field Sampling Plan for the Santa Susana Field Laboratory radiological background study. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Based on aerial photographs, drainage at and around Building 4029 is to the south. There do not appear to have been any floor drains at Building 4029.

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4029 area is Class 1 based on its previous use and the unknown source of the fill material used to backfill excavations during D&D activities.

Recommended Locations for Soil/Sediment Sampling: Plate 1 and Figure 2.5 provide a convenient reference for the following recommendations.

Soil sampling is recommended in the Building 4029 area. As discussed above, there were several radiological incidents at Building 4029 involving calibration sources and documented evidence of radiological releases. Information is lacking regarding the excavation activities at Building 4029.

In addition, previous characterization studies for the Building 4029 area were focused on delineating the extent of contamination to standards that were applicable at the time. Therefore, additional characterization is recommended for the Building 4029 area. This includes the following Building 4029 areas and appurtenances:

- In 1980, four small containers are visible directly west of the building. Given the building's use as a storage area of radioactive source materials, calibration facility, and hazardous waste management facility, and because the contents of these containers are unknown, it is possible the containers west of the building may have contained radioactive materials. Any leaks from these containers may have left residual contamination above background values in the area.

- Ground scarring located south-southwest of the building in the vicinity of a former storage area in 1995 aerial photography is recommended for sampling.

- Sampling within Building 4029 should be localized at the former location of the source wells, which were excavated and backfilled with fill from an unknown source and to confirm all residual contamination was removed during D&D operations.

[708] ETEC Document, 029-AR-0001, "Final D&D Report for Building T029," March 28, 1996.
[709] PoBe and PuBe were also sealed radioactive sources at Building 4029; however polonium-210 has a half life of 210 days and, therefore has been omitted from the list of radionuclides of concern.

3.0 RADIONUCLIDE LIST

3.1 U.S. ATOMIC ENERGY COMMISSION SPECIAL NUCLEAR MATERIAL LICENSE

The first license issued by the U.S. Atomic Energy Commission (AEC) for the SSFL site was Special Nuclear Material License No. SNM-21. It was initially issued on April 6, 1956 for use at the Canoga Park site. License No. SNM-21 authorized Atomics International Division of North American Aviation, Inc. (Atomics International) to receive and possess 50 grams of uranium enriched in uranium-235 (U-235) for use in fission counter tubes. License No. SNM-21 was amended eight times to increase the number and type of nuclear materials that could be handled at the Canoga Park and SSFL sites. This license was terminated on September 27, 1996. In February 1975, the AEC became known as the Nuclear Regulatory Commission (NRC) and License No. SNM-21 became an NRC license.

3.2 U.S. ATOMIC ENERGY COMMISSION CRITICAL EXPERIMENTS FACILITY LICENSE

On October 3, 1960, the AEC authorized Atomics International, under License No. CX-17, to possess and operate a separable-half type critical experiments facility at power levels not exceeding 200 watts (thermal) in Building 100 (now known as Building 4100). Atomics International conducted this research under contract to the Southwest Atomic Energy Associates of Shreveport, Louisiana. The license permitted the possession "and use of special nuclear materials as follows:

- 25 kilograms of U-233 and 110 kilograms of U-235 as fuel for the reactor;
- 135 grams of U-233, 1,135 grams of U-235, and 135 grams of Pu-239 in foils and capsules for use in connection with operation of the reactor;
- 0.5 gram each of U-233, U-235, and Pu-239 in fission counters for use in connection with operation of the reactor; and
- 32 grams of Pu in encapsulated neutron sources for use in connection with operation of the reactor."

License No. CX-17 also permitted the possession "and use of source materials as follows:

- 656 kilograms of Th-232 for use in the core and buffer regions of the reactor;
- 700 grams of natural uranium in foils and capsules for use in connection with operation of the reactor; and
- 0.5 gram each of U-234, U-236, and U-238 in fission counters for use in connection with operation of the reactor."

License No. CX-17 also permitted the possession "and use of 0.5 gram of Np-237 in fission counters for use in connection with operation of the reactor and to possess, but not to separate such byproduct materials as may be produced by operation of the reactor."

License No. CX-17 was amended ten times before it was terminated on October 6, 1980.

3.3 CALIFORNIA DEPARTMENT OF PUBLIC HEALTH RADIOACTIVE MATERIAL LICENSE

On September 11, 1963, the State of California, Department of Public Health issued Radioactive Material License No. 0015-59 to Atomics International. This license authorized the possession and use of a wide range of radioactive materials at the De Soto Avenue, Canoga Park, and SSFL sites as listed in Table 3.1, below.

Table 3.1
Radioactive Materials Covered by License No. 0015-59

Radioactive Material (element and mass number)	Chemical and/or Physical Form	Maximum Quantity that Licensee may Possess
Any byproduct material between atomic number 3 and 83	Any	7 curies of each byproduct material between atomic number 3 and 83
Antimony-124	Any	50 curies
Iridium-192	Any	70 curies
Cobalt-60	Sealed sources	10 sources not to exceed 400 curies each
Hydrogen-3	Any	550 curies
Polonium-210	Any	150 curies
Any byproduct material	Separated from irradiated thorium and uranium samples	250 microcuries total
Hydrogen-3	Titanium tritide foil (U.S. Nuclear Corporation)	500 millicuries
Hydrogen-3	Titanium tritide foil (U.S. Radium Corporation)	1 curie
Strontium-90	Sealed source (U.S. Nuclear Corporation Model 312)	5 microcuries
Radium-226	Any	2,000 milligrams
Radium-226	Sealed neutron sources	500 milligrams
Cobalt-60	Sealed source (U.S. Nuclear Corporation Model 338)	1 source not to exceed 5 curies
Cobalt-60	Sealed source (Isotopes Specialties Company Model 338)	1 source not to exceed 5 curies
Cerium-144	Sealed source (Isotopes Specialties Company Model 160)	50 microcuries
Iridium-192	Sealed source (Technical Operations Model A424-1)	1 source not to exceed 20 curies
Radium-226	Sealed sources (NRC Equipment Corporation)	Seven sources not to exceed 0.4 milligram each
Strontium-90	Sealed sources	Two sources of 3 millicuries each
Americium-241	Any	2 millicuries
Natural or depleted uranium	Any	20,000 pounds
Natural thorium	Any	700 pounds

This license is assumed to have covered the use and possession of radioactive materials in SNAP Reactor Building 4059. Up until December 1969, when reactor operations ceased in Building

4059, there had been 39 amendments to this license. The radioactive materials covered in the 39th amendment are listed in Table 3.2, below.

Table 3.2
Radioactive Materials Covered by License No. 0015-59, Amendment No. 39

Radioactive Material (element and mass number)	Chemical and/or Physical Form	Maximum Quantity that Licensee may Possess
Any radionuclide with atomic number 3 through 83	Any	25 curies for any one radionuclide
Antimony-124	Any	100 curies
Iridium-192	Any	100 curies
Cobalt-60	Sealed sources	10 sources not to exceed 400 curies each
Hydrogen-3	Any	10,000 curies
Polonium-210	Any	150 curies
Krypton-85	Any	100 curies
Neptunium-237	Any	100 microcuries
Radium-226	Any except as neutron sources	5 grams
Radium-226	Sealed neutron sources	500 milligrams
Cobalt-60	Sealed source (U.S. Nuclear Corporation Model 338)	1 source not to exceed 5 curies
Cobalt-60	Sealed source (Isotopes Specialties Company Model 338)	1 source not to exceed 5 curies
Cobalt-60	Sealed source (Lockheed Nuclear Products Dwg 442-1001)	25,000 +/- 2,500 curies in 12 sources
Iridium-192	Sealed source (Technical Operations Model A424-1)	4 sources not to exceed 100 curies each
Radium-226	Sealed sources (NRC Equipment Corporation)	Seven sources not to exceed 0.4 milligram each
Califonium-252	Sealed source (Oak Ridge)	2 sources not to exceed 550 microcuries each
Any radionuclide with atomic number 3 through 83	Any	Not to exceed 100 curies for any one radionuclide
Promethium-147	Promethium oxide	150,000 curies
Americium-241	Any	10 curies
Natural or depleted uranium	Any	20,000 pounds
Natural thorium	Any	1,000 pounds
Tantalum-182	Metal	500 curies
Natural or depleted uranium	Any	50,000 pounds
Mixed fission products (Hot Lab)	Any	10,000,000 curies
Any radionuclide with atomic number 3 through 83 (Hot Lab)	Any	100,000 curies for any one radionuclide

This license was amended 64 times up until August 2, 1979 when the license number was changed to No. 0015-70. Up until October 21, 1996, there had been 94 amendments.

3.4 RADIONUCLIDE LIST TO BE USED IN SOIL AND GROUNDWATER SAMPLING

From a review of historical documents and radioactive material licenses issued for the SSFL, all of the radionuclides selected for radiochemical analysis of soil and groundwater samples are likely to have been used or generated on the SSFL. Promethium-147 is yet to be placed on the list, but its short half-life of 2.62 years should not make it a radionuclide of concern.

A historical review of operations in Buildings 4009 and 4020 has not yet been conducted. Additional radionuclides may be identified after these buildings have been investigated.

Table 3.3
Summary of Subarea HSA-5A Sites
Potential Contaminants of Concern

Site No.	Use(s)	Current Status	Potential Radiological Contaminants of Concern	MARSSIM Class
4005	Uranium Carbide Fuel Pilot Plant	Demolished	Potential radioactive contaminants include natural and enriched uranium (U-238, U-234, U-235), activation products (iron-59 (Fe-59), cobalt-60 (Co-60)), isotopes of thorium (Th-231, Th-234), carbon-14 (C-14), manganese-54 (Mn-54), sulfur-35 (S-35), phosphorous-32 (P-32).	1
4023	Liquid Metals Component Test Building	Demolished	Potential radioactive contaminants include natural and enriched uranium (U-234, U-238 and U-235), isotopes of thorium (Th-228, TH-232), isotopes of plutonium (Pu-238, Pu-239, Pu-240, Pu-241, Pu-242), Ne-237, Am-241, fission products (Cs-134, Cs-137, Sr-90), and activation products (Co-60, Fe-55, Eu-152, Eu-154, Ni-59, Ni-63, Ta-182, Mn-54).	1
4024	SNAP Environmental Test Facility	Partially Standing	Potential radioactive contaminants include natural and enriched uranium (U-238 and U-235), isotopes of thorium (Th-232), isotopes of plutonium (Pu-238, Pu-239, Pu-240, Pu-241, Pu-242), Am-241, fission products (Cs-137, Sr-90), and activation products (Co-60, H-3, Fe-55, Eu-152, Eu-154, Ni-59, Ni-63, Mn-54), K-40, Na-22.	1
4027	SNAP Engineering Development Laboratory	Demolished	Radionuclides of concern at the RMHF include all radionuclides that are included in the background study plus any additional radionuclides identified during the HSA.	2
4029	Radiation Measurement Facility	Standing	Potential radioactive contaminants include fission products (Cs-137) and activation products (Co-60), Ra-226	1
4030/ 4035	AE-6 Counting Room and Workshop	Demolished	Potential radioactive contaminants include H-3.	1
4032	Space Environmental Test Facility	Demolished	Potential radioactive contaminants include activation product Co-60.	2

Table 3.3 (continued)
Summary of Subarea HSA-5A Sites
Potential Contaminants of Concern

Site No.	Use(s)	Current Status	Potential Radiological Contaminants of Concern	MARSSIM Class
4036	Non-Nuclear Office Building	Demolished	None specifically identified; however, direct radiation and skyshine from RMHF may affect ambient radiation conditions in the area.	1
4042	SNAP Shield Casting Facility	Demolished	Potential radioactive contaminants include natural and enriched uranium (U-238 and U-235).	1
4046	Material Office Annex	Demolished	None specifically identified.	2
4048	Plant Development Unit Instrumentation Building	Demolished	None specifically identified.	1
4049	Hydraulic Test Control Center	Demolished	Potential radioactive contaminants include activation products (Co-60, Mn-54, Ni-59, Ni-63, Fe-55, Fe-59), C-14, S-35, P-32.	1
4073	Kinetic Experiment Water Boiler Reactor	Demolished	Potential radioactive contaminants include natural and enriched uranium (U-238 and U-235), fission products (Cs-137, Sr-90), and activation products (Co-60, Eu-152, Eu-154).	1
4074	Storage and Film Processing Building	Demolished	Potential radioactive contaminants include natural and enriched uranium (U-238 and U-235), fission products (Cs-137, Sr-90), and activation products (Co-60, Eu-152, Eu-154).	1
4083/ 4103	Control Building	Demolished	None specifically identified.	1
4093	AE-6 Reactor Building	Demolished	Potential radioactive contaminants include natural and enriched uranium (U-238 and U-235), fission products (Cs-137, Sr-90), and activation products (Co-60, Eu-152, Eu-154).	1
4123	KEWB Waste Storage Building	Demolished	Potential radioactive contaminants include natural and enriched uranium (U-238 and U-235), fission products (Cs-137, Sr-90), and activation products (Co-60, Eu-152, Eu-154).	1
4185	Unknown	Demolished	None specifically identified.	1
4453	Fuel Handling Building	Demolished	Potential radioactive contaminants include natural and enriched uranium (U-238 and U-235), fission products (Cs-137, Sr-90), and activation products (Co-60, Eu-152, Eu-154).	1
4501	Parking Lot	Vegetated	None specifically identified.	2
4536	Parking Lot	Evidence remains	None specifically identified.	2
4633	Reactor Cooling Water Pad	Demolished	None specifically identified.	1

Table 3.3 (continued)
Summary of Subarea HSA-5A Sites
Potential Contaminants of Concern

Site No.	Use(s)	Current Status	Potential Radiological Contaminants of Concern	MARSSIM Class
4641	Shipping and Receiving	Demolished	Regulated radioactive material handled in the building; however, a complete list of materials handled in Building 4641 could not be located. As a result, the potential radioactive contaminants include natural and enriched uranium (U-238, U-234, U-235), isotopes of plutonium (Pu-238, Pu-239, Pu-240, Pu-241), Am-241, fission products (primarily Cs-137, Sr-90), and activation products (H-3, Fe-55, Co-58, Co-60, Ni-63, Ba-133, Eu-152, Eu-154, Eu-155, Pm-147, Ta-182).	2
4643	KEWB Exhaust Building	Demolished	Potential radioactive contaminants include natural and enriched uranium (U-238 and U-235), fission products (Cs-137, Sr-90), and activation products (Co-60, Eu-152, Eu-154).	1
4793	KEWB Heating and Air Conditioning	Demolished	Potential radioactive contaminants include natural and enriched uranium (U-238 and U-235), fission products (Cs-137, Sr-90), and activation products (Co-60, Eu-152, Eu-154).	1
4927	Nitrogen Storage Tank	Demolished	None specifically identified.	1

4.0 REACTOR/CRITICALITY FACILITIES WORKS CITED

4.1 BUILDING 4024

Reactor Acronym	Building No.	Facility Name	Power Level (kW)	Period of Operation	Power Generated (MWd)	Radioactivity at End of Operation (10^3 Ci)
S2DR	4024	SNAP Environmental Test Facility	65	4/1961 to 12/1962	13	390
S10FS3	4024	SNAP Environmental Test Facility	37	1/1965 to 3/1966	16	6000

Facility Name	Building No.	Period of Operation	Notes
SNAP Transient Test	4024	1967 to 1969	SNAP transient response tests

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4.2 BUILDING 4073

Reactor Acronym	Building No.	Facility Name	Power Level (kW)	Period of Operation	Power Generated (MWd)	Radioactivity at End of Operation (10^3 Ci)
KEWB	4073	Kinetics Experiment Water Boiler	1	7/1956 to 11/1966	1	6

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4.3 BUILDING 4093

Reactor Acronym	Building No.	Facility Name	Power Level (kW)	Period of Operation	Power Generated (MWd)	Radioactivity at End of Operation (10^3 Ci)
L-85/AE-6	4093	L-85 Nuclear Experimentation Reactor	3	11/1956 to 2/1980	2	18

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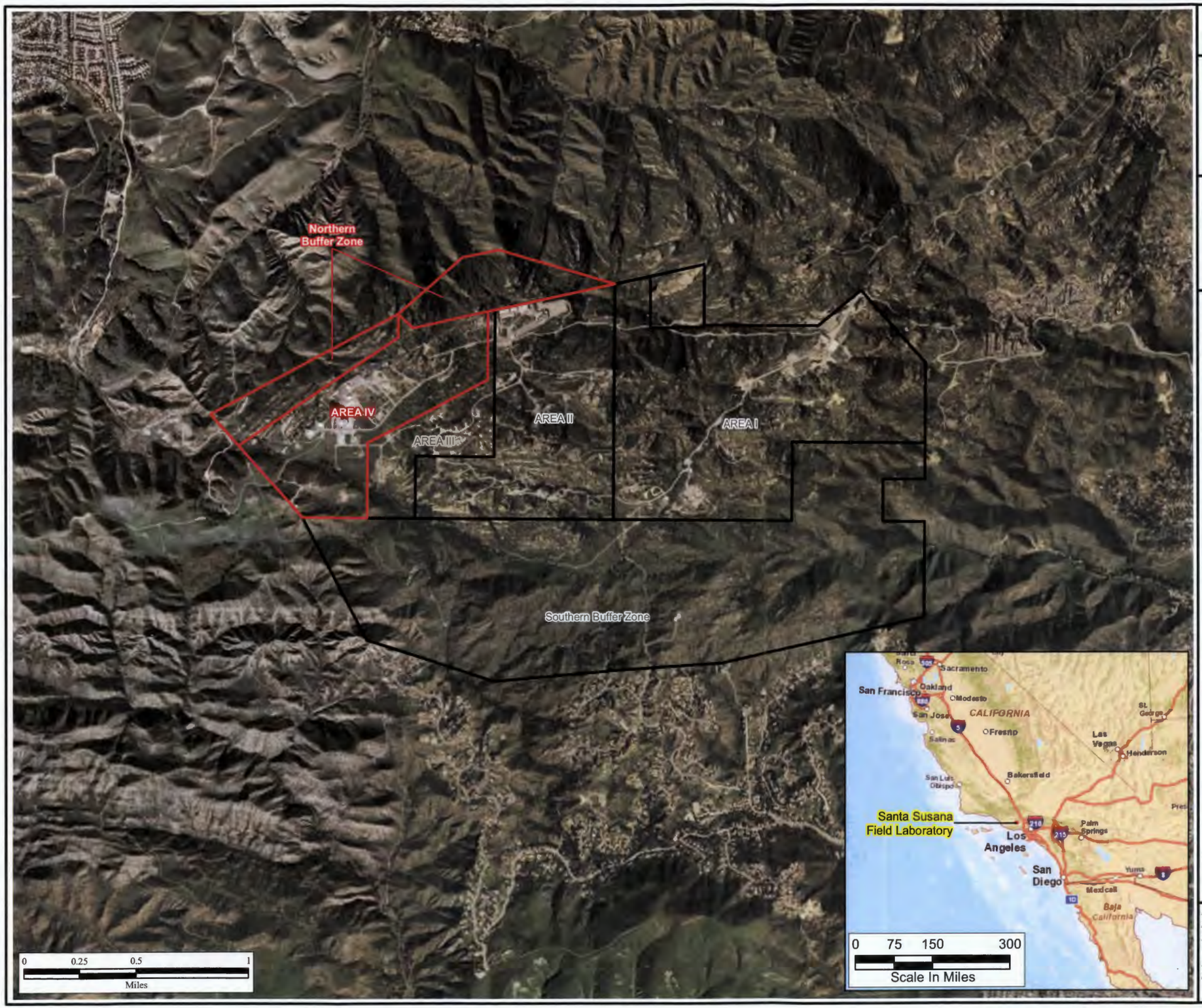
FIGURES

PARTIALLY SCANNED
OVERSIZE ITEM(S)

See document # 2266487
for partially scanned image(s).
PLATE 1
SUBAREA HSA - 5A
For complete hardcopy version of the oversize document
contact the Region IX Superfund Records Center

Figure 1.1
Site Location
Santa Susana Field Laboratory

U.S. EPA Region 9



Legend

- EPA Study Area Boundary; Area IV and Northern Buffer Zone
- Santa Susana Field Laboratory Property Boundary

N

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Project: EP9038
Created: CLimoges
Revised: 10/15/2010 TJ
Sorce: CaSil, NAIP 2009; Boeing 2008

HGL HydroGeoLogic, Inc

Redacted

Figure 1.2
General Site Layout for
Area IV/HSA Subareas
Santa Susana Field Laboratory

U.S. EPA Region 9

Legend

HSA Subarea

Buildings

Existing

Removed

0 250 500 1000
Scale In Feet

N

Filepath: Y:\Santa_Susana\EP9038\TM\HSA_5A\(1-02)site_layout.mxd
Project: EP9038
Created: CLimoges
Revised: 10/15/2010 TJ
Sorce: Boeing Company, 2008
CIRGIS, 2007

HGL

Redacted

Figure 1.3
Subarea HSA-5A
Santa Susana Field Laboratory

U.S. EPA Region 9

Legend

Buildings

- Existing
- Removed
- Lined Channel
- Intermittent Stream*
- Pipe (Unknown Type)

*Intermittent streams also represent unlined channels.

N

0 50 100 200
Scale In Feet

Filepath: Y:/Santa_Susana/EP9038/TM/HSA_5A/subarea_HSA_5A.mxd
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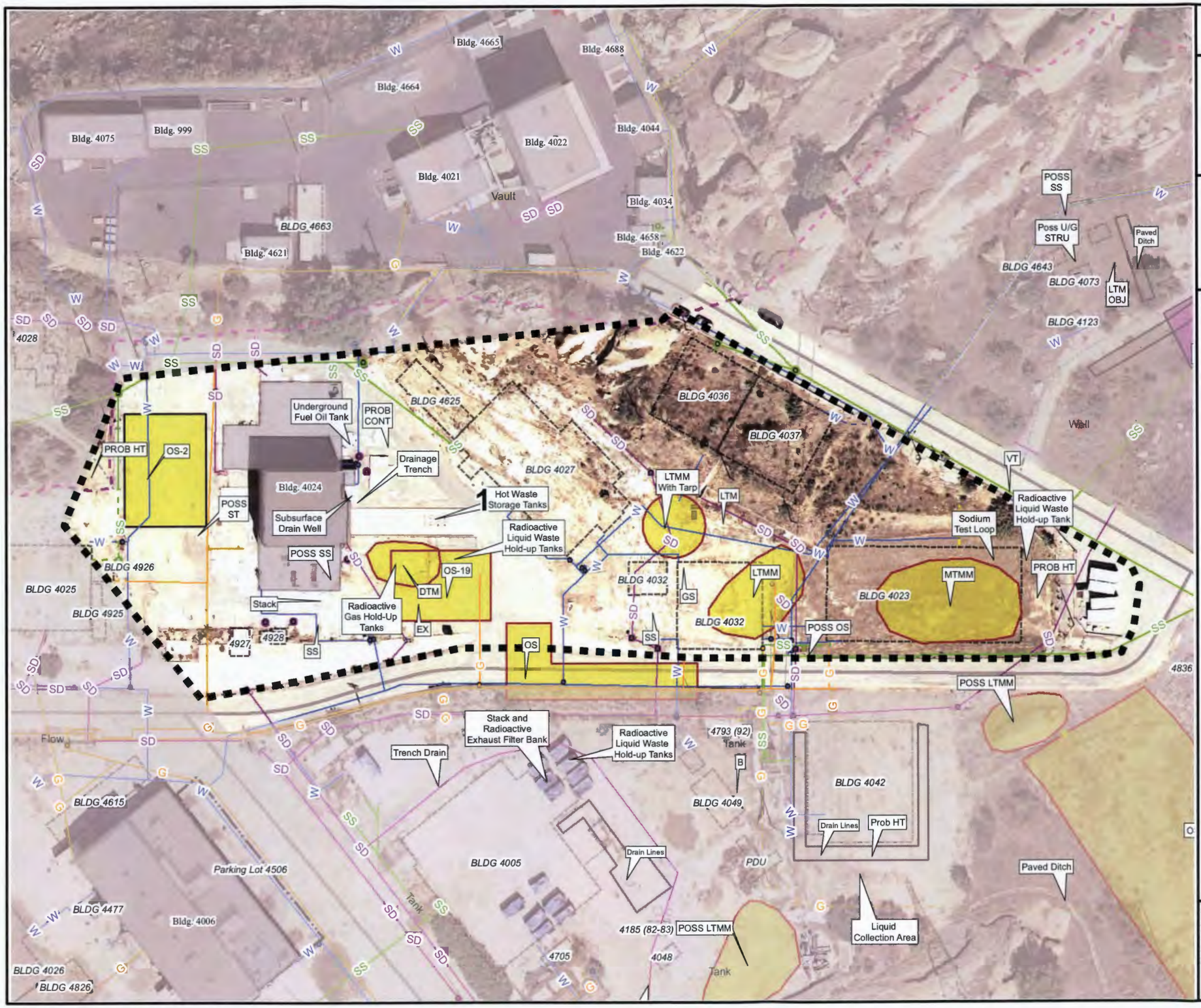
Edited: 10/15/2010 TJ
Source: Boeing Company, 2008
CIRGIS, 2007

HGL HydroGeoLogic, Inc.

Redacted



Historical Site Assessment
Final Technical Memorandum - HSA-5A

Figure 2.1
Area IV Subarea 5A-1
Santa Susana Field Laboratory

U.S. EPA Region 9

Legend

- Subarea 5A-1 Boundary
- Primary Roads
- Secondary Roads
- Underground Storage Tank
- Unknown Tank Type
- Sump
- Dry Well
- Tank Footprint
- Above ground Storage Tank
- Demolished Bldg.
- Existing Bldg.
- Parking Lots
- Drainage
- Drain
- Well

Aerial Photo Features

- Aerial Photography Features
- Leach Field
- Other

Surface Water

- Intermittent Stream
- Permanent Stream
- Surface Water
- Lined Channel
- French Drain
- Drainage
- Leach Field
- Septic System

Utilities

- Channel
- Drain
- Drain
- Drainage Divide
- Gutter
- Tank
- Tank
- Vault
- Well
- Gas
- Storm Drain
- Sanitary Sewer
- Water

B	Building
CONT	Container
CR	Crates
DB	Debris
DG	Disturbed Ground
DTM	Dark Tone Material
EX	Excavation
FA	Fill Area
GS	Ground Scar
HT	Horizontal Tank
IM	Impoundment
MTMM	Medium Toned Mounded Material
OS	Open Storage
PA	Processing Area
PL	Parking Lot
POSS	Possible
PROB	Probable
S-T	Storage Tank
SS	Smoke Stack
ST	Storage
UO	Unidentified Object
VT	Vertical Tank
WDA	Waste Disposal Area

N

0 25 50 100
Scale In Feet

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Revised: 10/19/2010 TJ
Sorce: Boeing Company, 2008
CIRGIS, 2007

HGL

Redacted

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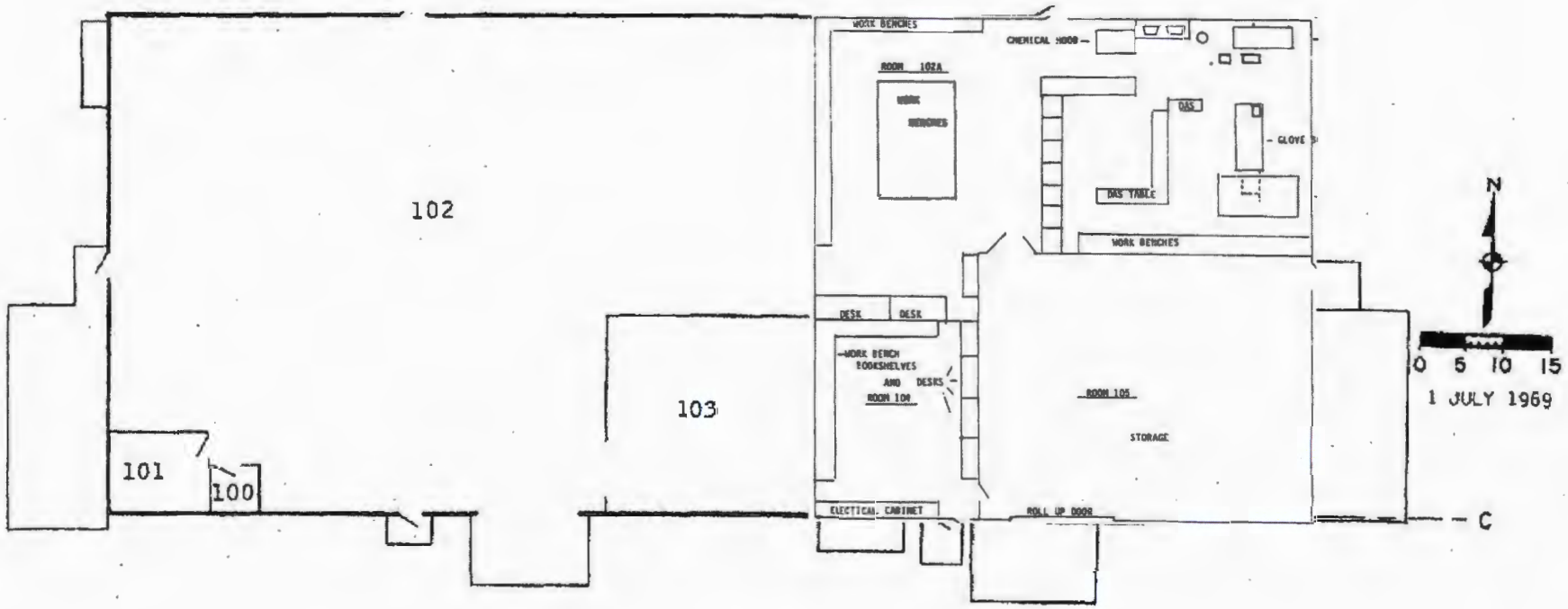
Revised: 10/05/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.1a
Building 4023
Site Photograph



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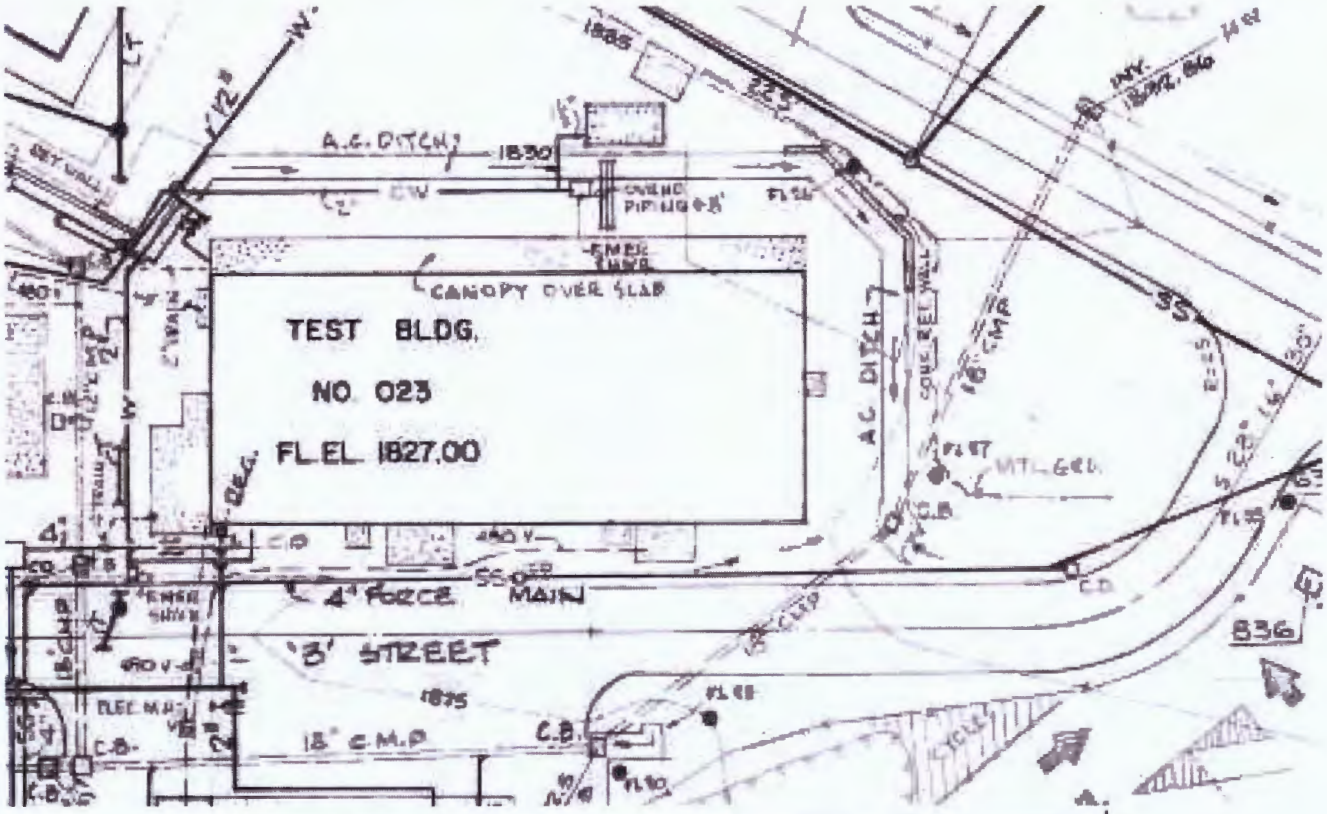
Project:EP9038
Revised: 10/18/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.1b
Building 4023
Floor Plan



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6900 DESOTO AVENUE, CANOGA PARK, CALIF.

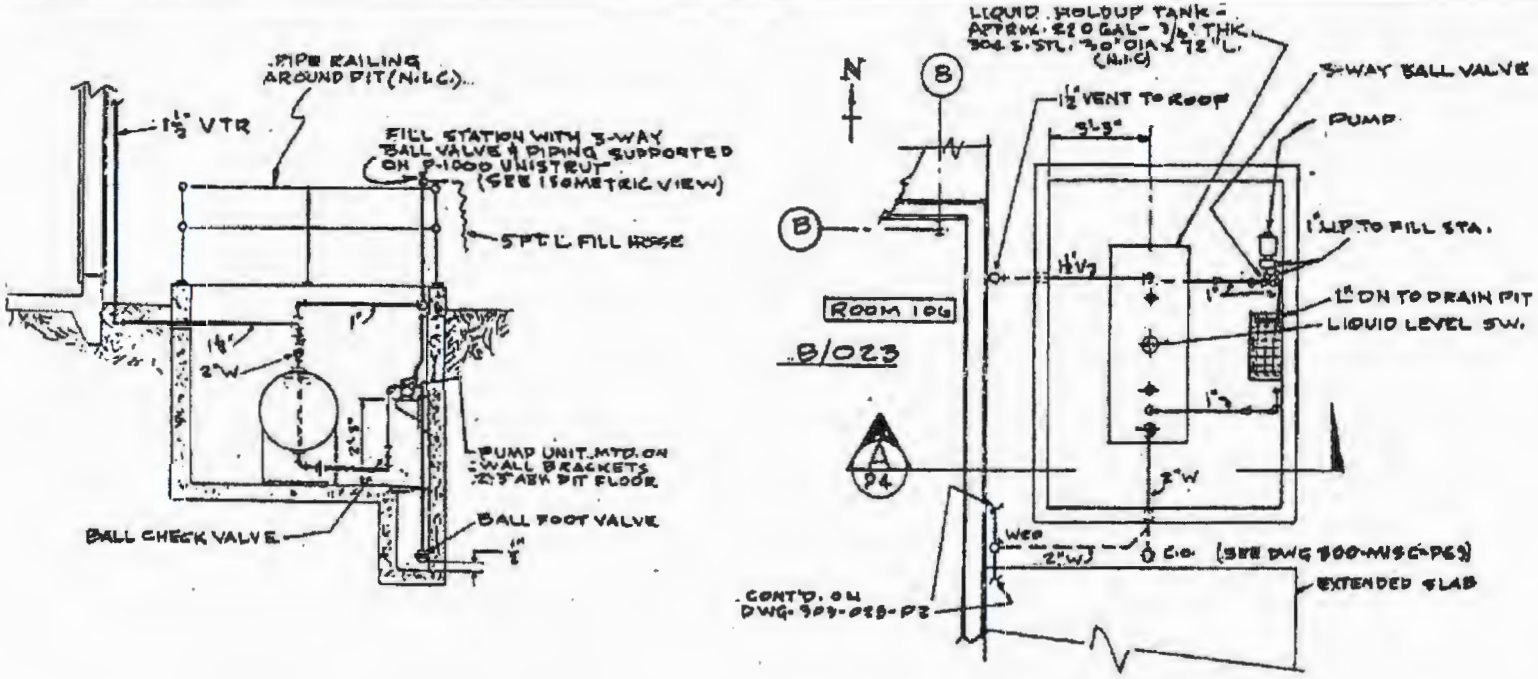
SANTA SUSANA FACILITY
PLOT PLAN

DRAWN	HAMMAN	DWG. SIZE E	303-GEN.-C 38
CHECKED			
ENGINEER	R.P. HAMMAN	SCALE 1" = 40'	SHEET NO. 4 OF 14
APPROVED			

Y:/Santa_Susana/EP9038/TM/HSA_5A (2-1-1c)bldg4023PP.cdr
Project:EP9038
Revised: 09/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.1c
Building 4023
Plot Plan



SECTION A P4
1/4" = 1'-0"

DETAIL C P4
1/4" = 1'-0"

FACILITIES ENGINEERING	Rockwell International Corporation Atomics International Division

PIPING SECTIONS & DETAILS
LAB TEST AREA BLDG. 023
SANTA SUSANA FACILITY, VENTURA CTY., CA.

APPROVED BY	DESIGNED BY L. BENEDICT	RELEASE DATE 11-15-76	REF. NO. PEWR 75194
APPROVED BY	DRAWN BY L. BENEDICT	DRAWING NO. 303-023-P4	REV. NO.
APPROVED BY	CHECKED BY		

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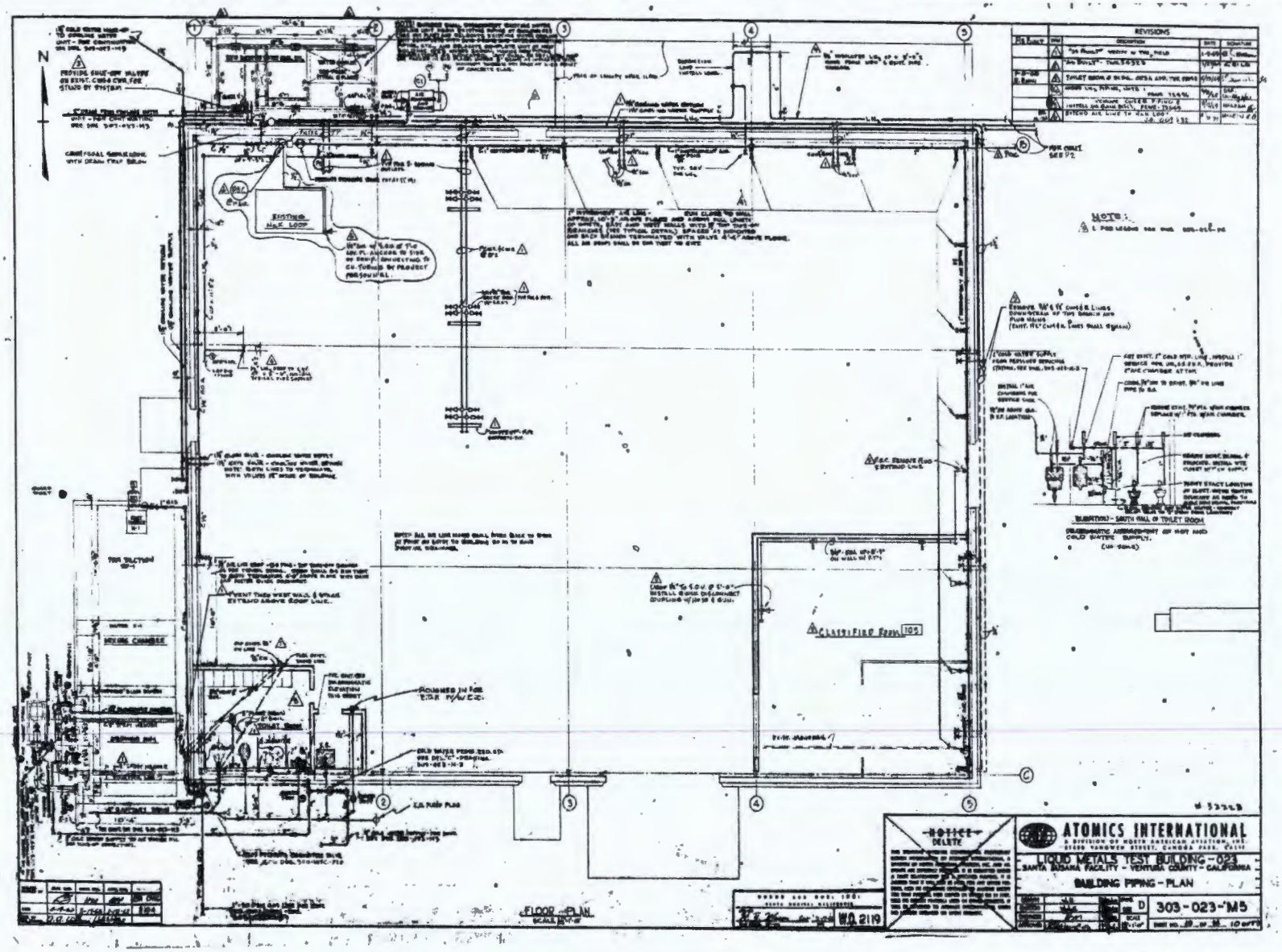
Figure 2.1.1d
Building 4023
Radioactive
Holdup Tank



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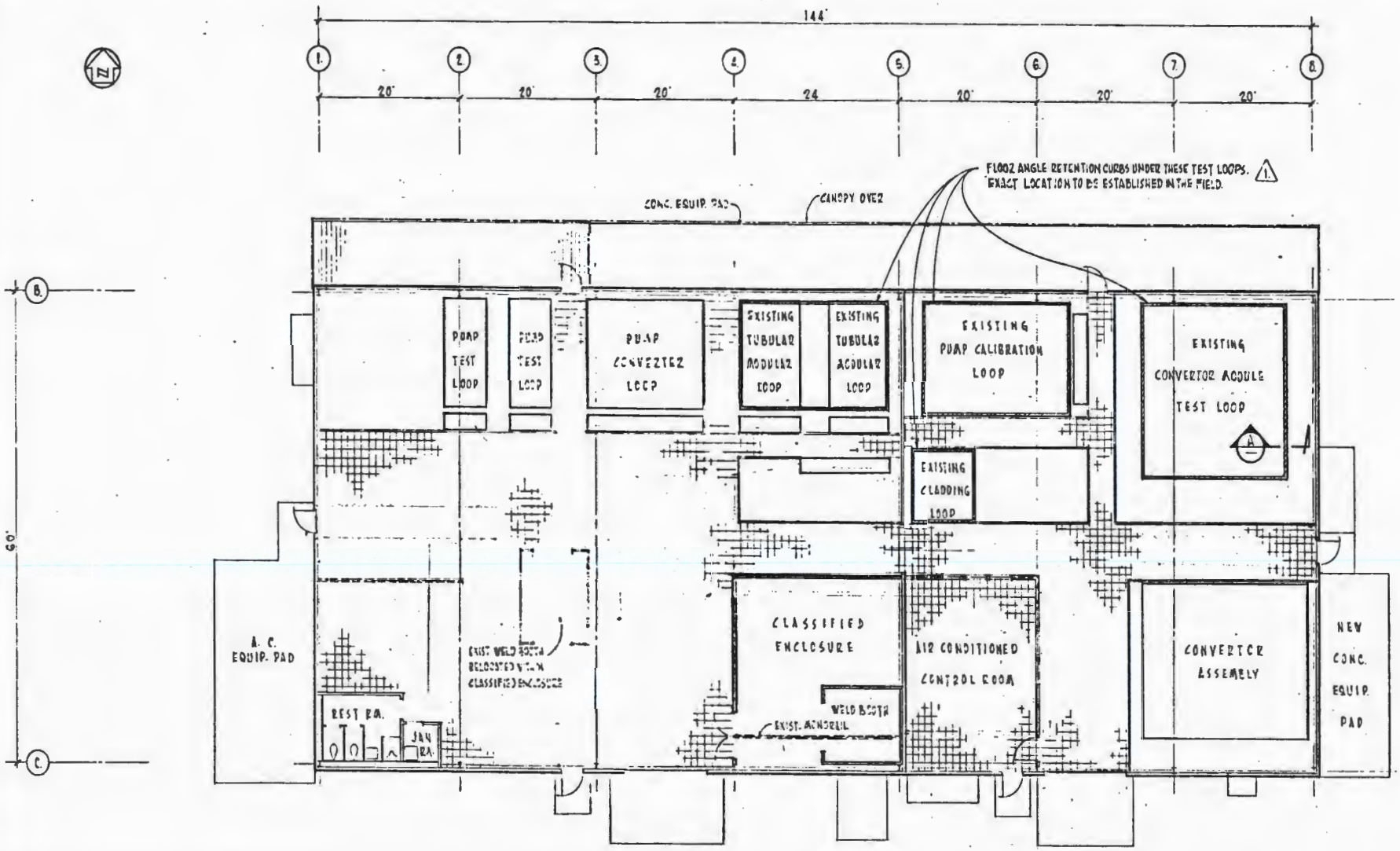
Project:EP9038
Revised: 10/18/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.1e
Building 4023
Piping Plan



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Revised: 10/18/2010 TJ
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Figure 2.1.1f
Building 4023
Zirconium Hydride
Tests Floor Plan

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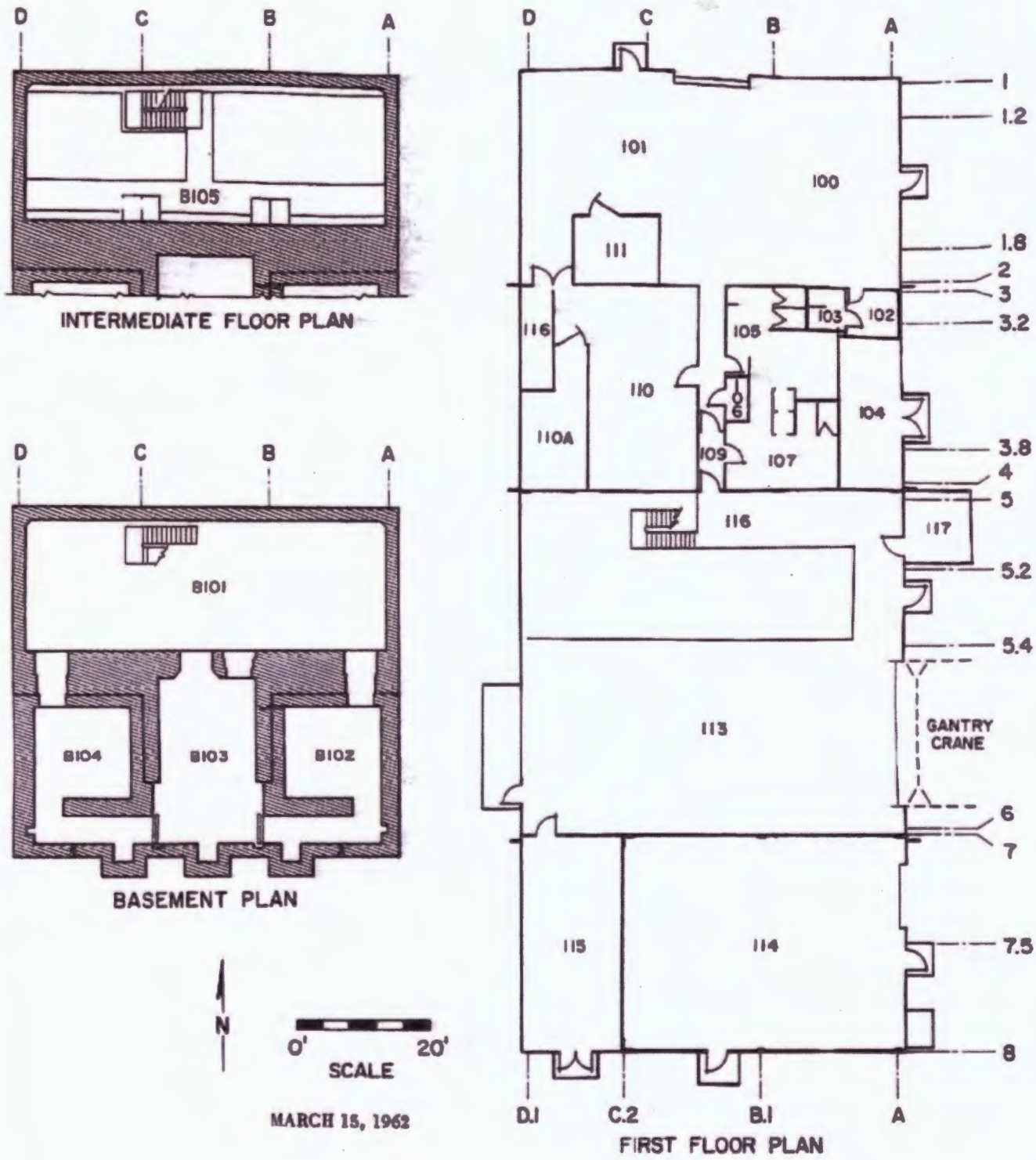
Revised: 10/05/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.2a
Building 4024
Site Photograph



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Source: Boeing Company, 2008

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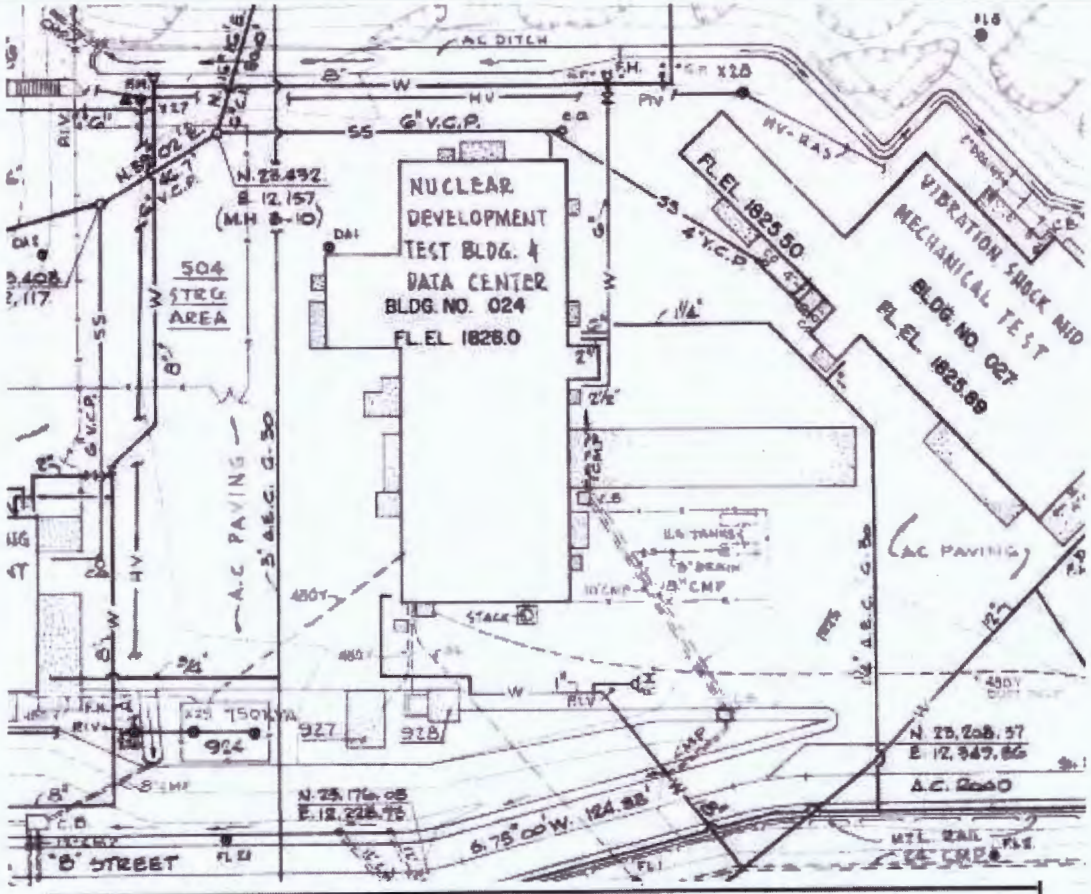
Figure 2.1.2b
Building 4024
Floor Plan



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SANTA SUSANA FACILITY
PLOT PLAN

DRAWN	HAMMAN	DWG. SIZE E	303-GEN.-C40
CHECKED			
ENGINEER	R P HAMMAN	SCALE 1"=40'	SHEET NO. 6 OF 14
APPROVED			

FORM NSA-R9 REV. 1961

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Project:EP9038
Revised: 09/23/2010 TJ
Source: Boeing Company, 2008

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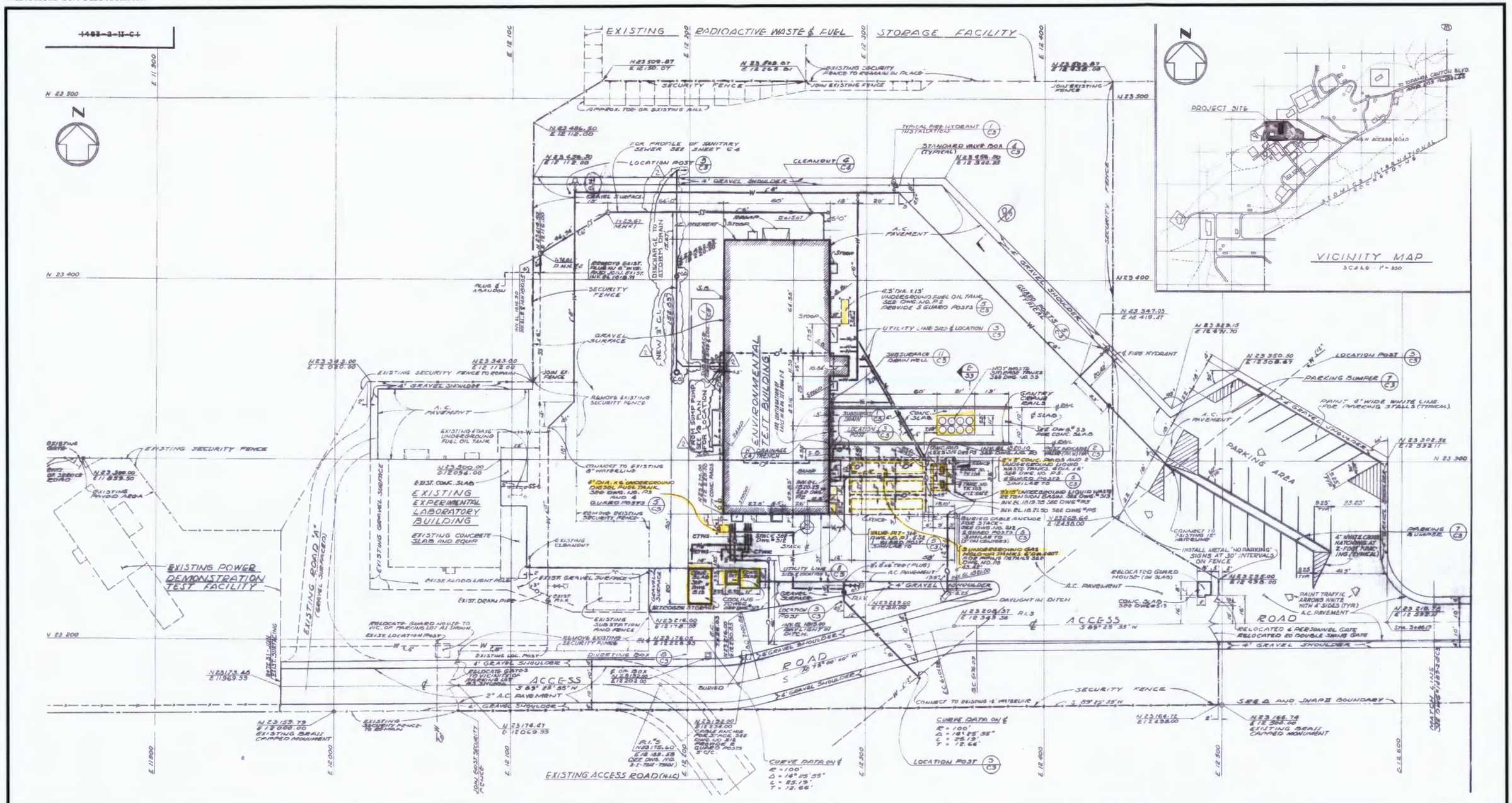
Figure 2.1.2c
Building 4024
Plot Plan



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Project:EP9038
Revised: 10/18/2010 TJ
Source: Boeing Company, 2008

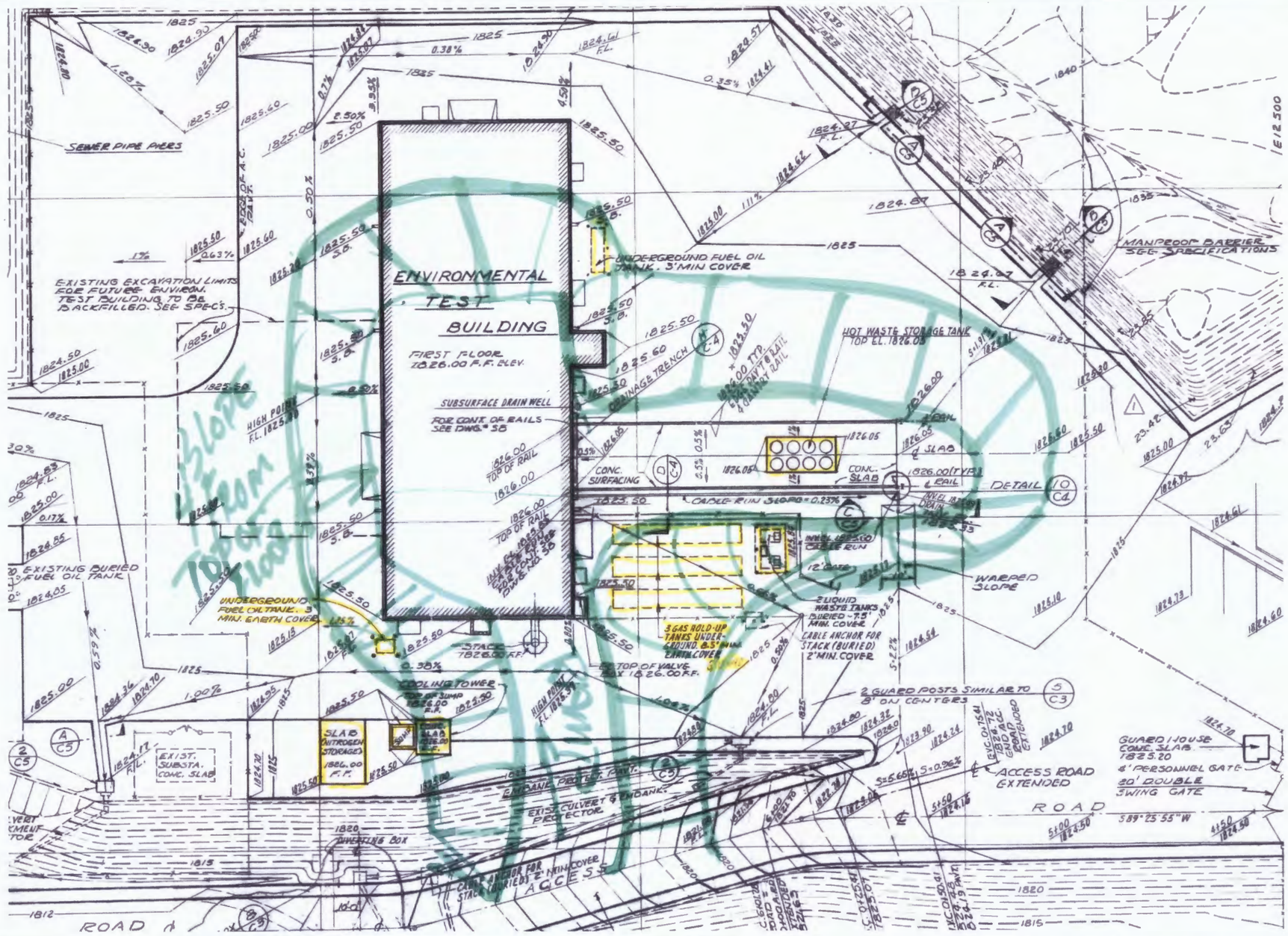
U.S. EPA Region 9

Legend

- PHASE II BUILDING CONSTRUCTION
- SECURITY FENCE LINE (NEW)
- EXISTING SECURITY FENCE LINE
- EXISTING FACILITIES (N.I.C.)
- MANHOLE
- CO. CLEANOUT
- D WASTE DRAIN LINE
- N_2 NITROGEN GAS LINE
- C.T.W.R. COOLING TOWER WATER RETURN
- C.T.W.S. COOLING TOWER WATER SUPPLY
- W_c CONTAMINATED WASTE
- DS SUBSURFACE DRAIN
- S.B. SPLASH BLOCK
- W EXISTING WATER SERVICE
- W WATER LINE
- GATE VALVE
- P.I.V. POST INDICATOR VALVE
- FIRE HYDRANT
- SS SANITARY SEWER LINE

Figure 2.1.2d
Building 4024
1961 Site and Utilities Plan

Redacted



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Project:EP9038
Revised: 10/18/2010 TJ
Source: Boeing Company, 2008

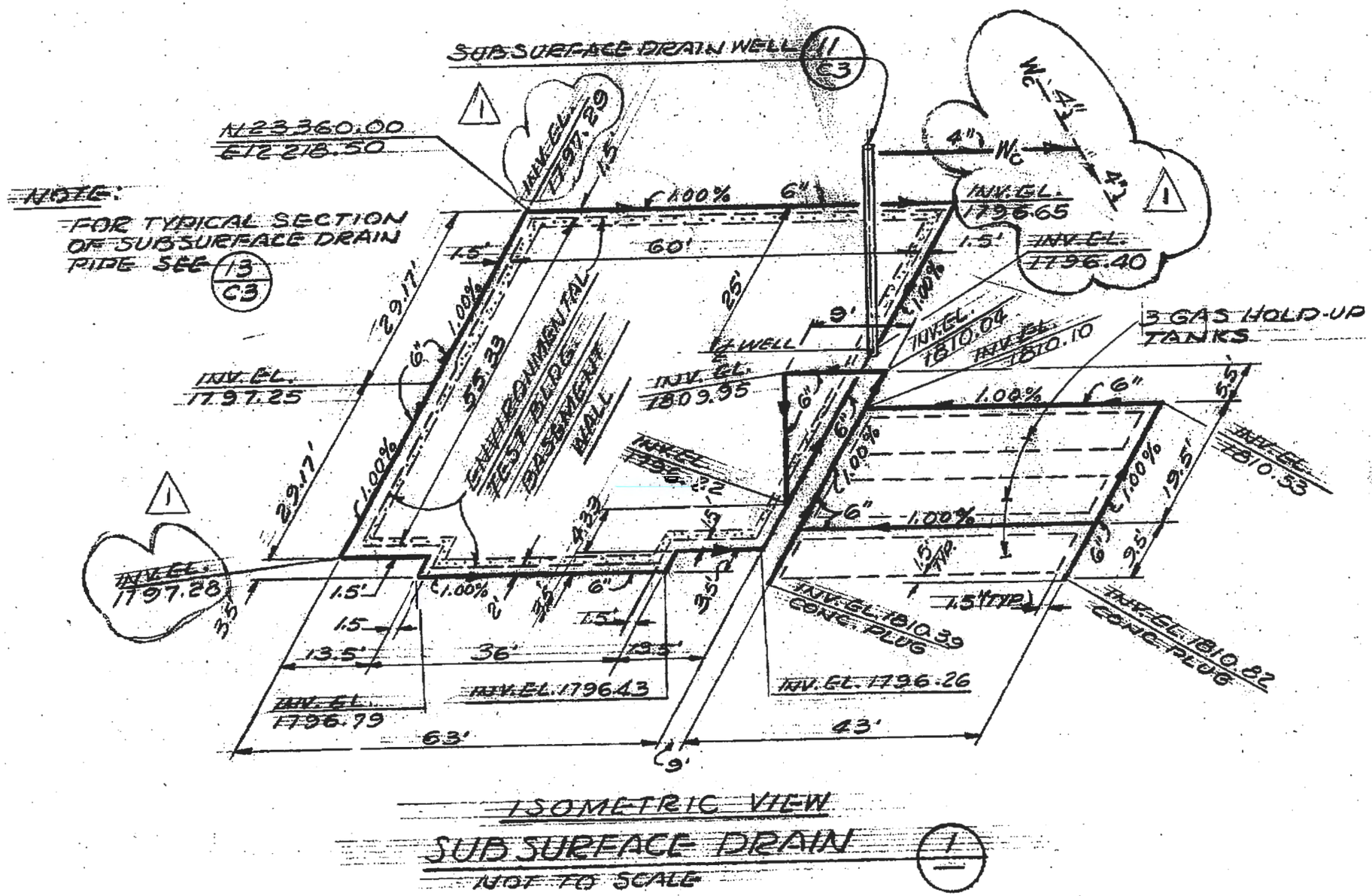
U.S. EPA Region 9

Legend

- BUILDING CONSTRUCTION
- ELEVATION AT FLOW LINE
- ELEVATION FIN SHED FLOOR OR SLAB
- ELEVATION SPLASH BLOCK
- NEW SECURITY FENCE
- EXISTING SECURITY FENCE
- EXISTING 1:1 CUT SLOPE IN ROCK OUTCROP
- ROCK OUTCROPPING AT NATURAL GROUND
- EXISTING CONTOUR AT NATURAL GRADE
- GRADING CONTOUR AND ELEVATION
- EXISTING CONTOUR
- EXISTING FACILITIES (W. C.)
- SRE Δ AND SNAP II BOUNDARY
- FLOW LINE

Figure 2.1.2e
Building 4024
1961Grading and Drainage Plan

Redacted



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Project:EP9038
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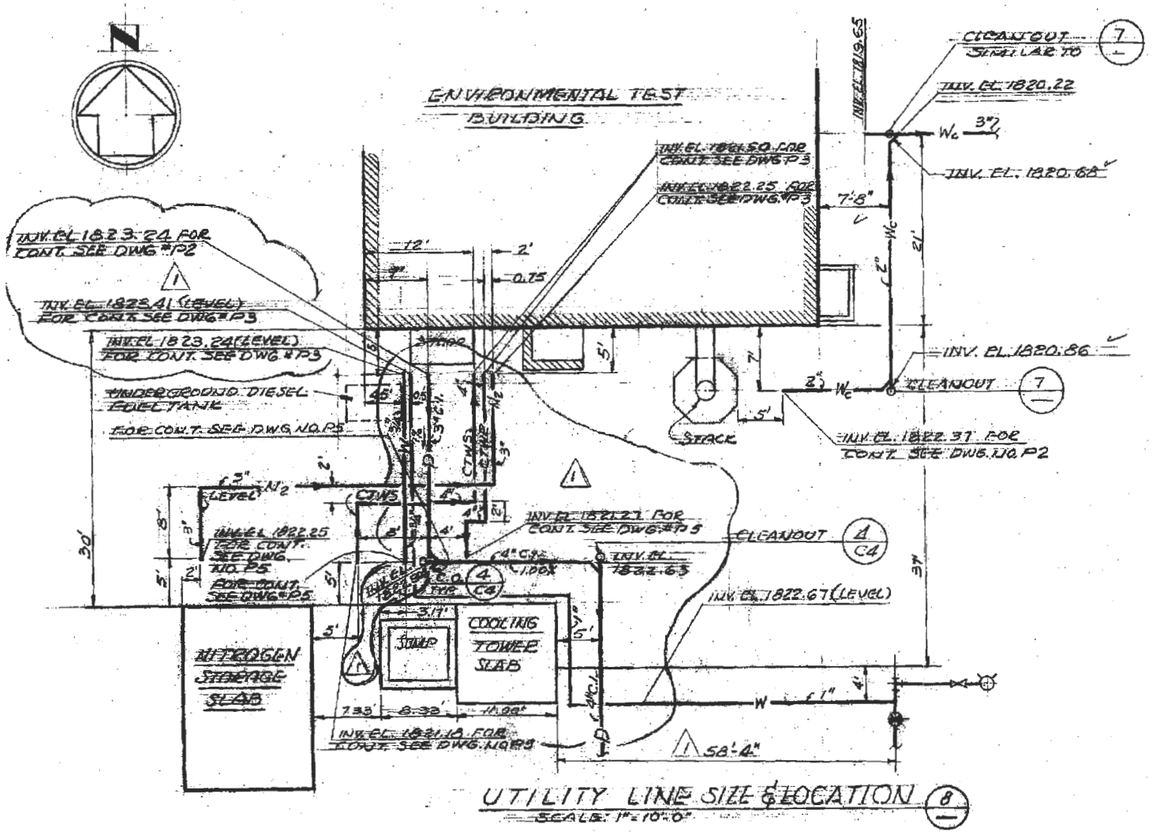
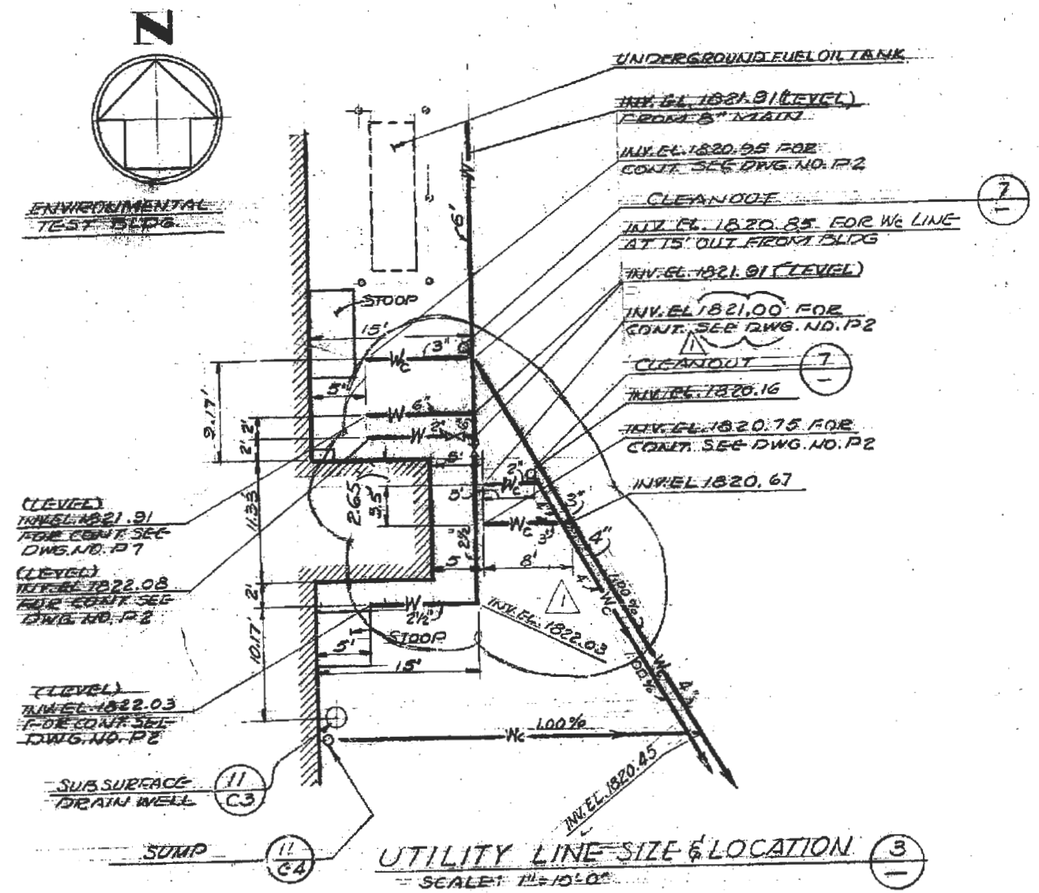
Legend

Figure 2.1.2f
Building 4024
Subsurface
Drainage Plan





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Source: Boeing Company, 2008

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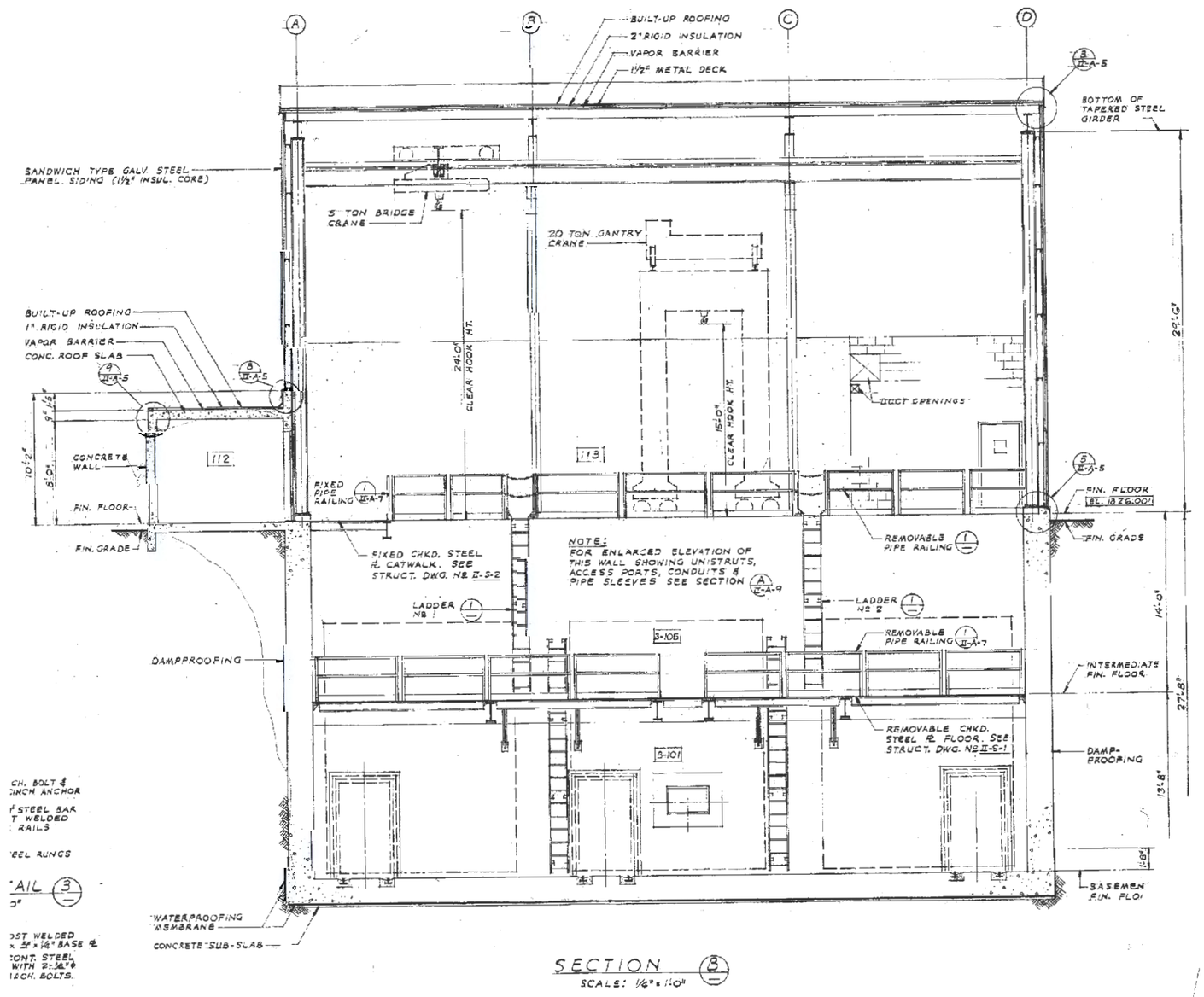
Legend

Figure 2.1.2g
Building 4024
1961 Utility Lines



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Source: Boeing Company, 2008

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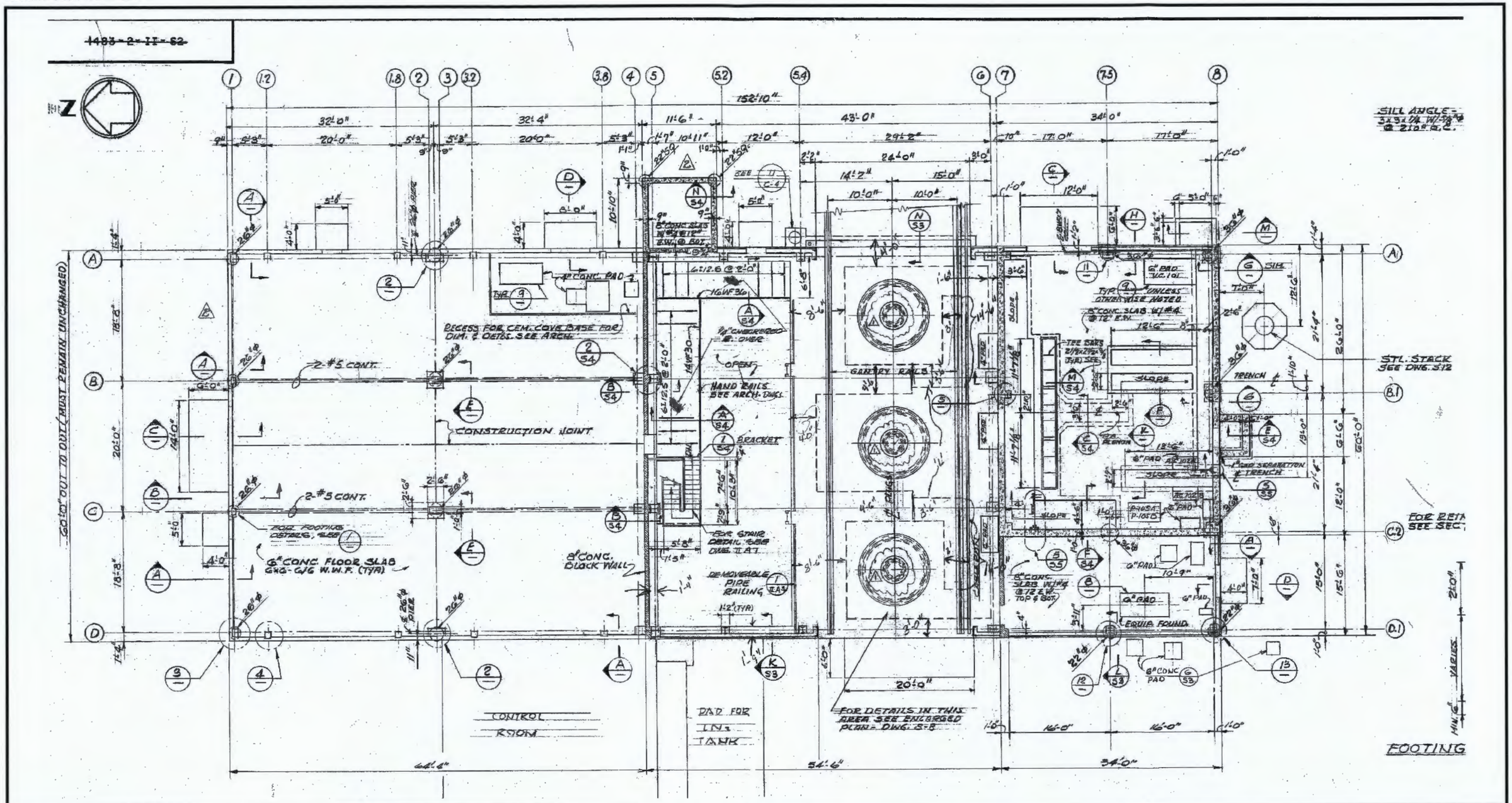
Legend

Figure 2.1.2h
Building 4024
Building Cross Section



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Revised: 10/18/2010 TJ
Source: Boeing Company, 2008

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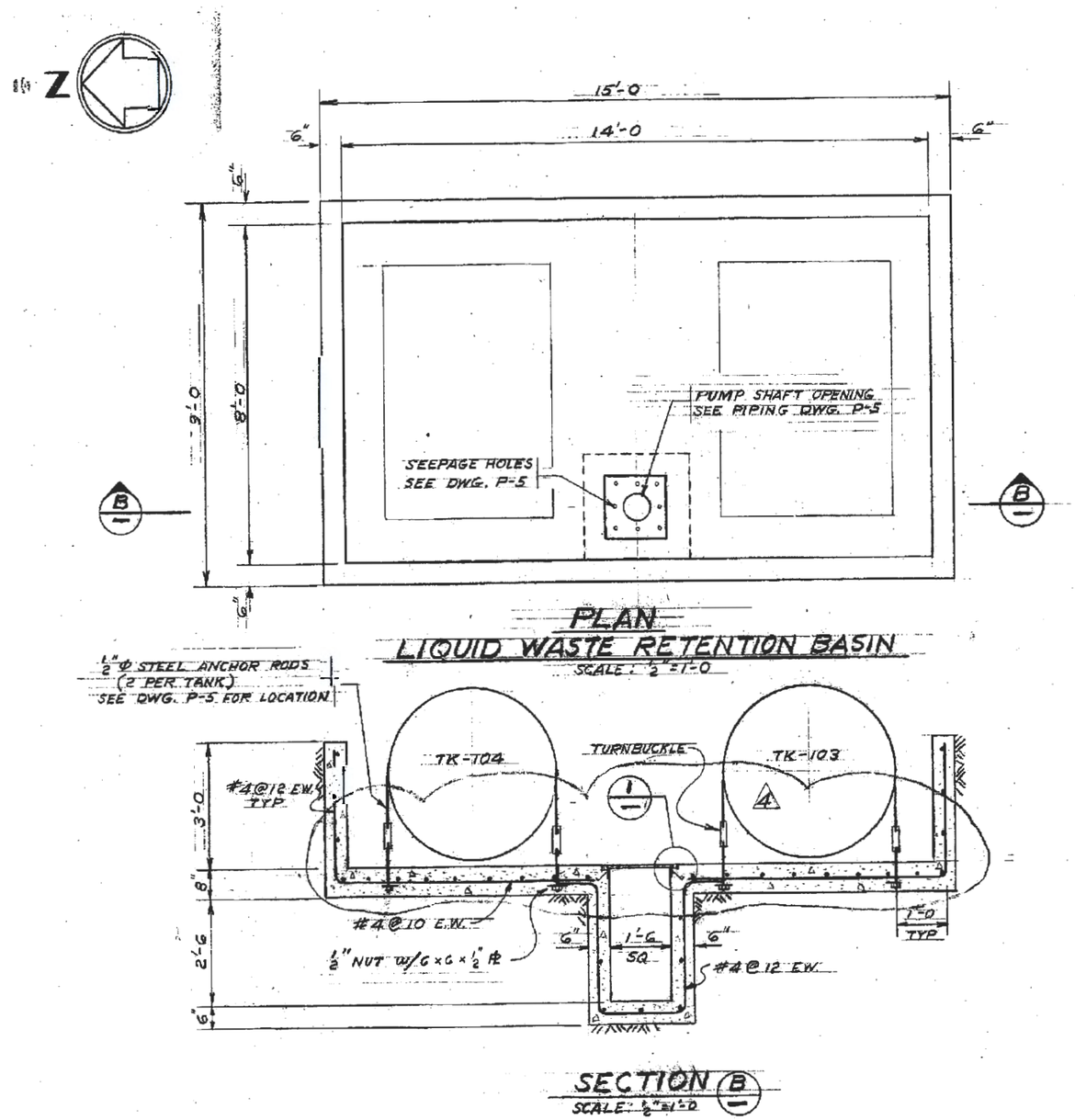
Legend

Figure 2.1.2i
Building 4024
1961 First
Floor Plan



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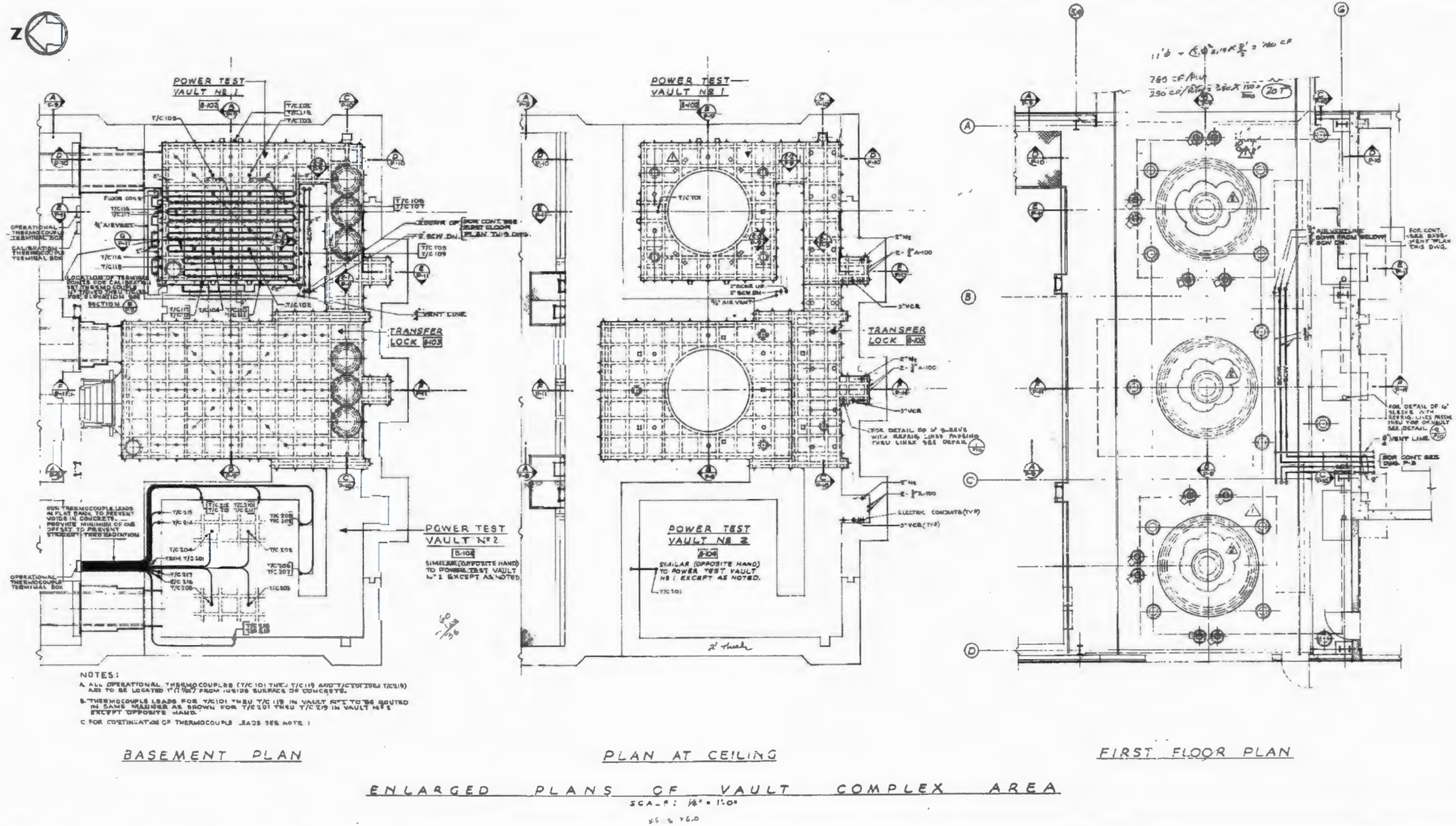
Legend

Figure 2.1.2j
Building 4024
1961 Liquid Waste
Retention Basin



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Source: Boeing Company, 2008

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Legend

Figure 2.1.2k
Building 4024
1961 Vault
Complex Area

Redacted

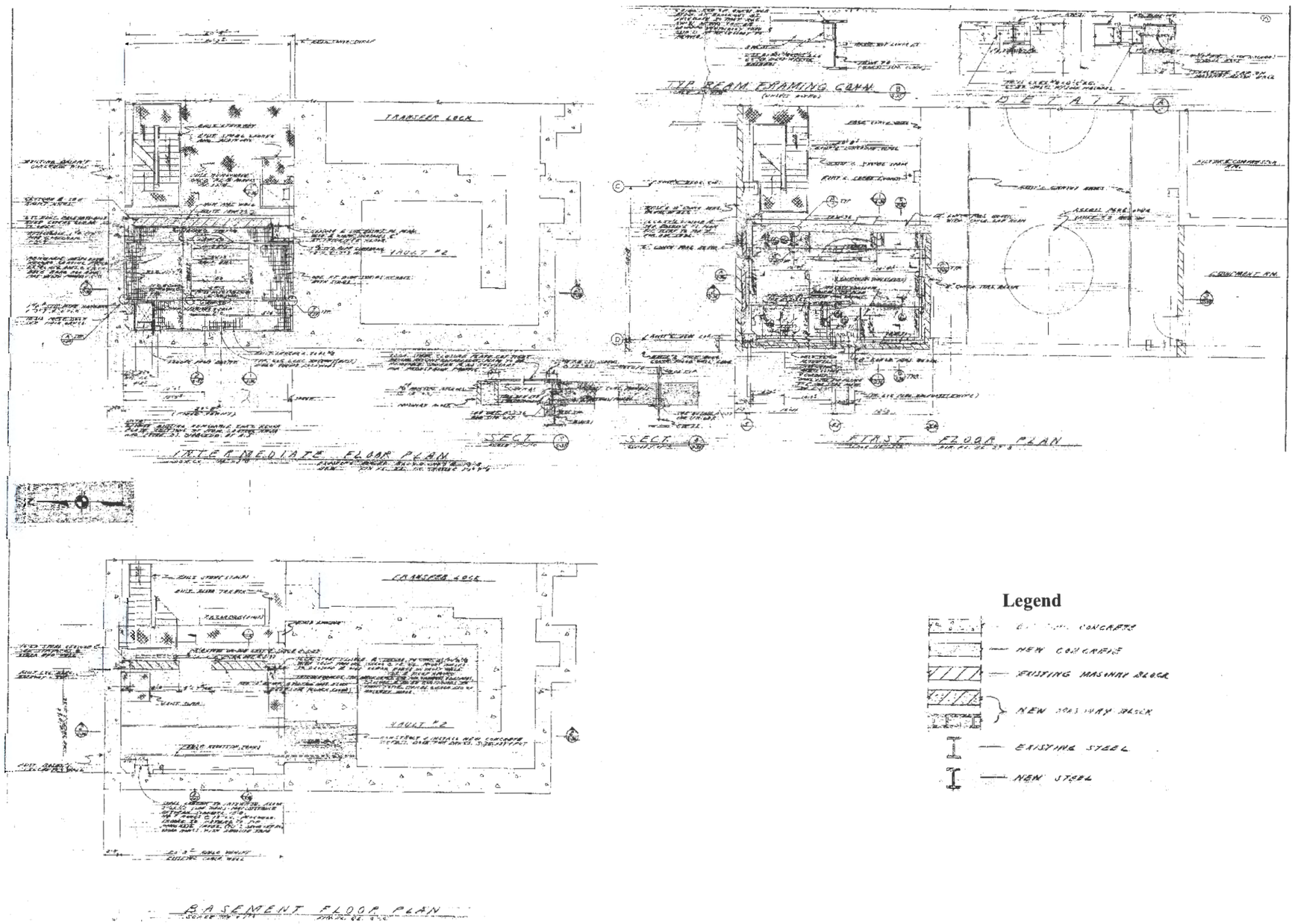

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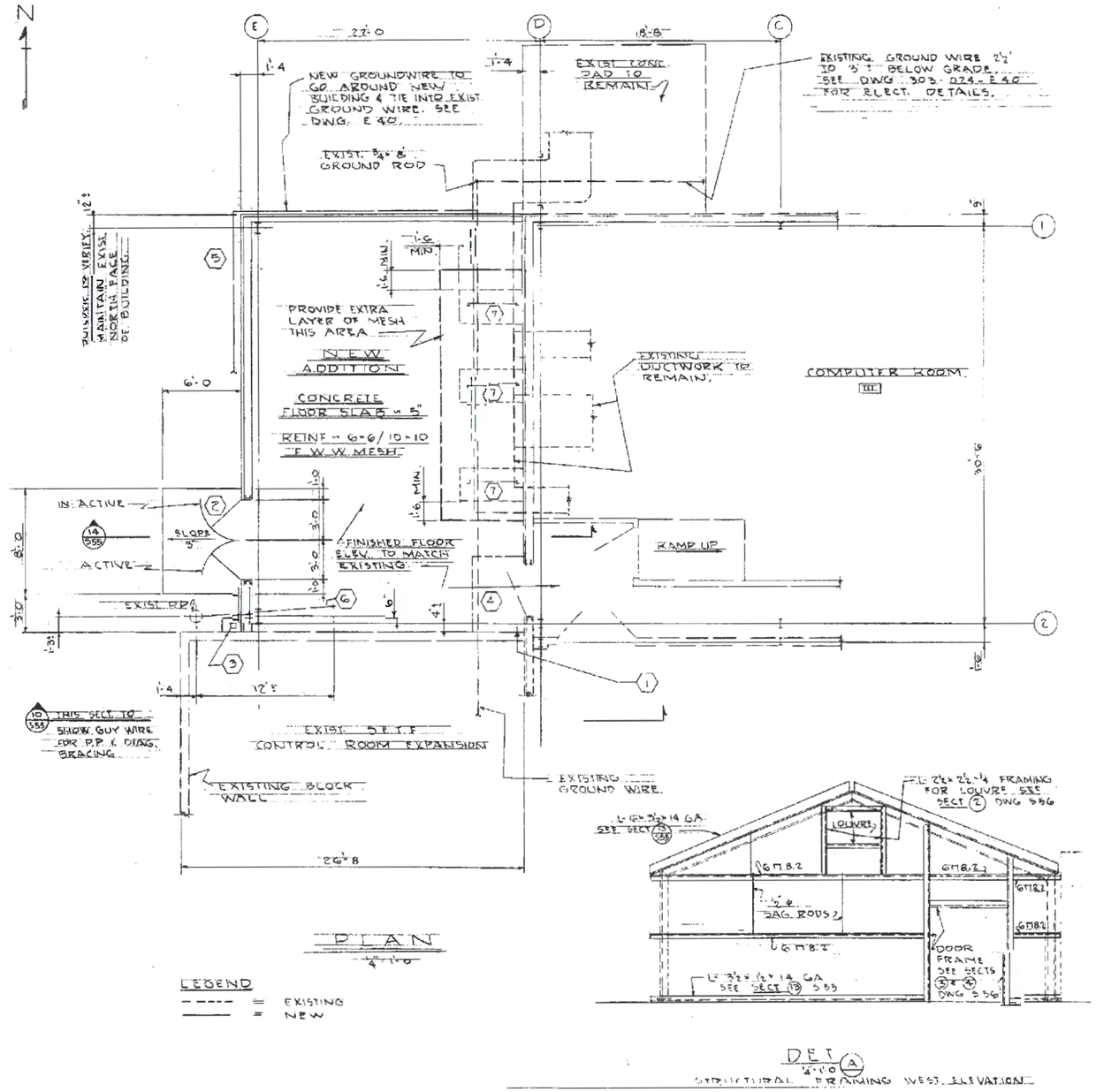
Figure 2.1.2l
Building 4024
1962 SNAP
10FS-1 Floor Plan



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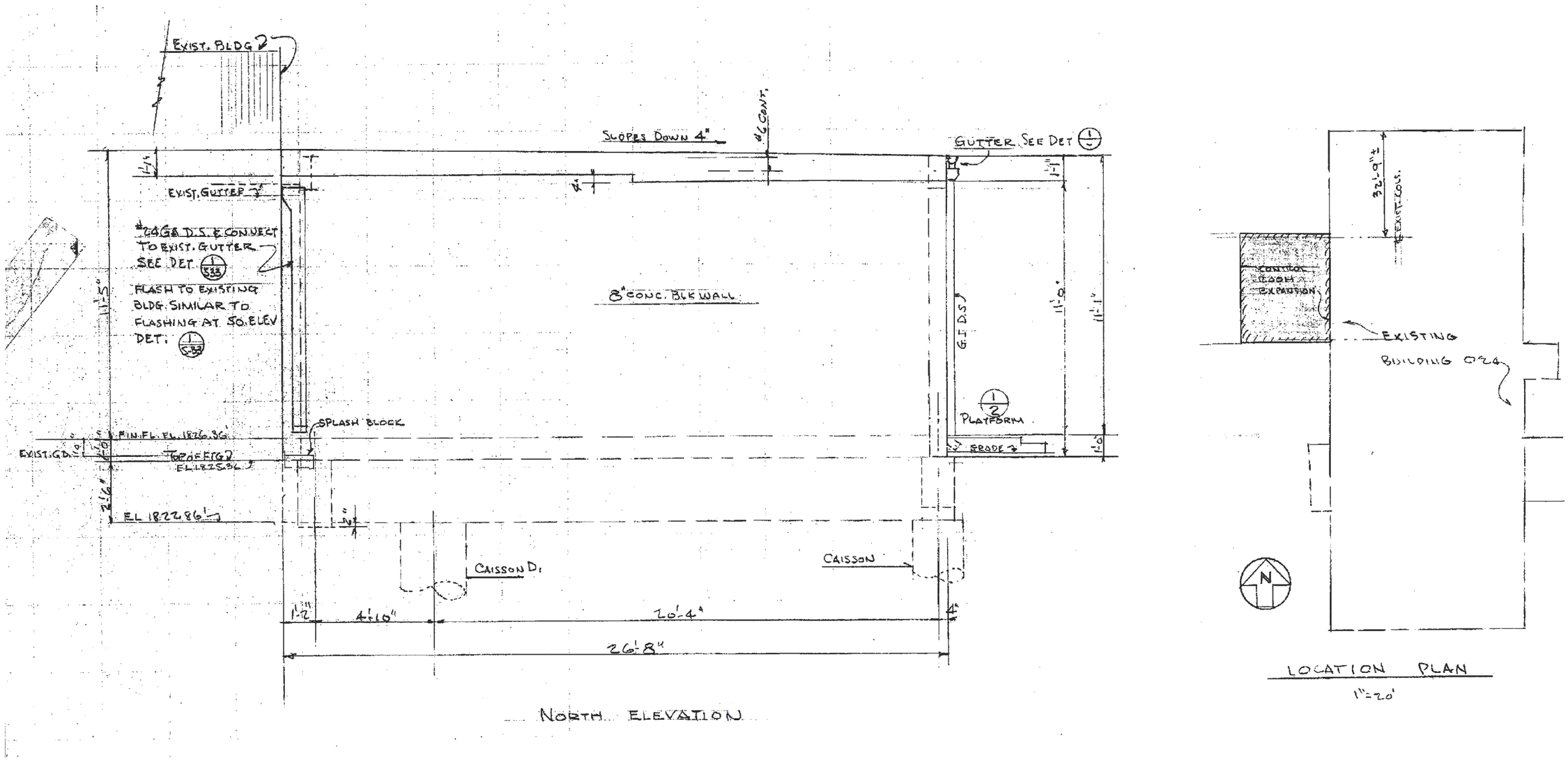
Legend

Figure 2.1.2m
Building 4024
1966 Storage
Area Addition



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Legend

Figure 2.1.2n
Building 4024
1967 Control
Room Expansion

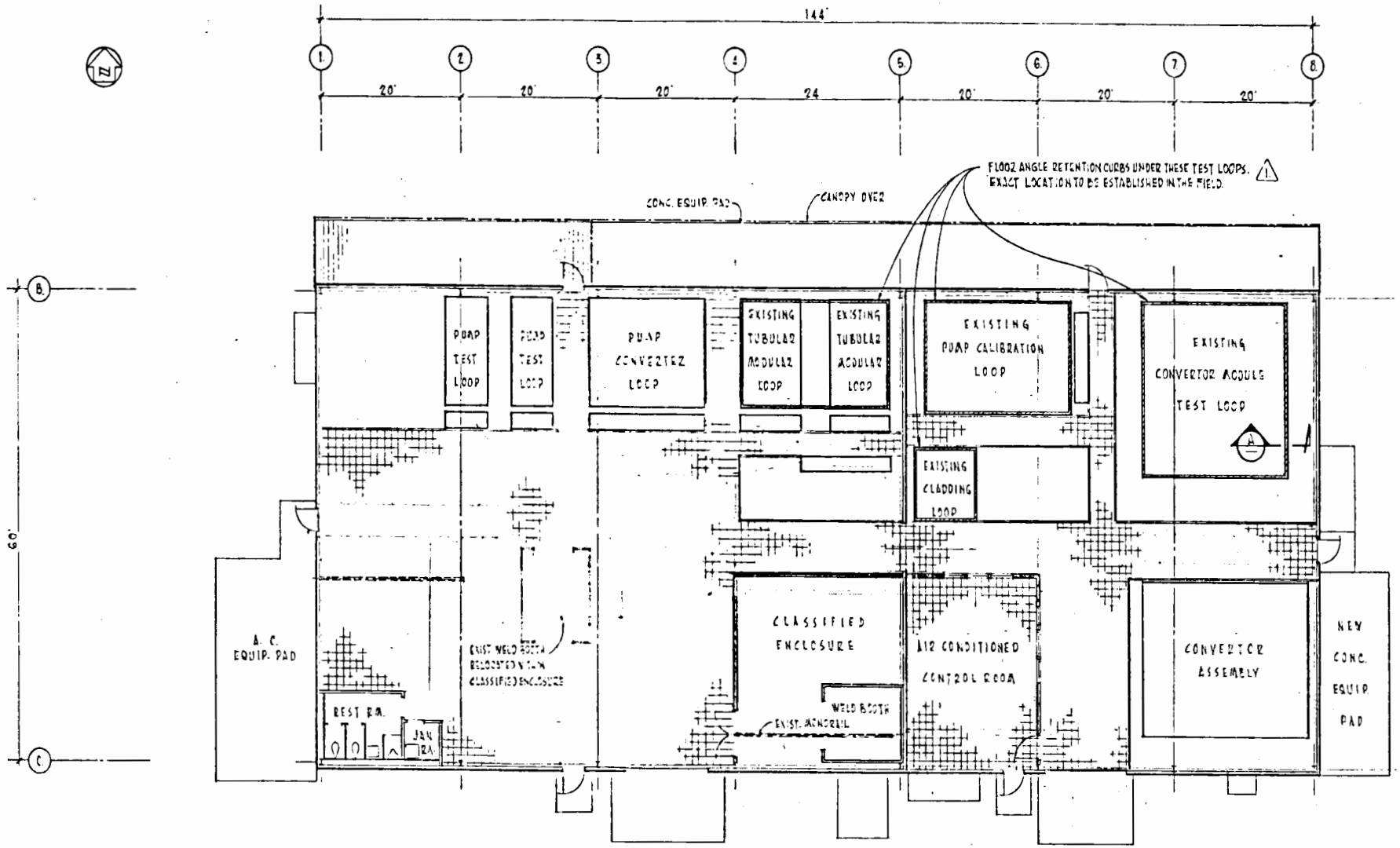

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Figure 2.1.2o
Building 4024
Piping Plan

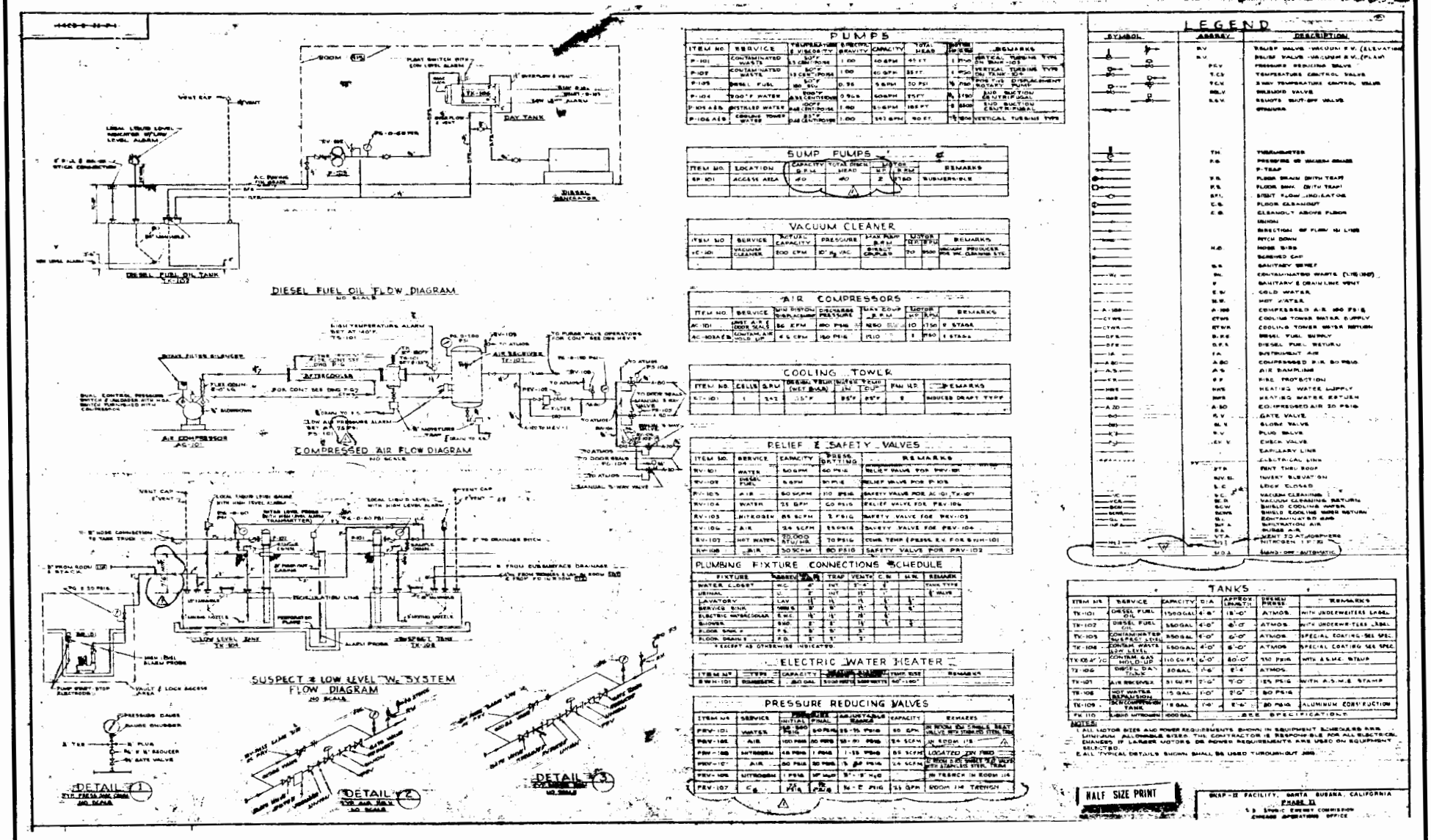

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Figure 2.1.2p
Building 4024
Flow Diagram

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Project:EP9038
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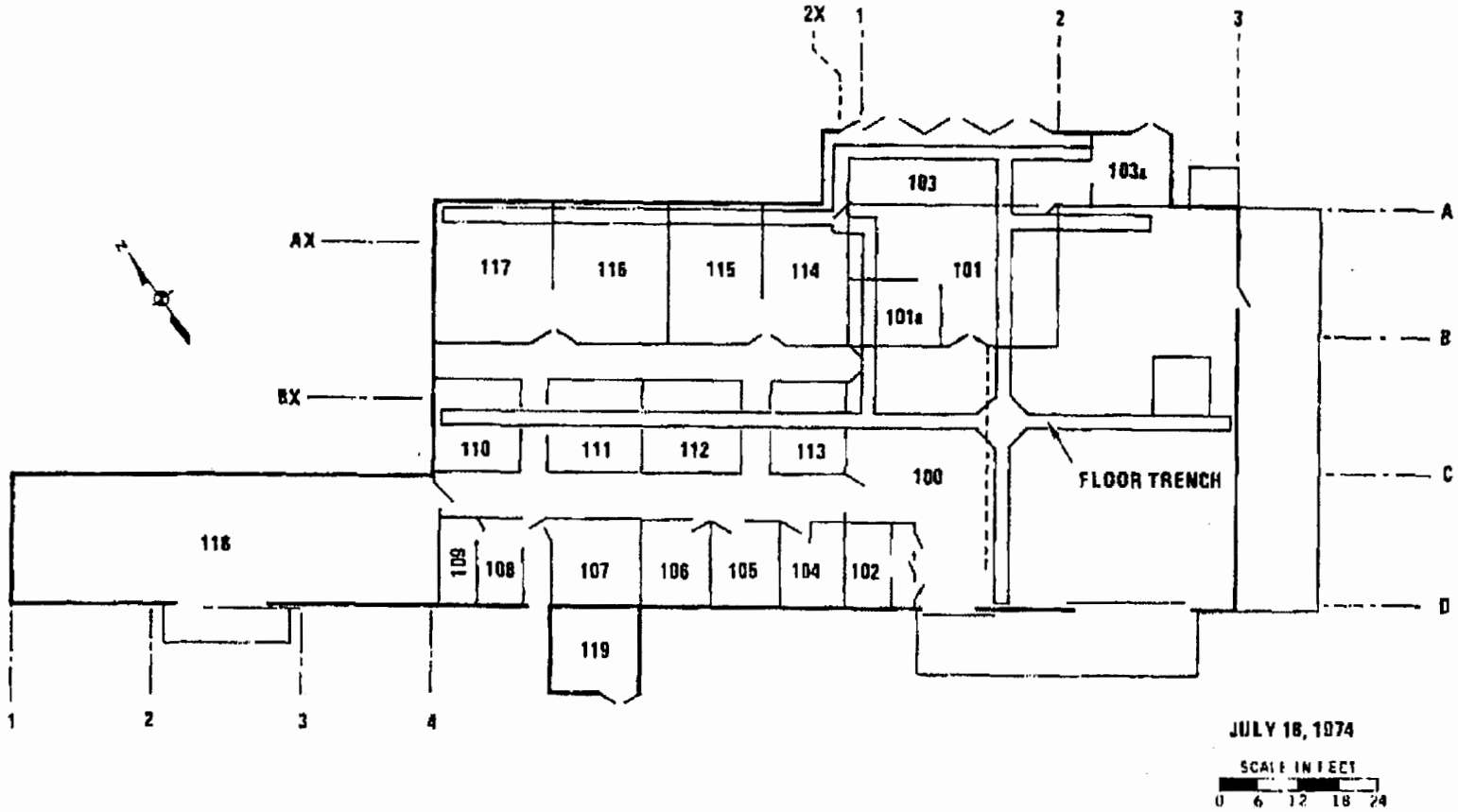
Figure 2.1.3a
Building 4027
Site Photograph



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Page 21
09/20/88

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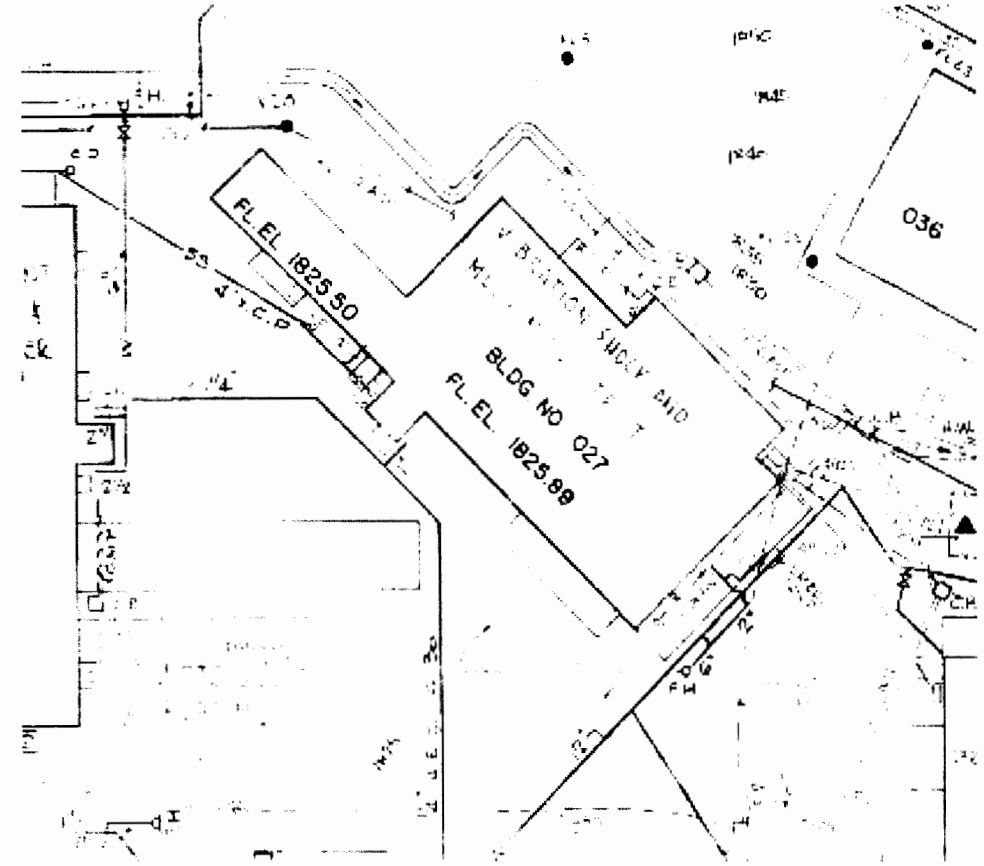
Figure 2.1.3b
Building 4027
Floor Plan



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SANTA SUSANA FACILITY
PLOT PLAN

DRAWN	HAMMAN	DWG SIZE E	303-GEN.-C40
CHECKED			
ENGINEER	R PHAMMAN	SCALE 1"=40'	SHEET NO. 6 OF 14
APPROVED			

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Project:EP9038
Revised: 09/23/2010 TJ
Source: Boeing Company, 2008

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Figure 2.1.3c
Building 4027
Plot Plan

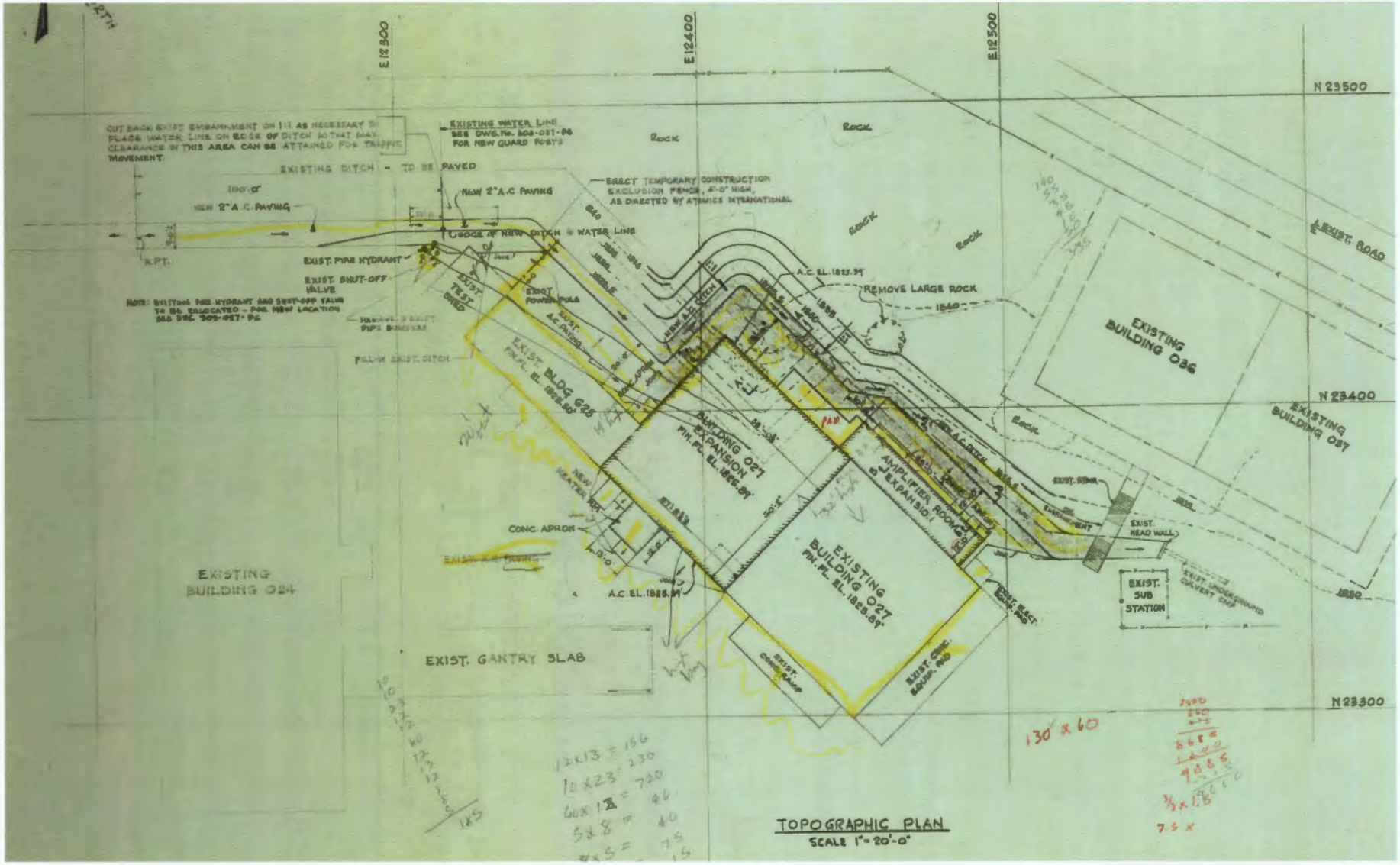

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Figure 2.1.3d
Building 4027
1963 Topographical Plan

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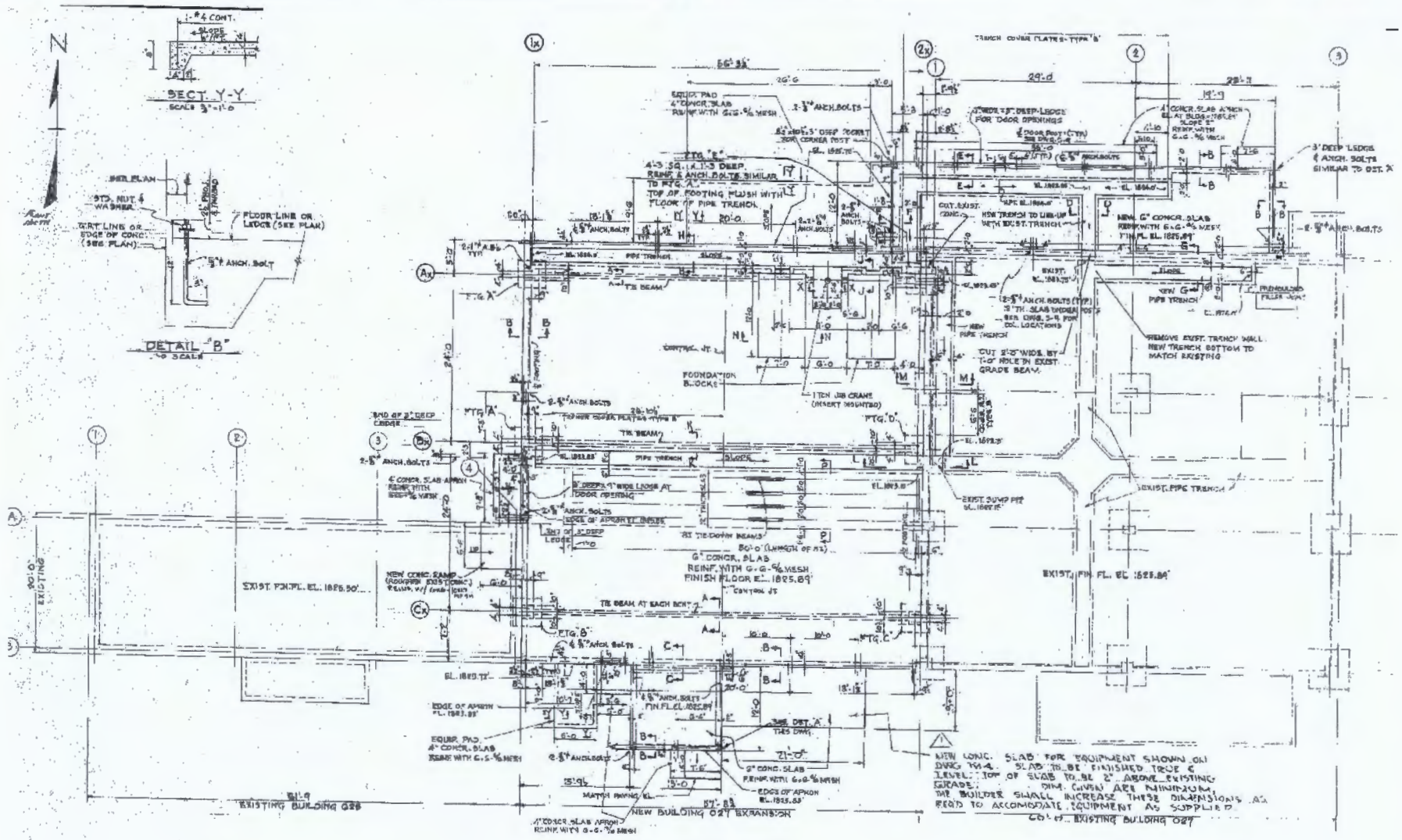

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Figure 2.1.3e
Building 4027
1963 Foundation
Plan

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Project:EP9038
Revised: 09/23/2010 TJ
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Figure 2.1.4a
Building 4032
Site Photograph

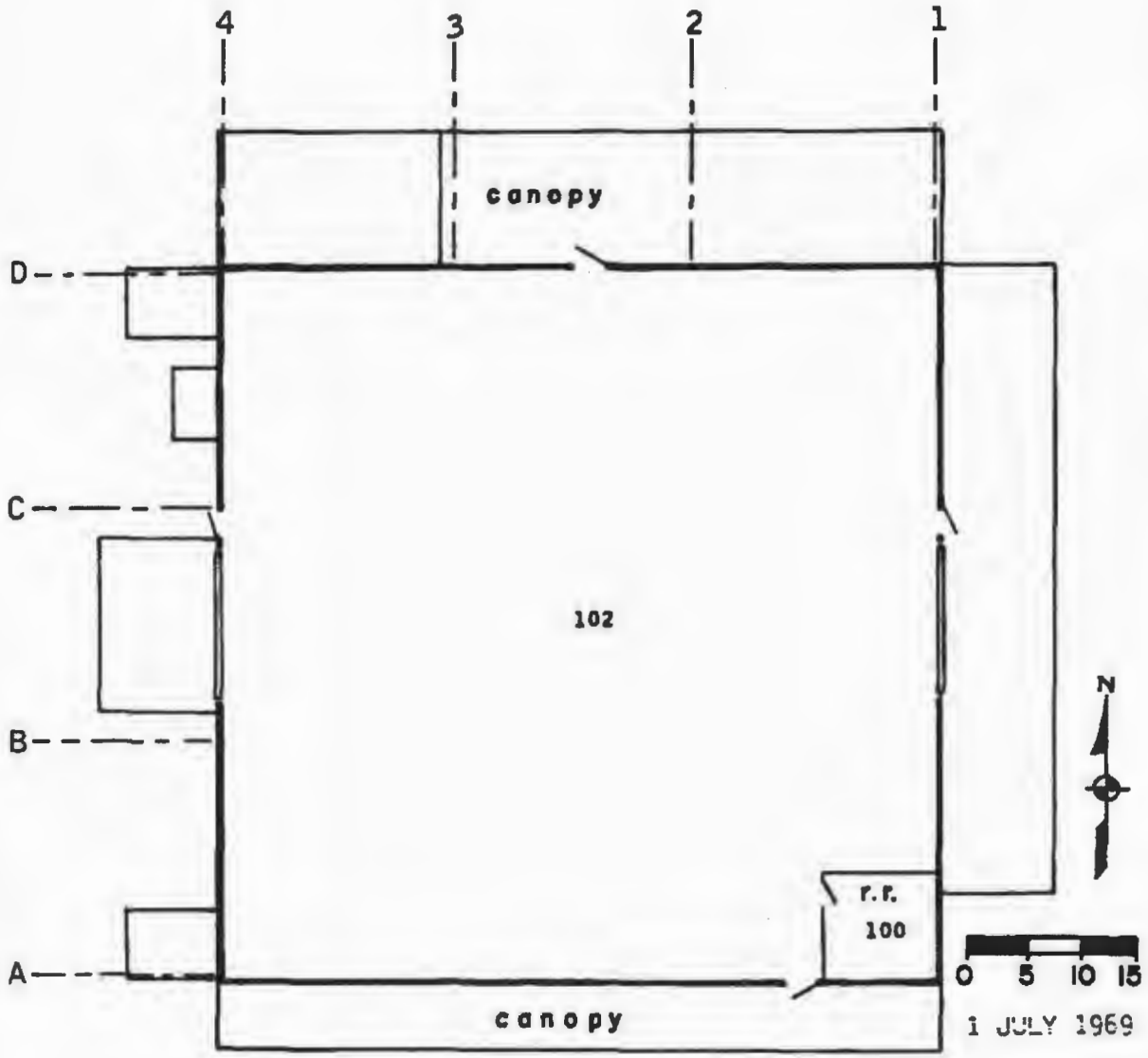

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Figure 2.1.4b
Building 4032
Floor Plan

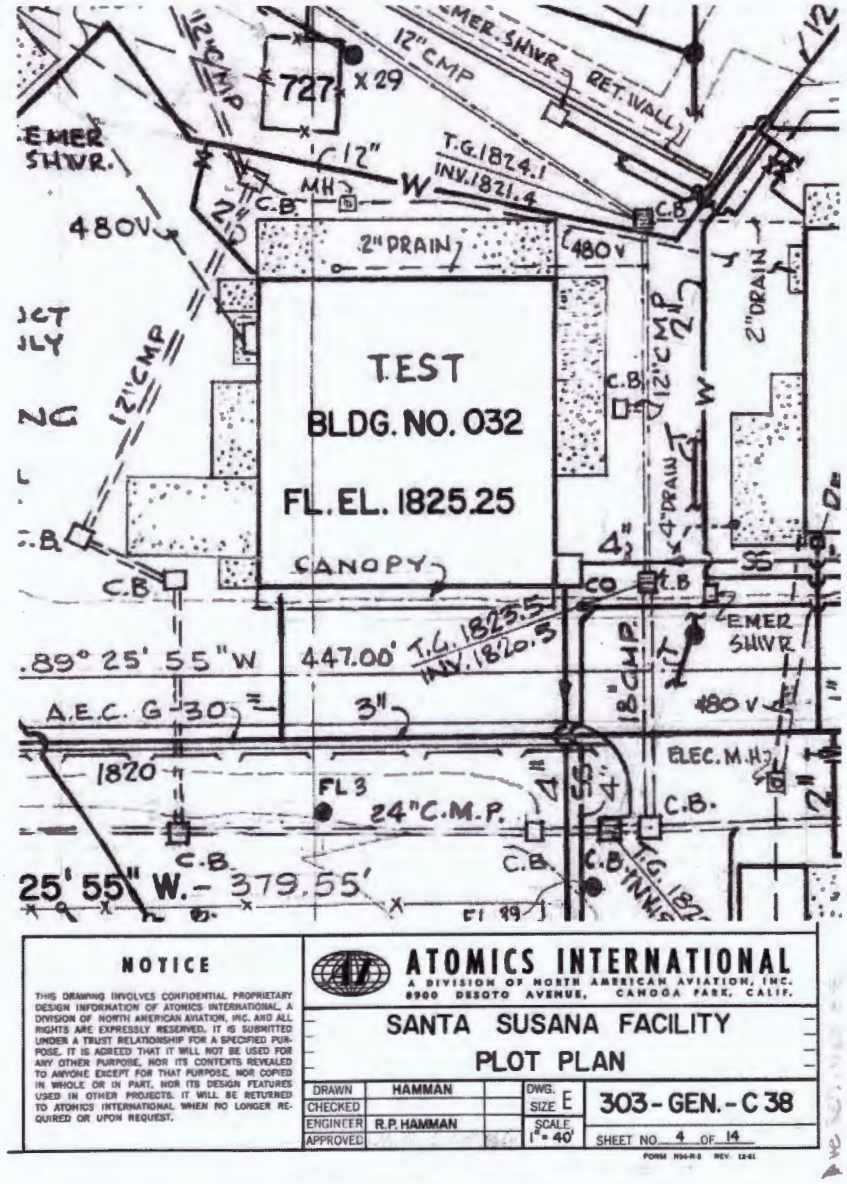

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Figure 2.1.4c
Building 4032
Plot Plan

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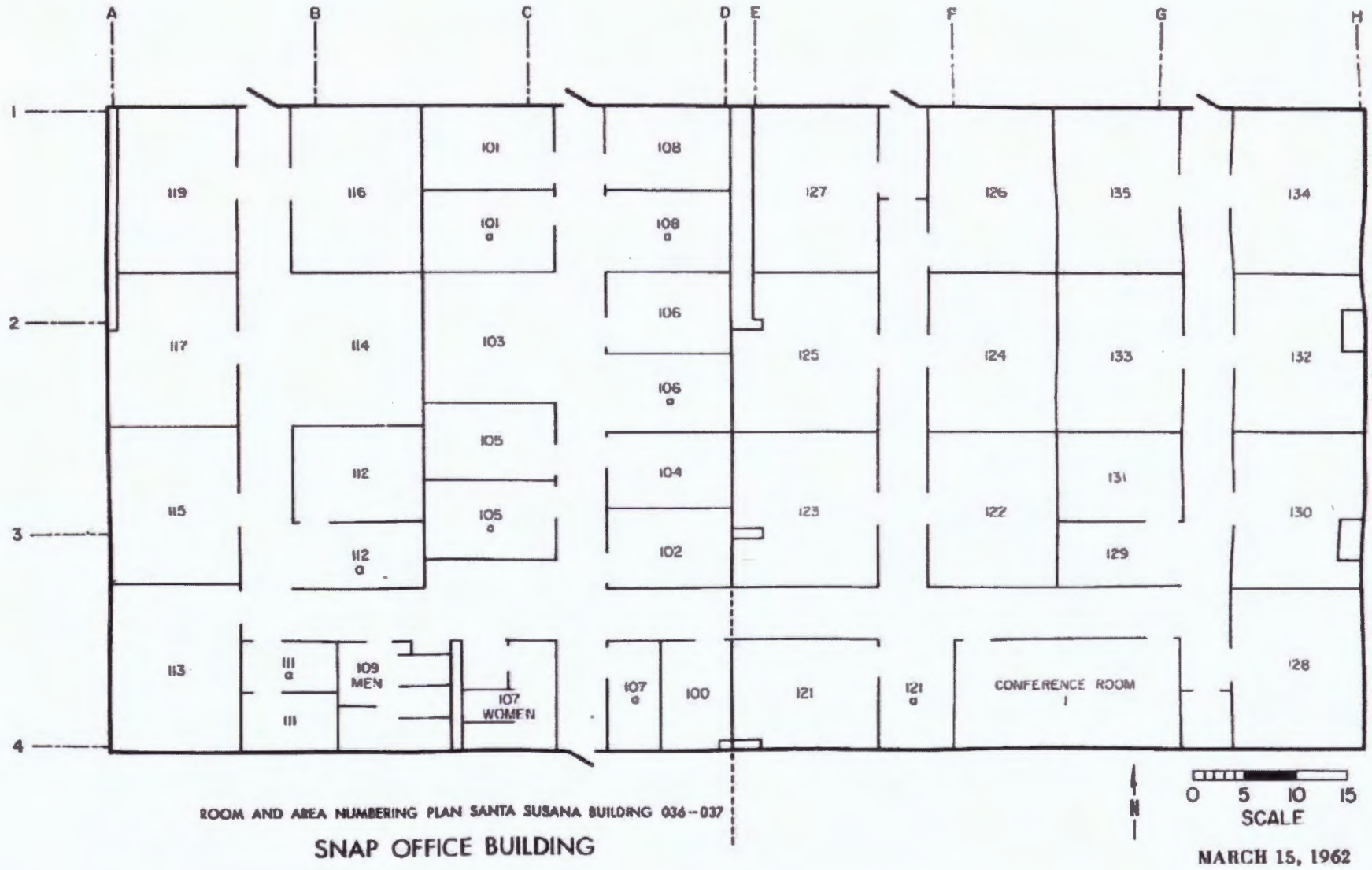
Figure 2.1.5a
Building 4036
Site Photograph



ROOM AND AREA NUMBERING PLAN SANTA SUSANA BUILDING 036-037

SNAP OFFICE BUILDING

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Project:EP9038
Revised: 10/18/2010 TJ
Source: Boeing Company, 2008

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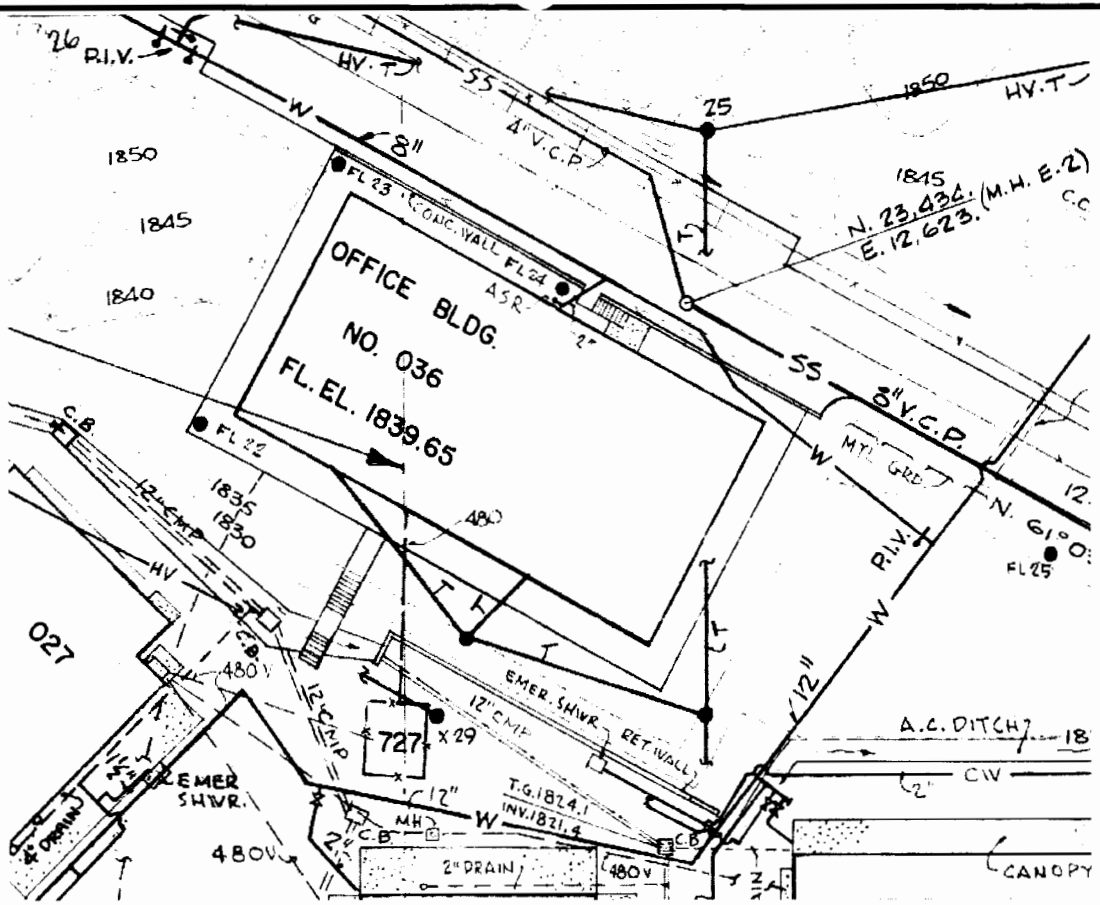
Figure 2.1.5b
Building 4036
Floor Plan



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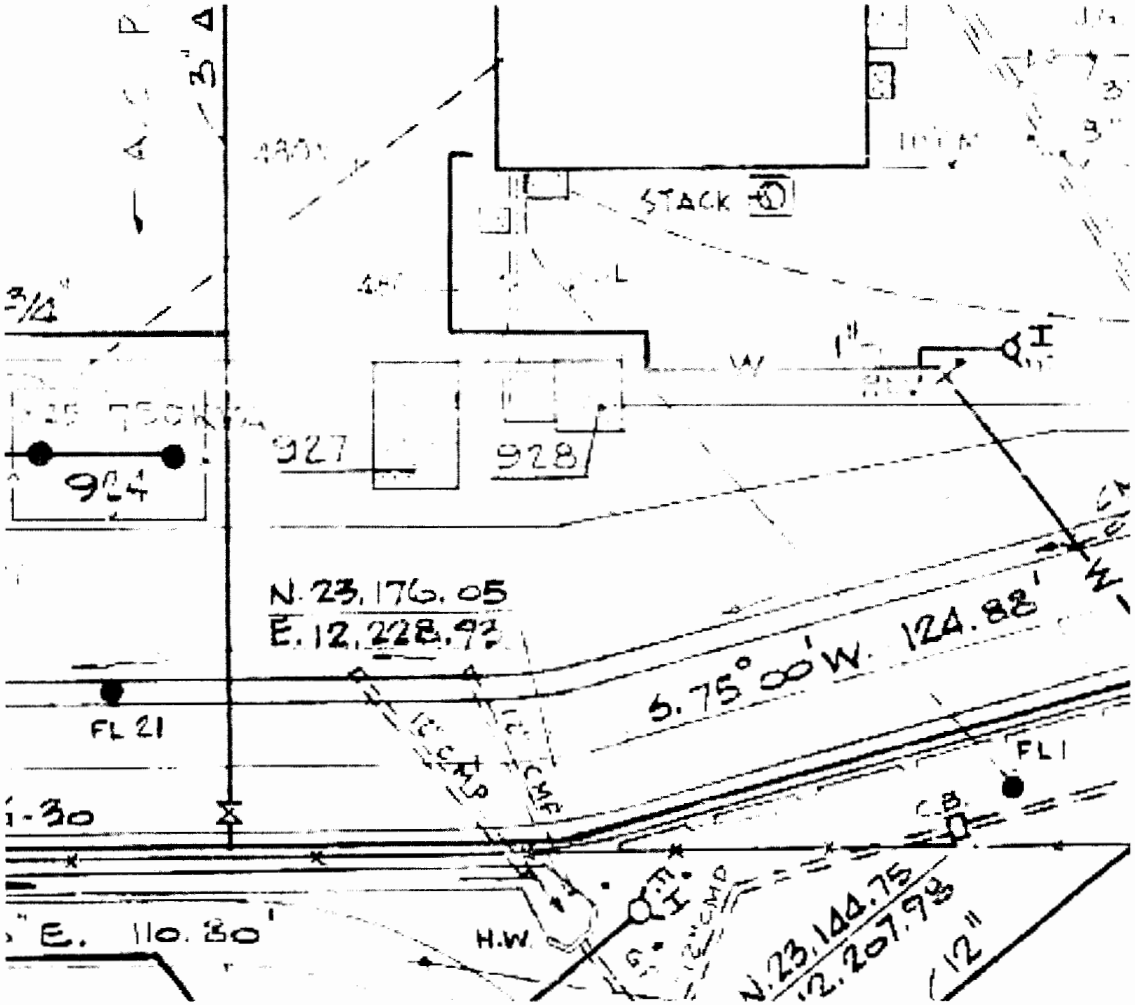
SANTA SUSANA FACILITY
PLOT PLAN

DRAWN	HAMMAN	DWG. SIZE E	303 - GEN. - C 38
CHECKED			
ENGINEER	R.P. HAMMAN	SCALE 1" = 40'	
APPROVED			SHEET NO. 4 OF 14

Y:/Santa_Susana/EP9038/TM/HSA_5A (2-1-5c)bldg4036PP.cdr
Project:EP9038
Revised: 09/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.5c
Building 4036
Plot Plan



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SANTA SUSANA FACILITY
PLOT PLAN

303-GEN-C40

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(2-1-6a)Site4927PP.cdr
Project:EP9038
Revised: 10/18/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.6a
Site 4927
Plot Plan

Historical Site Assessment
Final Technical Memorandum - HSA-5A

Figure 2.2
Area IV Subarea 5A-2
Santa Susana Field Laboratory

U.S. EPA Region 9

Legend

- Subarea 5A-2 Boundary
- Primary Roads
- Secondary Roads
- Underground Storage Tank
- Unknown Tank Type
- Sump
- Dry Well
- Tank Footprint
- Above ground Storage Tank
- Demolished Bldg.
- Existing Bldg.
- Parking Lots
- Drainage
- Drain
- Well

Aerial Photo Features
- Aerial Photography Features
- Leach Field
- Other

Surface Water
- Intermittent Stream
- Permanent Stream
- Surface Water
- Lined Channel
- French Drain
- Drainage
- Leach Field
- Septic System

Utilities
- Channel
- Drain
- Drain
- Drainage Divide
- Gutter
- Tank
- Tank
- Vault
- Well
- Gas
- Storm Drain
- Sanitary Sewer
- Water

B	Building
CONT	Container
CR	Crates
DB	Debris
DG	Disturbed Ground
DTM	Dark Tone Material
EX	Excavation
FA	Fill Area
GS	Ground Scar
HT	Horizontal Tank
IM	Impoundment
MTMM	Medium Toned Mounded Material
OS	Open Storage
PA	Processing Area
PL	Parking Lot
POSS	Possible
PROB	Probable
S-T	Storage Tank
SS	Smoke Stack
ST	Storage
UO	Unidentified Object
VT	Vertical Tank
WDA	Waste Disposal Area

N

0 25 50 100
Scale In Feet

Filepath: Y:\Santa_Susana\EP9038\TM\HSA_5A\(2-2)5BA-2.mxd
Project: EP9038
Created: TJansen
Revised: 10/19/2010 TJ
Sorce: Boeing Company, 2008
CIRGIS, 2007

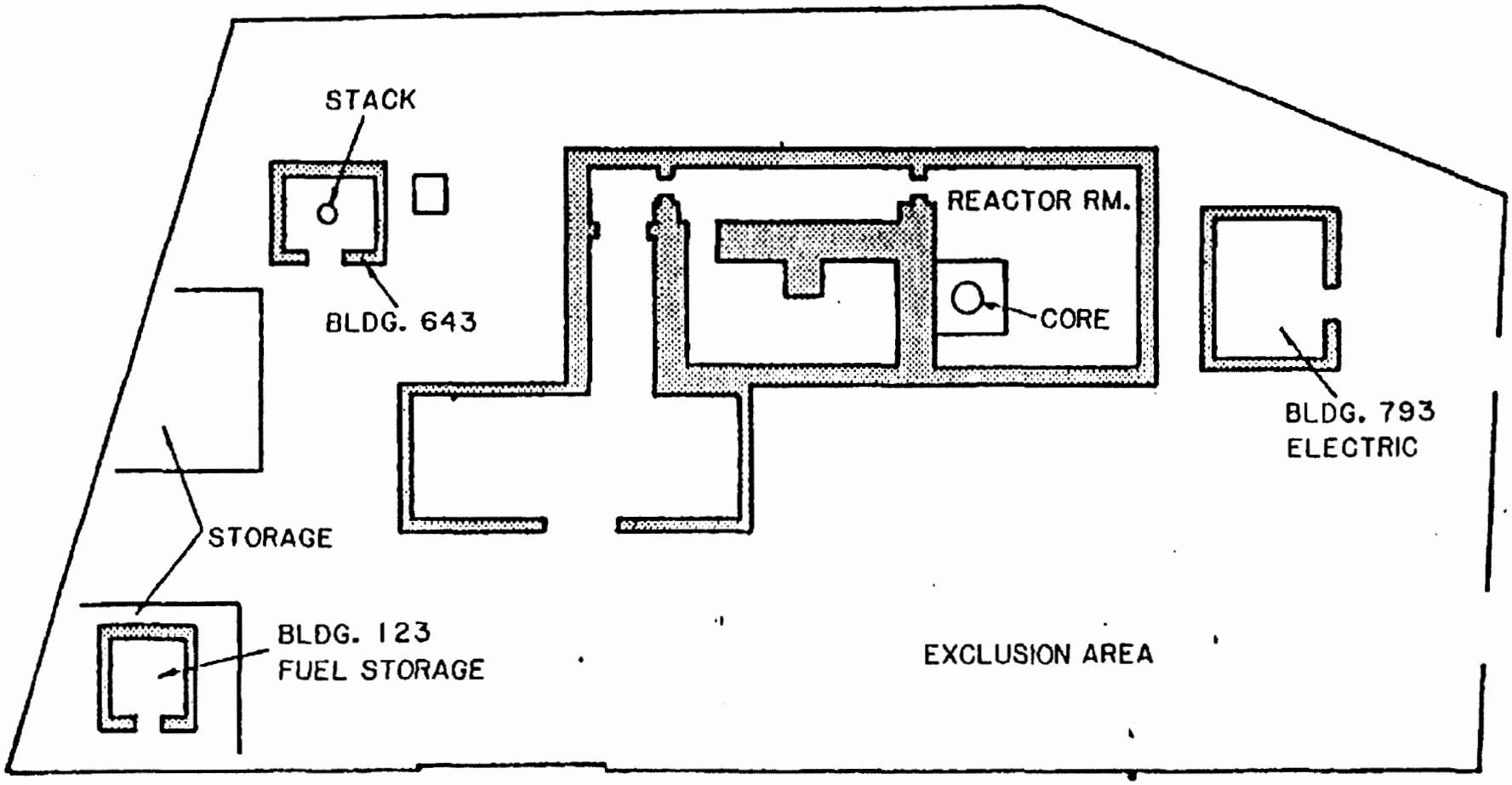
HGL HydroGeoLogic, Inc.

Redacted

Y:/Santa_Susana/EP9038/TM/HSA_5A (2-2-1a)bldg4073AP.cdr
Project:EP9038
Revised: 09/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.2.1a
Building 4073
Site Photograph



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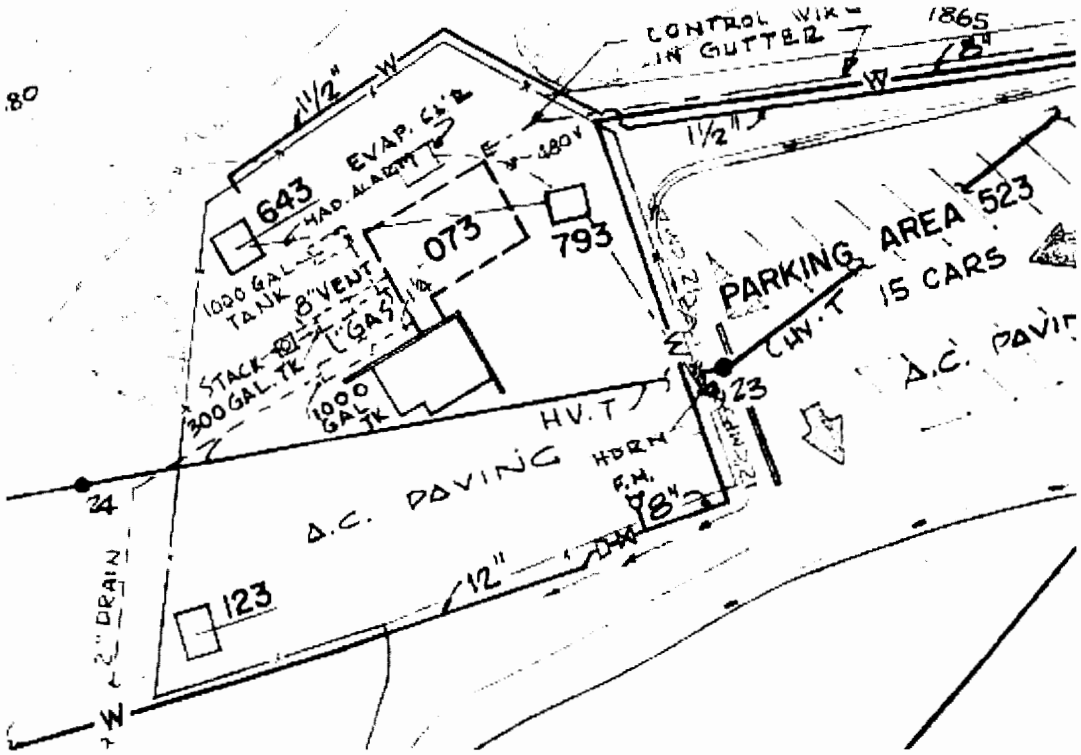
Project:EP9038
Revised: 10/18/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.2.1b
Building 4073
Floor Plan



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SANTA SUSANA FACILITY
PLOT PLAN

DRAWN	HAMMAN	DWG. SIZE E	303 - GEN. - C 38
CHECKED			
ENGINEER	R.P. HAMMAN	SCALE 1" = 40'	SHEET NO. 4 OF 14
APPROVED			

FORM N94-R-3 REV. 12-61

Y:/Santa_Susana/EP9038/TM/HSA_5A (2-2-1c)bldg4073PP.cdr
Project:EP9038
Revised: 09/23/2010 TJ
Source: Boeing Company, 2008

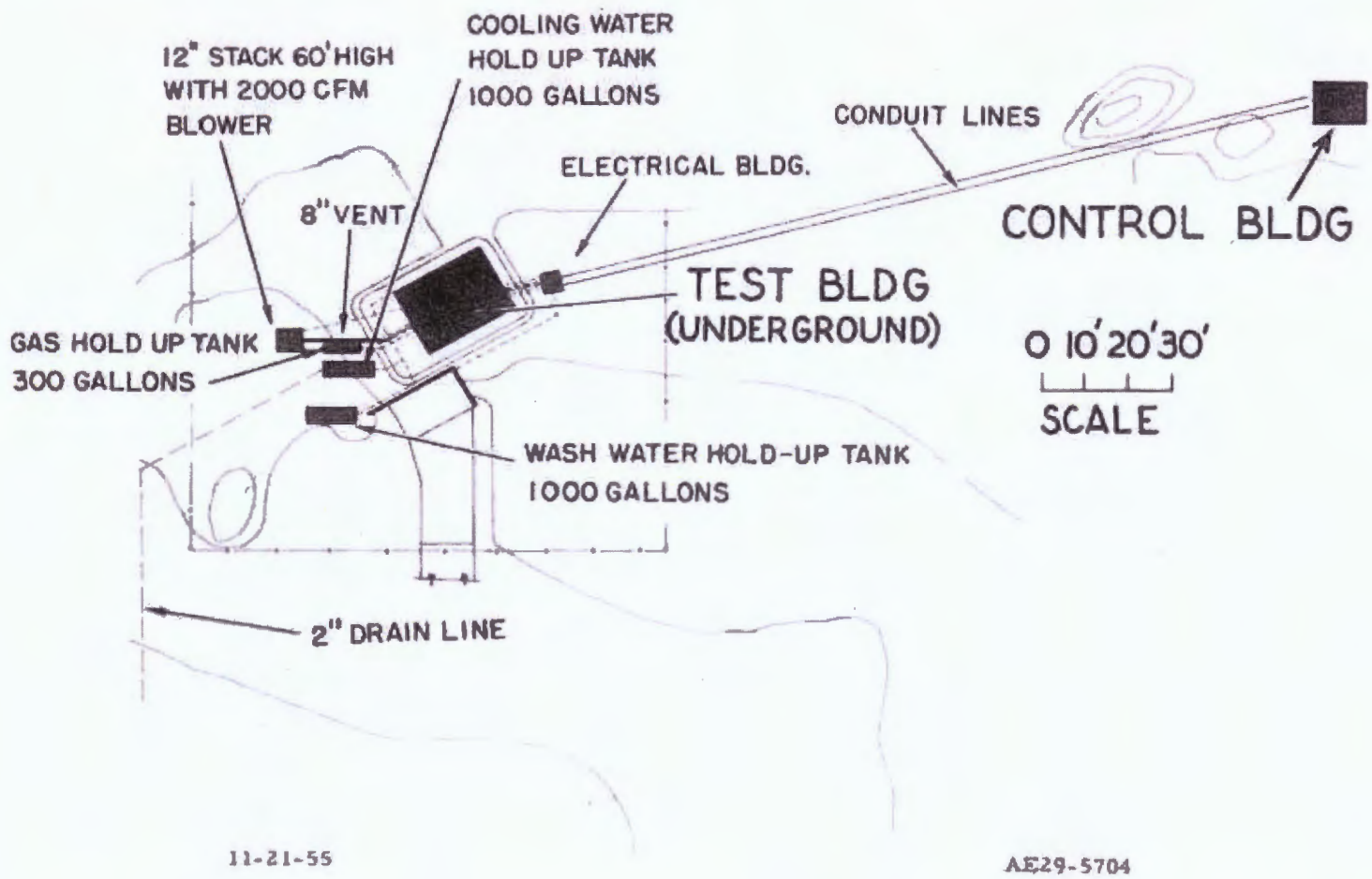
U.S. EPA Region 9

Figure 2.2.1c
Building 4073
Plot Plan

Y:/Santa_Susana/EP9038/TM/HSA_5A (2-2-1d)bldg4073KRFP.cdr
Project:EP9038
Revised: 08/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.2.1d
Building 4073
KEWB Reactor
Facilities Photograph



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Project:EP9038
Revised: 10/18/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.2.1e
Building 4073
1955 KEWB
Support Facilities

Y:/Santa_Susana/EP9038/TM/HSA_5A
(2-2-1f)bldg4073BD.cdr
Project:EP9038
Revised: 10/18/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.2.1f
Building 4073
Building
Demolition

Y:/Santa_Susana/EP9038/TM/HSA_5A (2-2-1g)bldg4073FG.cdr
Project:EP9038
Revised: 10/18/2010 TJ
Source: Boeing Company, 2008

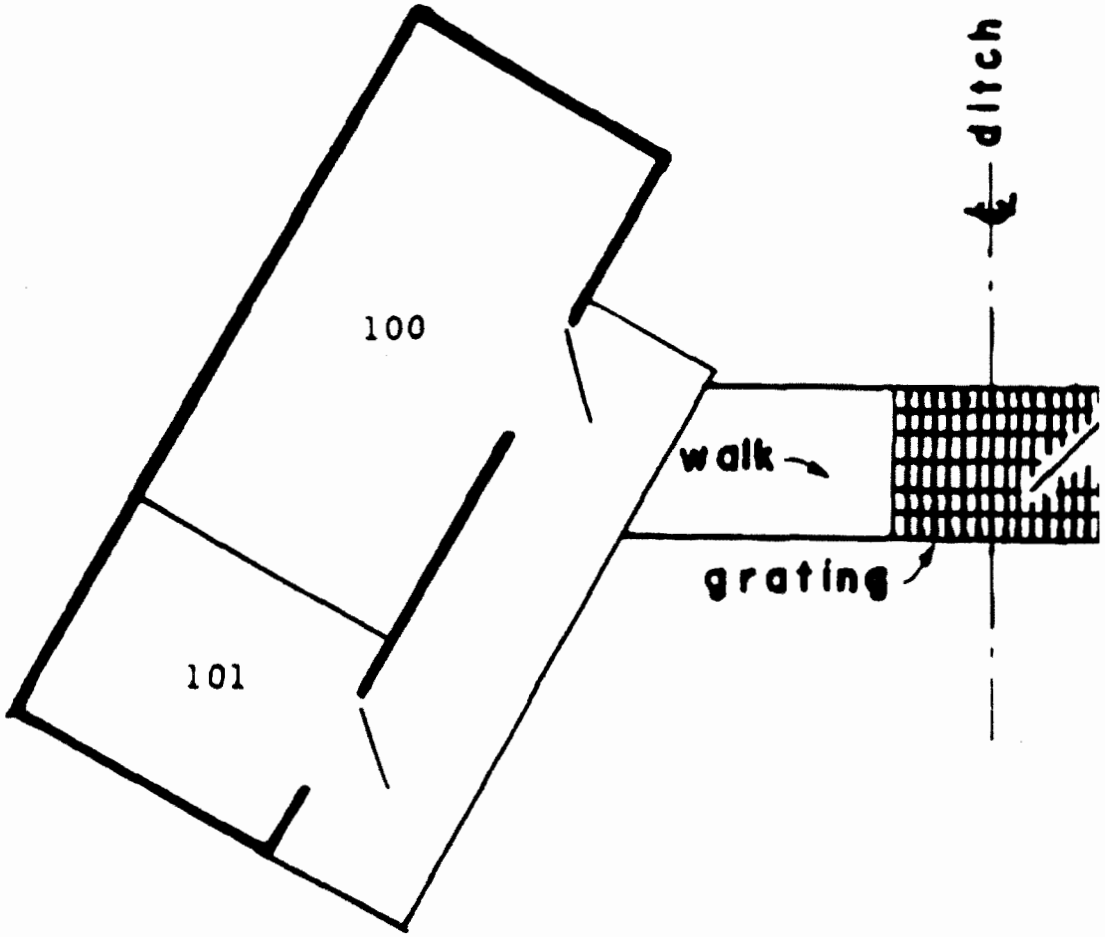
U.S. EPA Region 9

Figure 2.2.1g
Building 4073
Final Grading

Y:/Santa_Susana/EP9038/TM/HSA_5A (2-2-2a)bldg4074AP.cdr
Project:EP9038
Revised: 09/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.2.2a
Building 4074
Site Photograph



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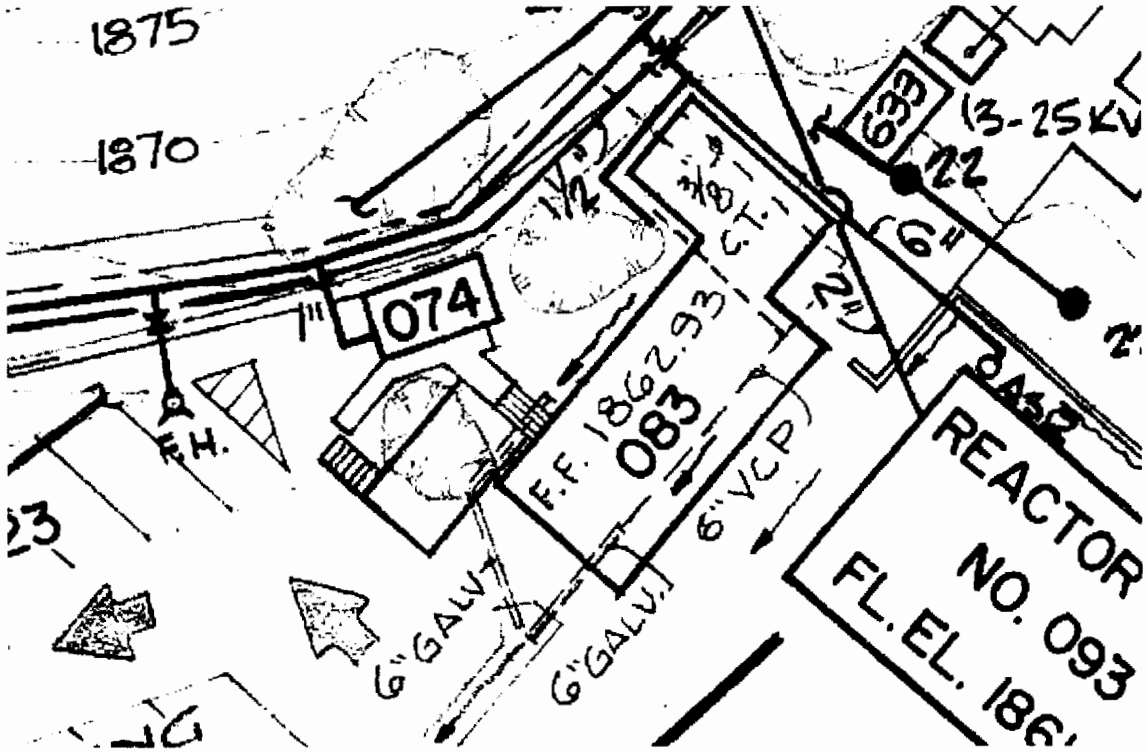
Project:EP9038
Revised: 10/18/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.2.2b
Building 4074
Floor Plan



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SANTA SUSANA FACILITY
PLOT PLAN

DRAWN	HAMMAN	DWG. SIZE E	303 - GEN. - C 38
CHECKED			
ENGINEER	R.P. HAMMAN	SCALE 1" = 40'	SHEET NO. 4 OF 14
APPROVED			

FORM NSH-R-3 REV. 12-61

Y:/Santa_Susana/EP9038/TM/HSA_5A (2-2-2c)bldg4074PP.cdr
Project:EP9038
Revised: 09/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.2.2c
Building 4074
Plot Plan

Y:/Santa_Susana/EP9038/TM/HSA_5A (2-2-3a)bldg4083AP.cdr
Project:EP9038
Revised: 09/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.2.3a
Building 4083
Site Photograph

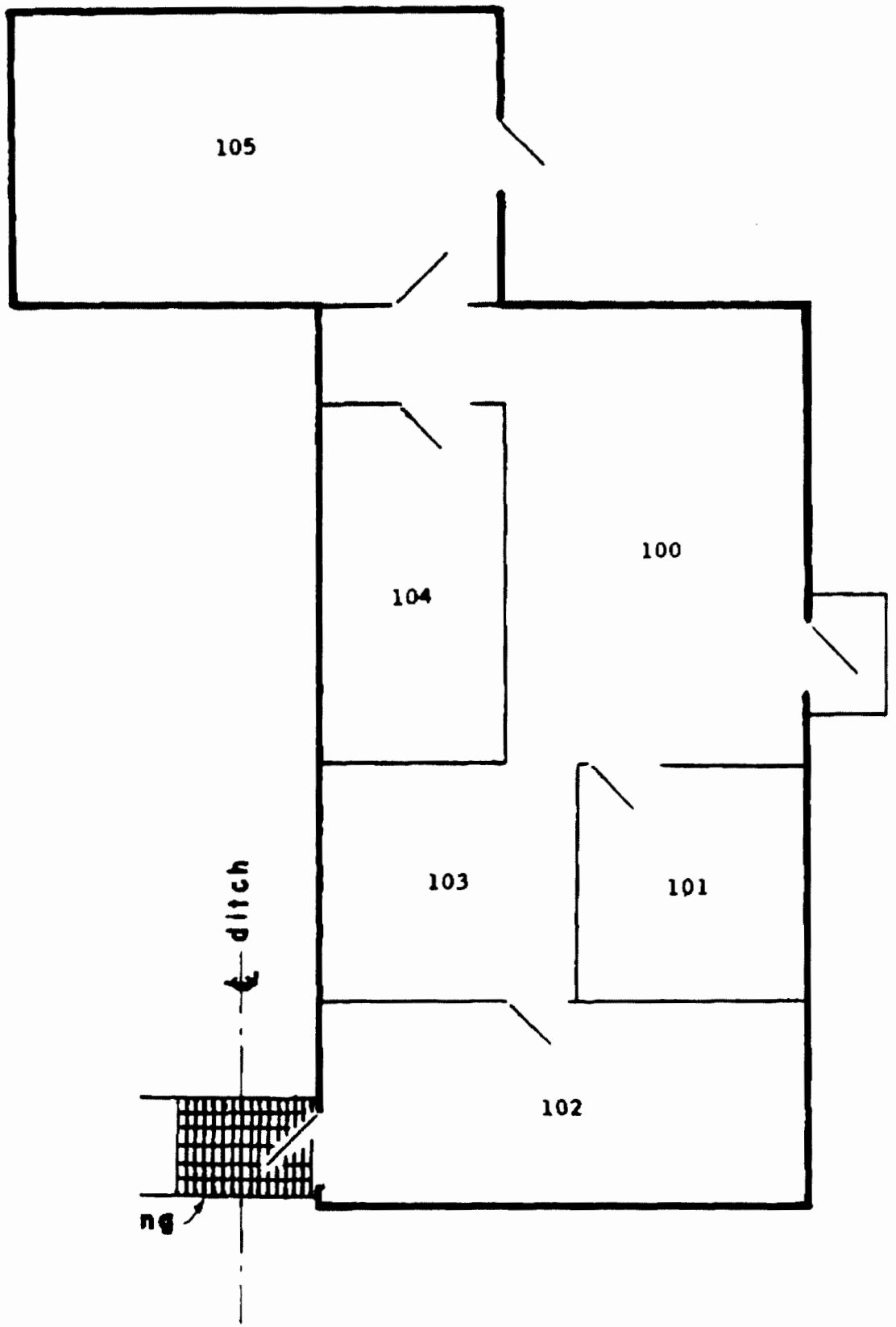

Figure not to Scale

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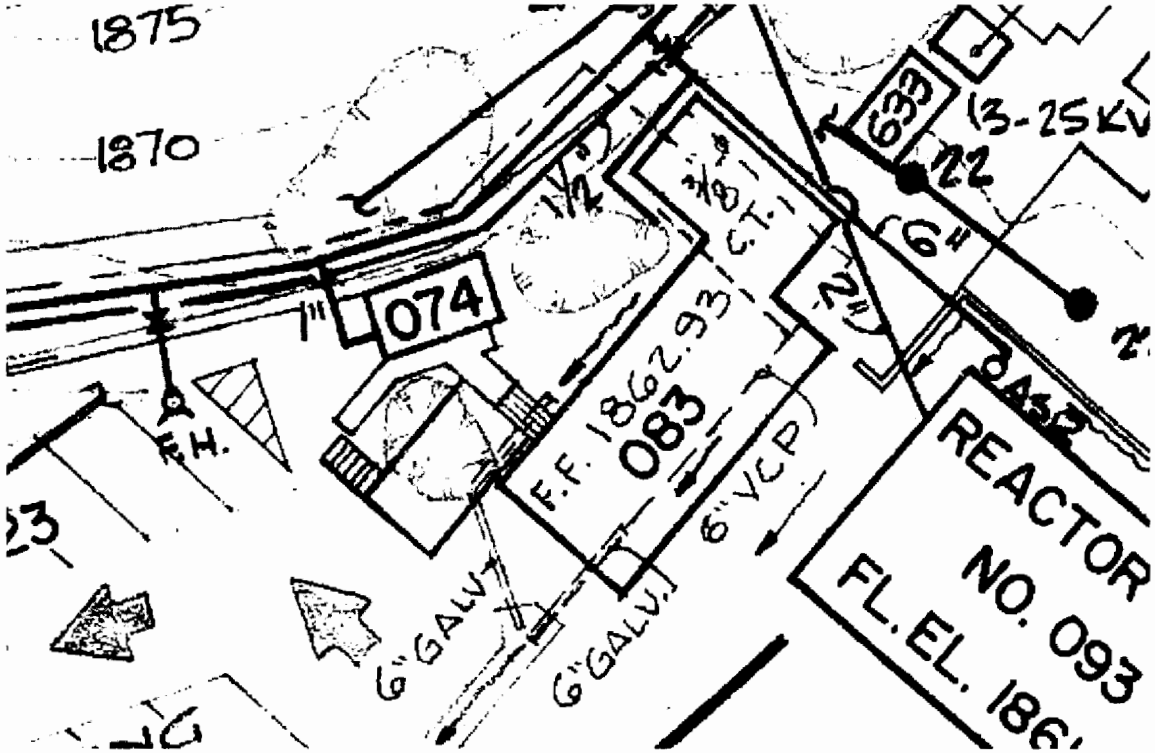
Project:EP9038
Revised: 08/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.2.3b
Building 4083
Floor Plan



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SANTA SUSANA FACILITY
PLOT PLAN

DRAWN	HAMMAN		DWG. SIZE E	303-GEN.-C 38
CHECKED				
ENGINEER	R.P. HAMMAN		SCALE 1" = 40'	SHEET NO. 4 OF 14
APPROVED				

FORM NH-R-3 REV 12-61

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Project:EP9038
Revised: 09/23/2010 TJ
Source: Boeing Company, 2008

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Figure 2.2.3c
Building 4083
Plot Plan

Y:/Santa_Susana/EP9038/TM/HSA_5A (2-2-4a)bldg4093AP.cdr
Project:EP9038
Revised: 09/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.2.4a
Building 4093
Site Photograph

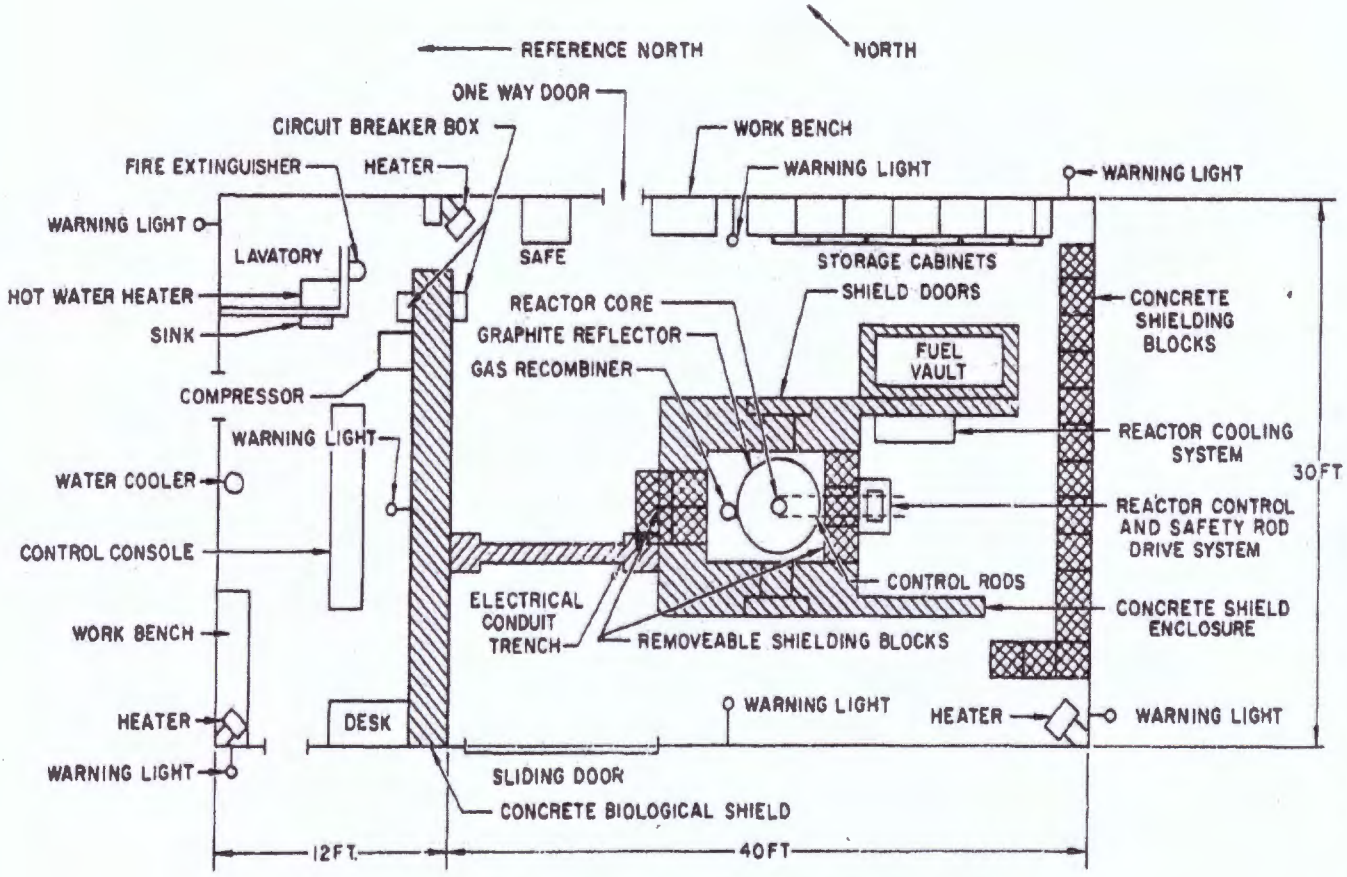

Figure V-11. Floor Plan of AE-6 Reactor Building

Figure not to Scale

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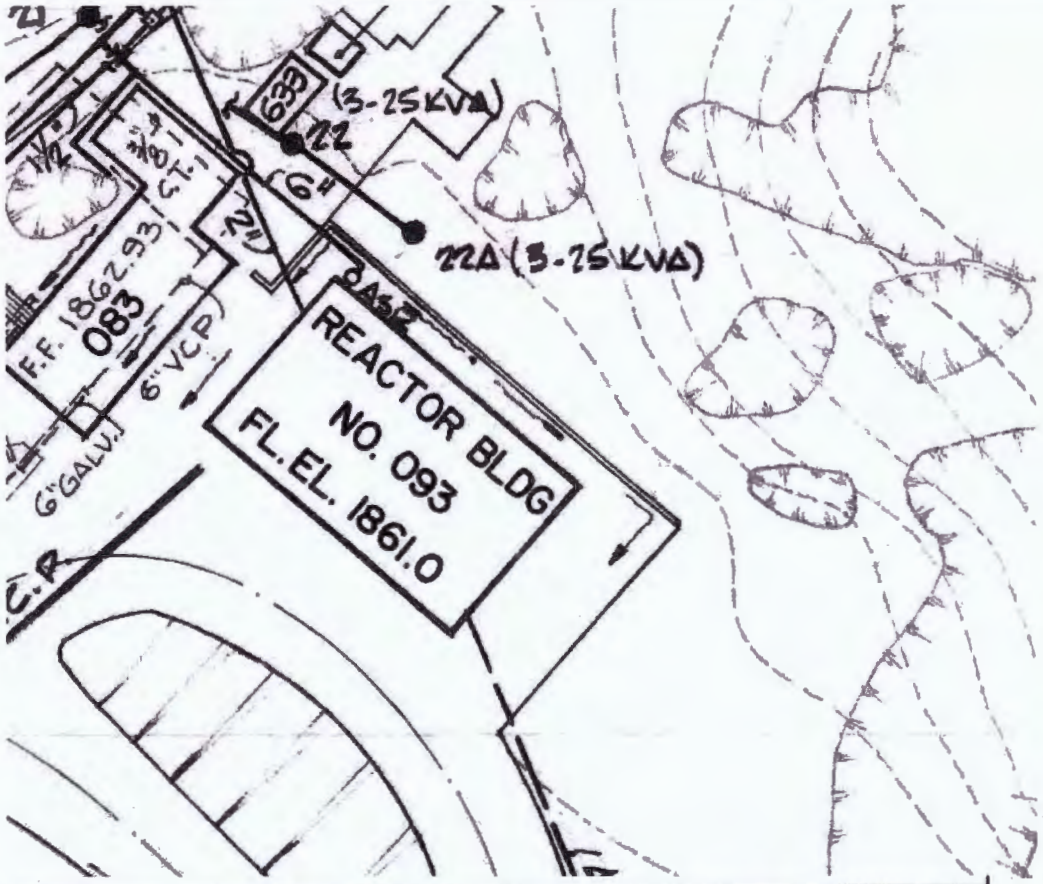
Project:EP9038
Revised: 08/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.2.4b
Building 4093
Floor Plan



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SANTA SUSANA FACILITY
PLOT PLAN

DRAWN	HAMMAN	DWG. SIZE E	303-GEN.-C 38
CHECKED			
ENGINEER	R.P. HAMMAN	SCALE 1" = 40'	SHEET NO. 4 OF 14
APPROVED			

FORM N94-R-3 REV. 12-61

Y:/Santa_Susana/EP9038/TM/HSA_5A (2-2-4c)bldg4093PP.cdr
Project:EP9038
Revised: 09/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.2.4c
Building 4093
Plot Plan

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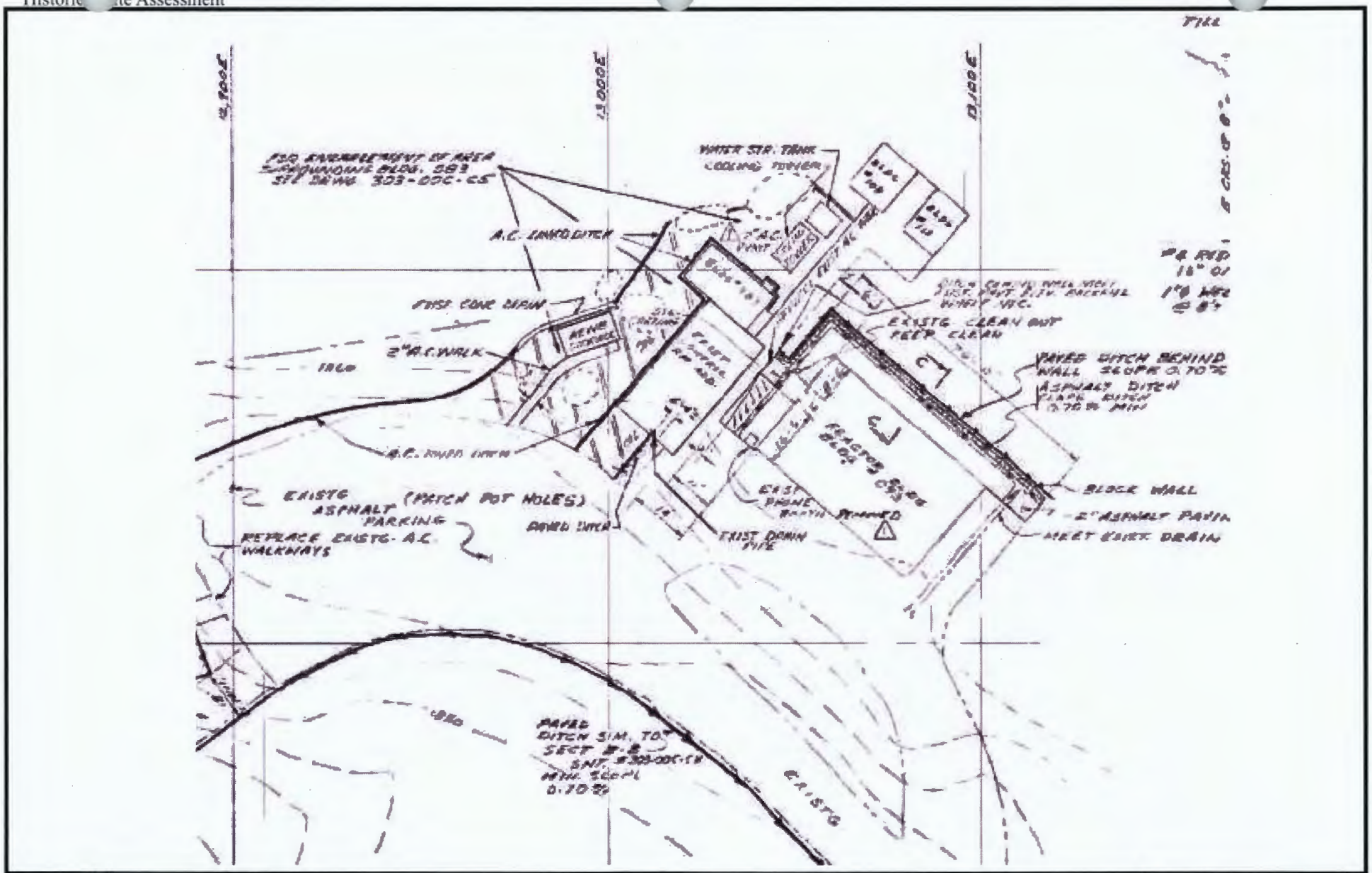
Project:EP9038
Revised: 10/05/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.2.4d
Building 4093
1960 Building
Photograph



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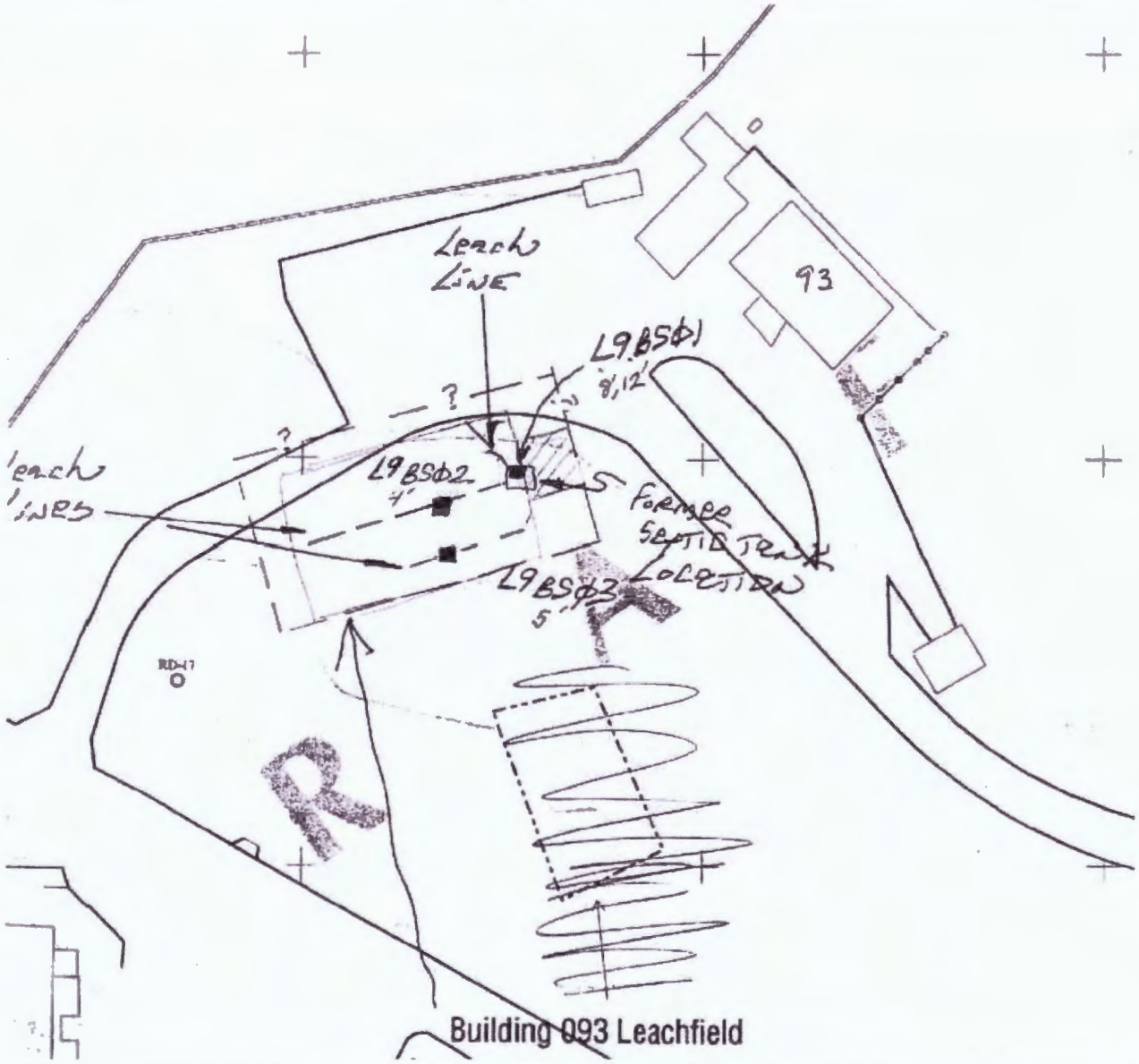
Project:EP9038
Revised: 10/05/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.2.4e
Building 4093
Drainage
Improvement



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Project:EP9038
Revised: 10/05/2010 TJ
Source: Boeing Company, 2008

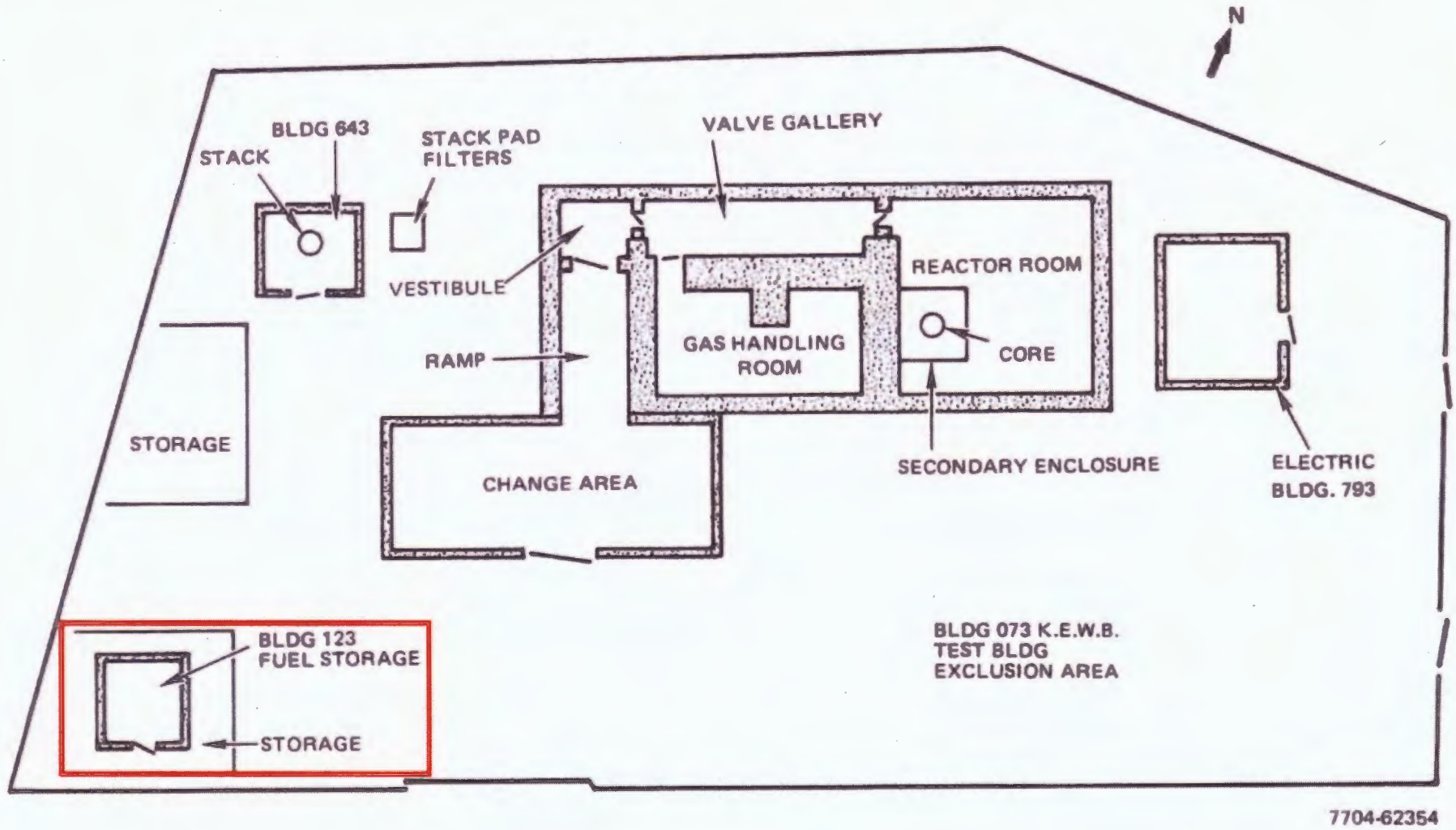
U.S. EPA Region 9

Figure 2.2.4f
Building 4093
Leachfield
Location

Y:/Santa_Susana/EP9038/TM/HSA_5A
(2-2-5a)bldg4123AP.cdr
Project:EP9038
Revised: 09/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.2.5a
Building 4123
Site Photograph



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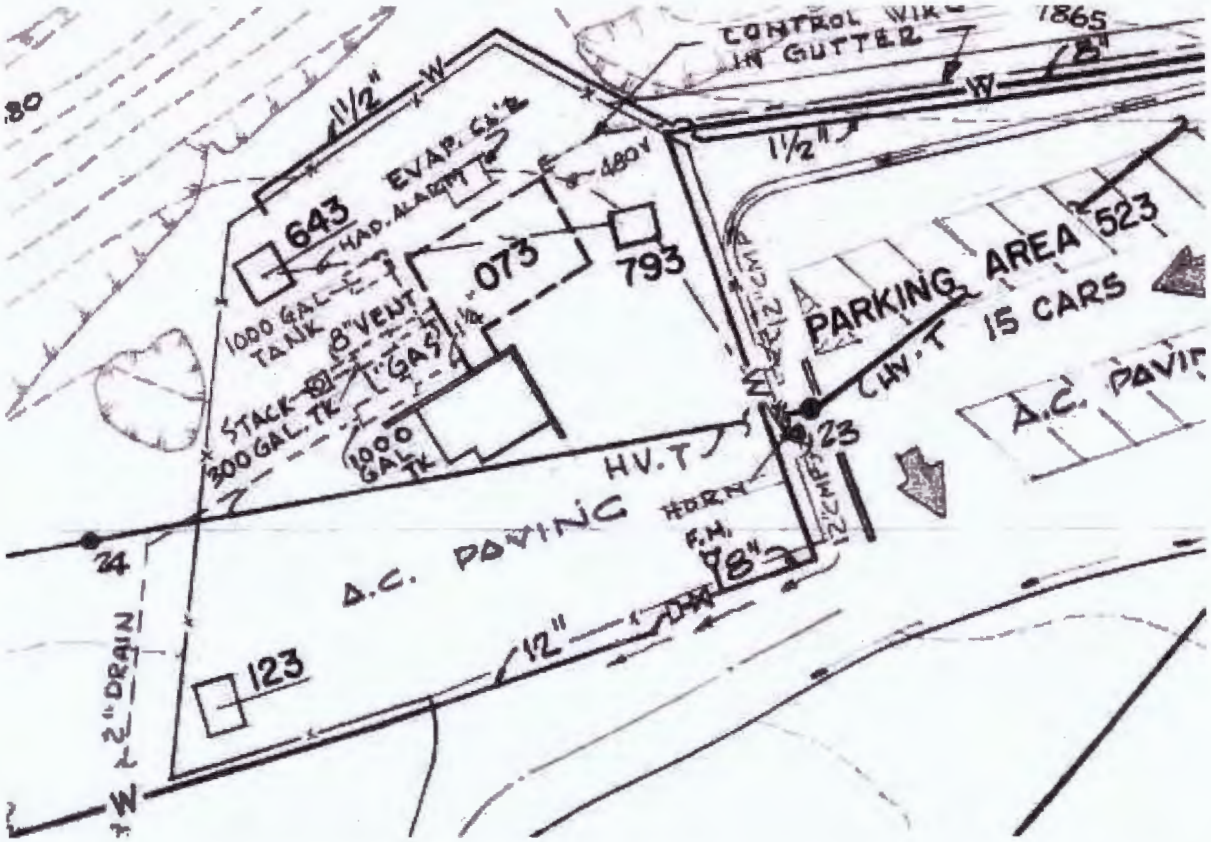
Project:EP9038
Revised: 09/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.2.5b
Building 4123
Floor Plan



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SANTA SUSANA FACILITY
PLOT PLAN

DRAWN	HAMMAN	DWG. SIZE E	303-GEN.-C 38
CHECKED			
ENGINEER	R.P. HAMMAN	SCALE 1" = 40'	SHEET NO. 4 OF 14
APPROVED			

FORM H64-H-3 REV 12-61

Y:/Santa_Susana/EP9038/TM/HSA_5A (2-2-5c)bldg4123PP.cdr
Project:EP9038
Revised: 09/23/2010 TJ
Source: Boeing Company, 2008

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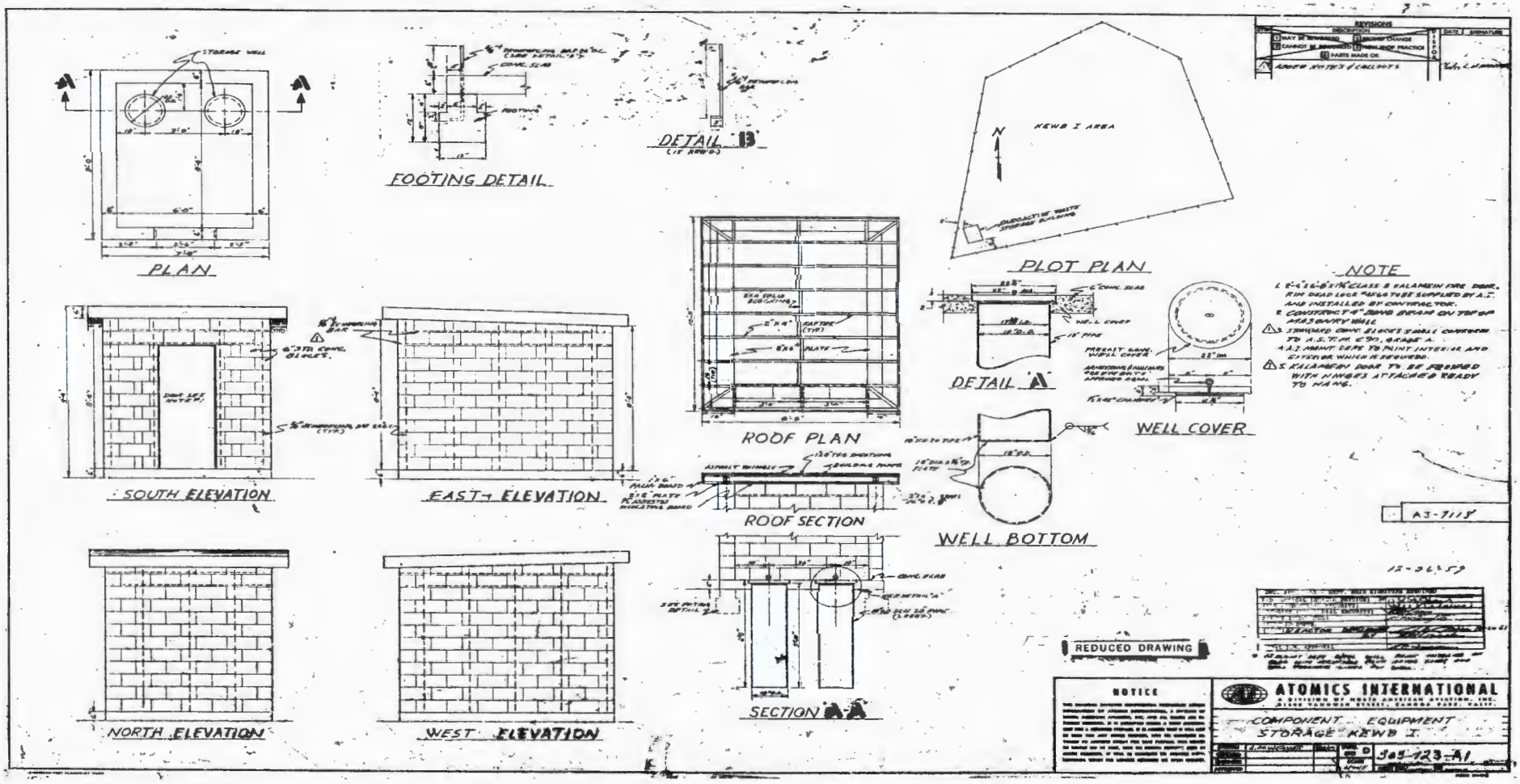
Figure 2.2.5c
Building 4123
Plot Plan

Y:/Santa_Susana/EP9038/TM/HSA_5A (2-2-5d)bldg4123DP.cdr
Project:EP9038
Revised: 09/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.2.5d
Building 4123
Demolition
Photograph

Redacted



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Project:EP9038
Revised: 10/18/2010 TJ
Source: Boeing Company, 2008

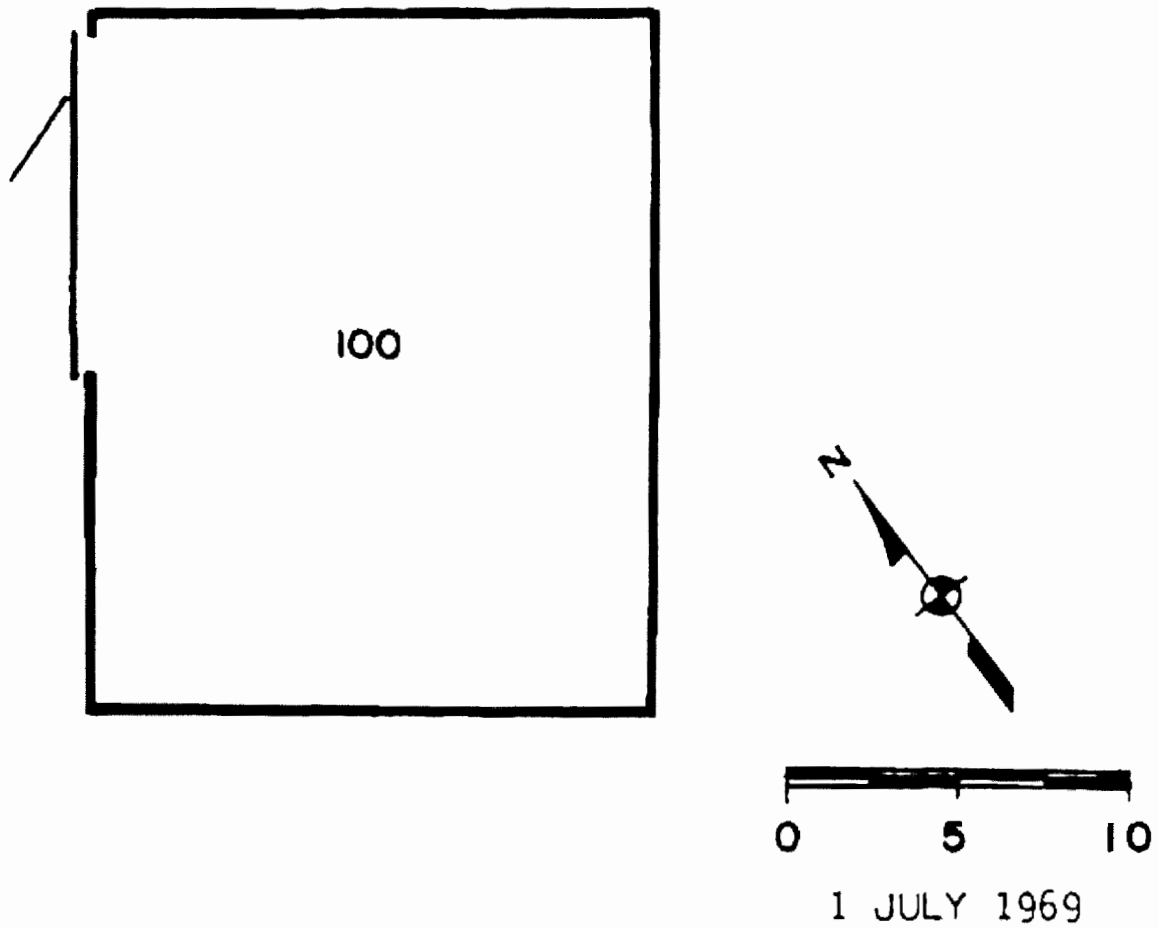
U.S. EPA Region 9

Figure 2.2.5e
Building 4123
Building Layout

Y:/Santa_Susana/EP9038/TM/HSA_5A (2-2-6a)bldg4453AP.cdr
Project:EP9038
Revised: 09/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.2.6a
Building 4453
Site Photograph



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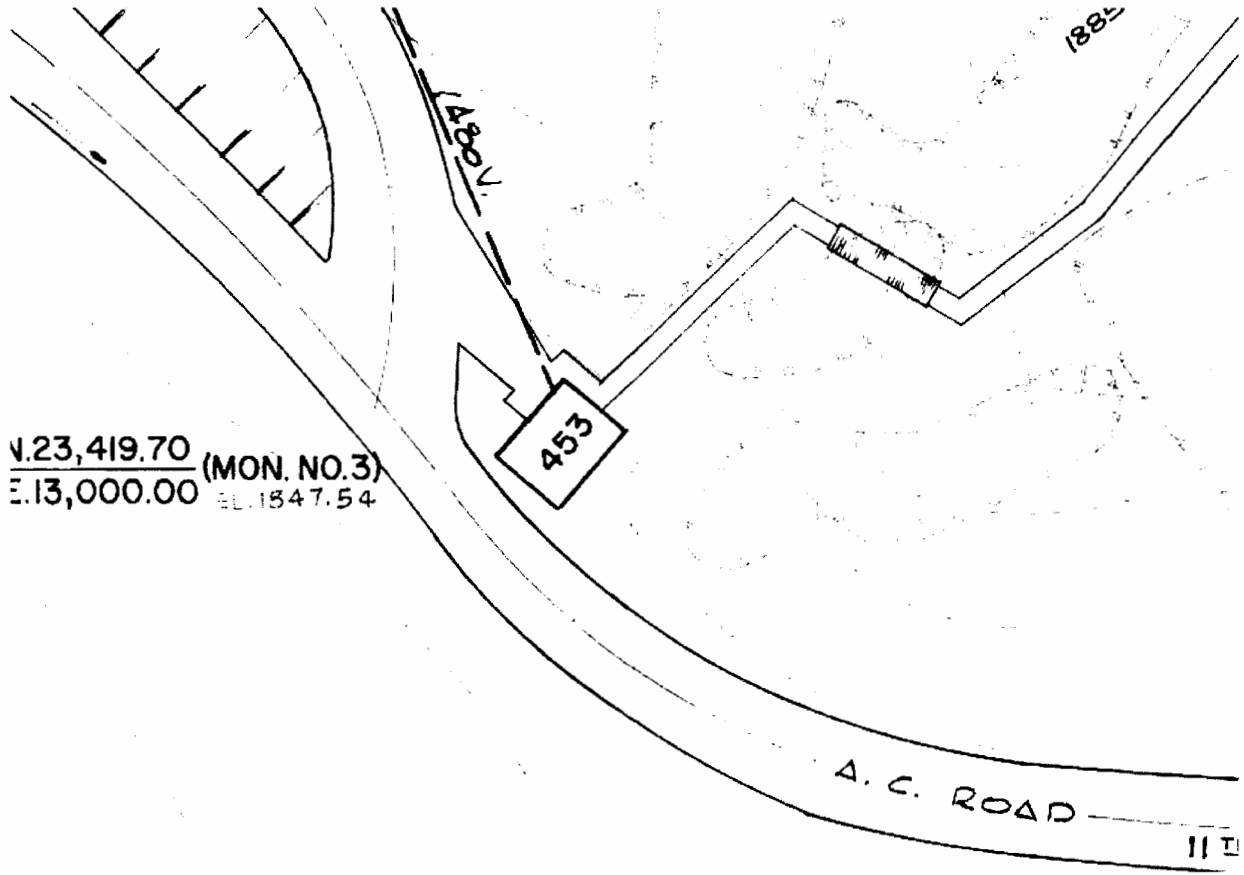
Project:EP9038
Revised: 09/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.2.6b
Building 4453
Floor Plan



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SANTA SUSANA FACILITY
PLOT PLAN

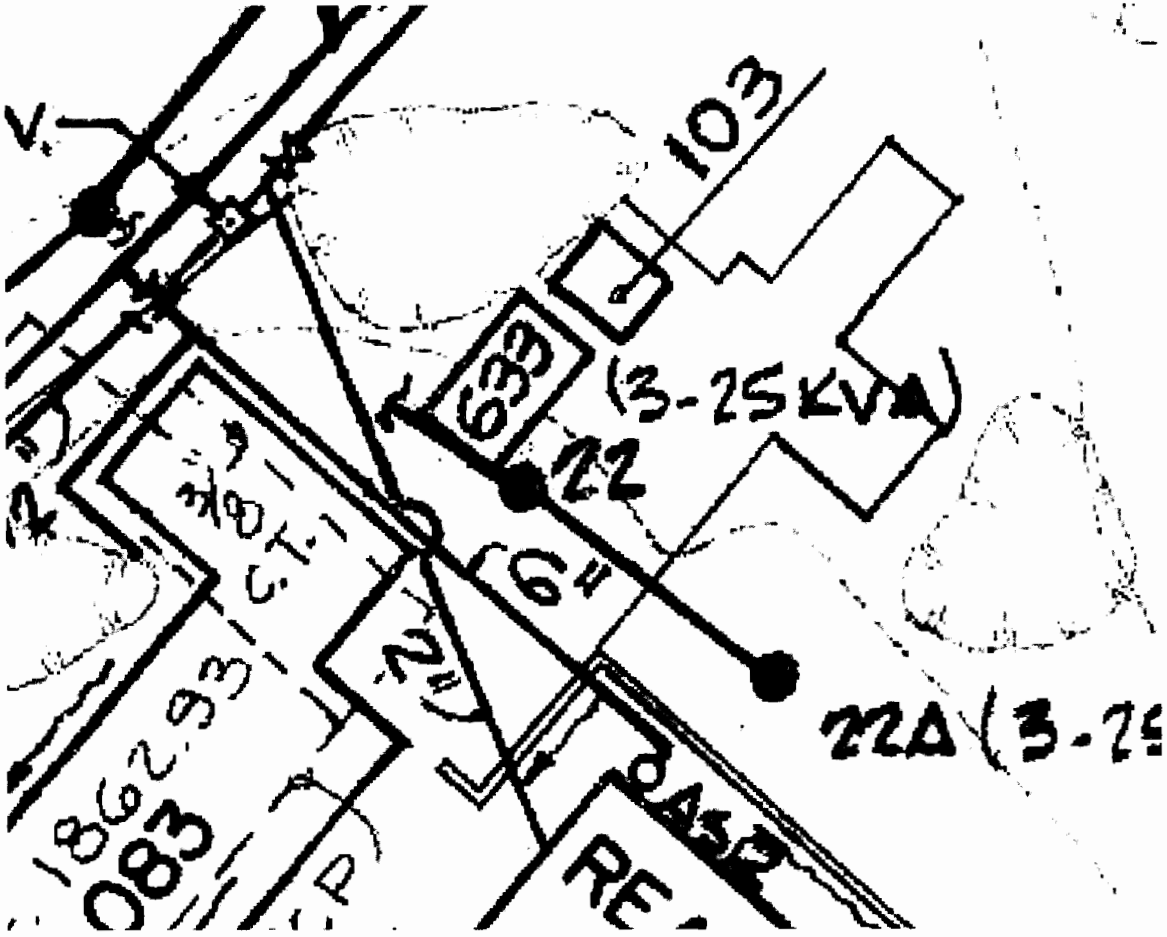
DRAWN	HAMMAN	DWG. SIZE E	303 - GEN. - C 38
CHECKED			
ENGINEER	R.P. HAMMAN	SCALE 1" = 40'	SHEET NO. 4 OF 14
APPROVED			

FORM N3603 REV 1261

Y:/Santa_Susana/EP9038/TM/HSA_5A (2-2-6c)bldg4453PP.cdr
Project: EP9038
Revised: 09/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.2.6c
Building 4453
Plot Plan



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SANTA SUSANA FACILITY
PLOT PLAN

DRAWN	HAMMAN	SIZE E	303-GEN.-C 38
CHECKED		SCALE 1" = 40'	
ENGINEER	R P HAMMAN	SHEET NO. 4 OF 14	

Y:/Santa_Susana/EP9038/TM/HSA_5A (2-2-7a)Site4633PP.cdr
Project:EP9038
Revised: 10/18/2010 TJ
Source: Boeing Company, 2008

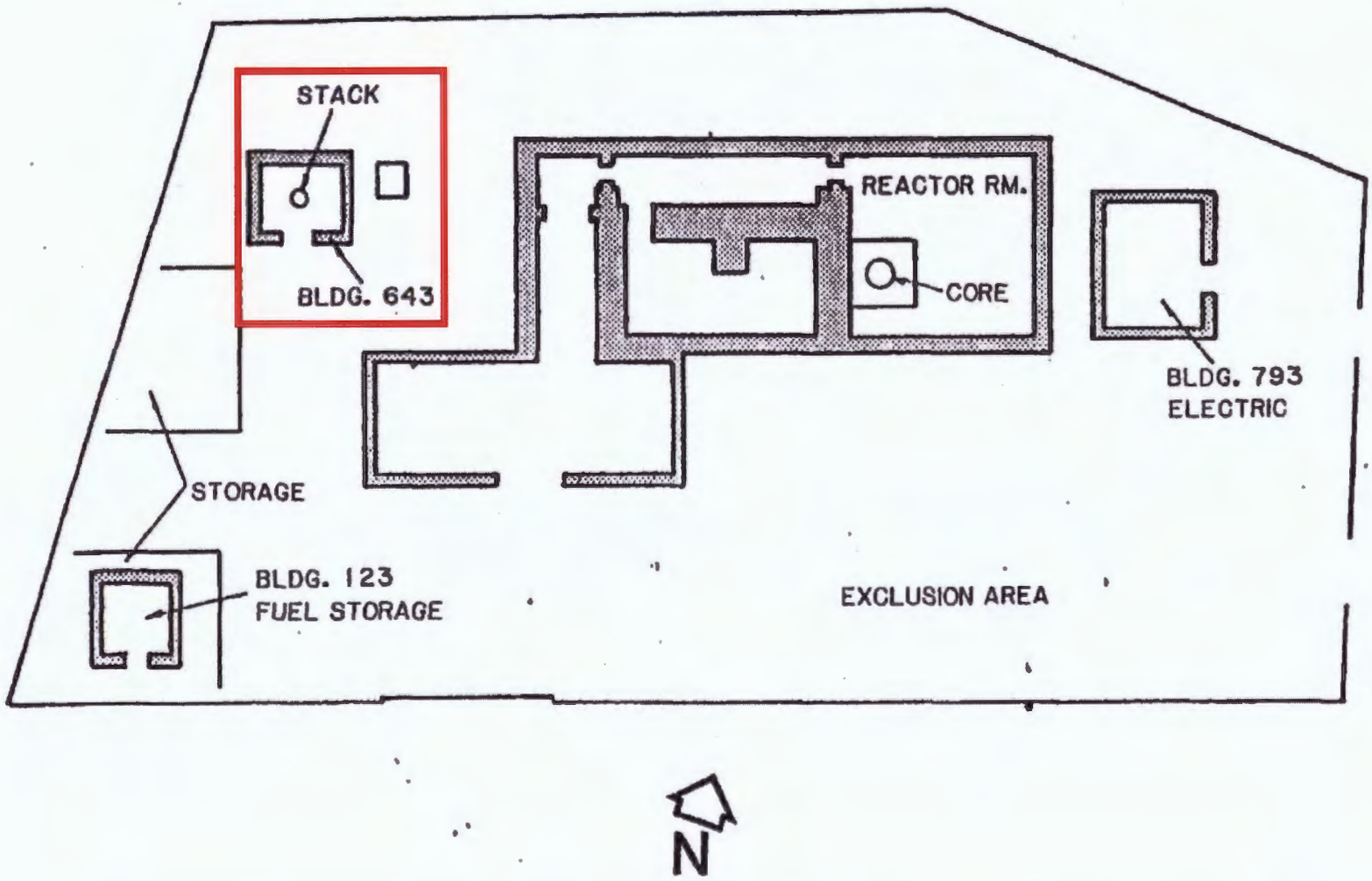
U.S. EPA Region 9

Figure 2.2.7a
Site 4633
Plot Plan

Y:/Santa_Susana/EP9038/TM/HSA_5A (2-2-8a)bldg4643AP.cdr
Project:EP9038
Revised: 09/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.2.8a
Building 4643
Site Photograph



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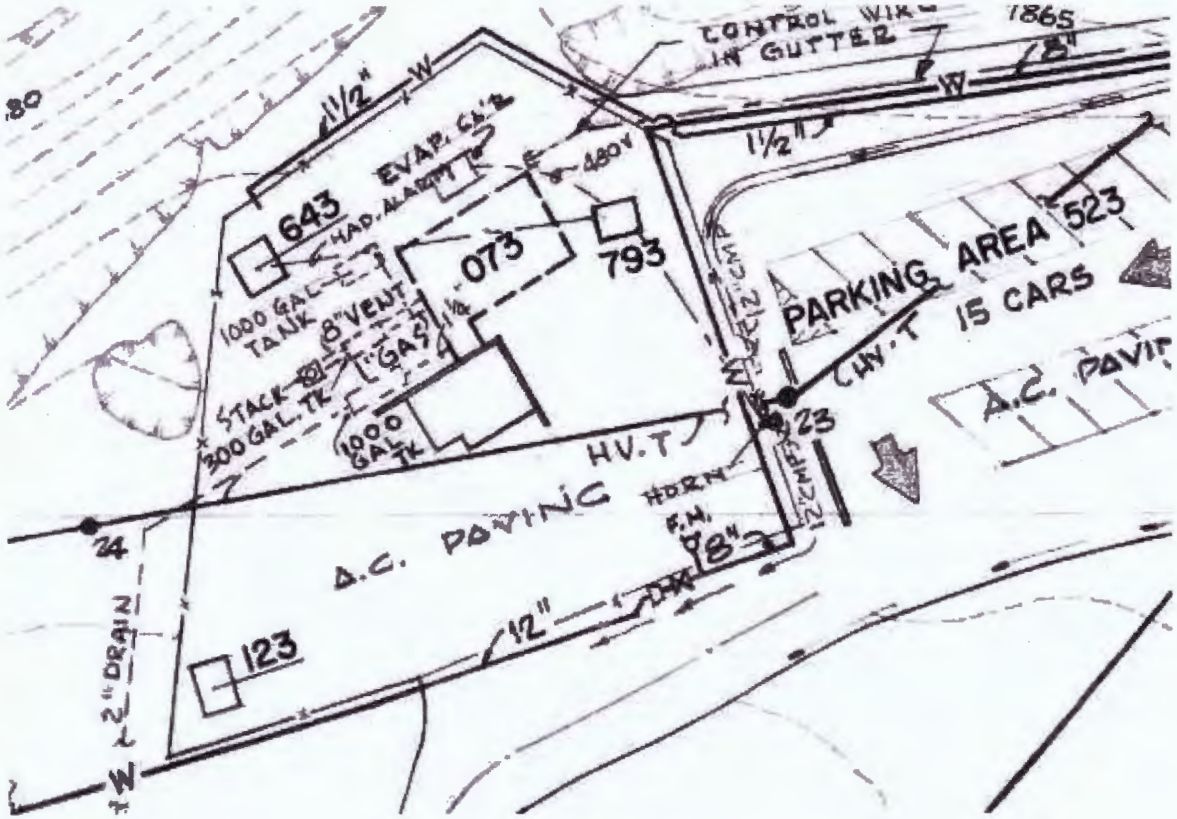
Project:EP9038
Revised: 09/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.2.8b
Building 4453
Floor Plan



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SANTA SUSANA FACILITY
PLOT PLAN

DRAWN	HAMMAN	DWG. SIZE E	303 - GEN. - C 38
CHECKED			
ENGINEER	R.P. HAMMAN	SCALE 1" = 40'	SHEET NO. 4 OF 14
APPROVED			

FORM N04-R-3 REV. 12-61

Y:/Santa_Susana/EP9038/TM/HSA_5A (2-2-8c)bldg4643PP.cdr
Project:EP9038
Revised: 09/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.2.8c
Building 4643
Plot Plan

Y:/Santa_Susana/EP9038/TM/HSA_5A (2-2-8d)bldg4643KRFP.cdr
Project:EP9038
Revised: 08/23/2010 TJ
Source: Boeing Company, 2008

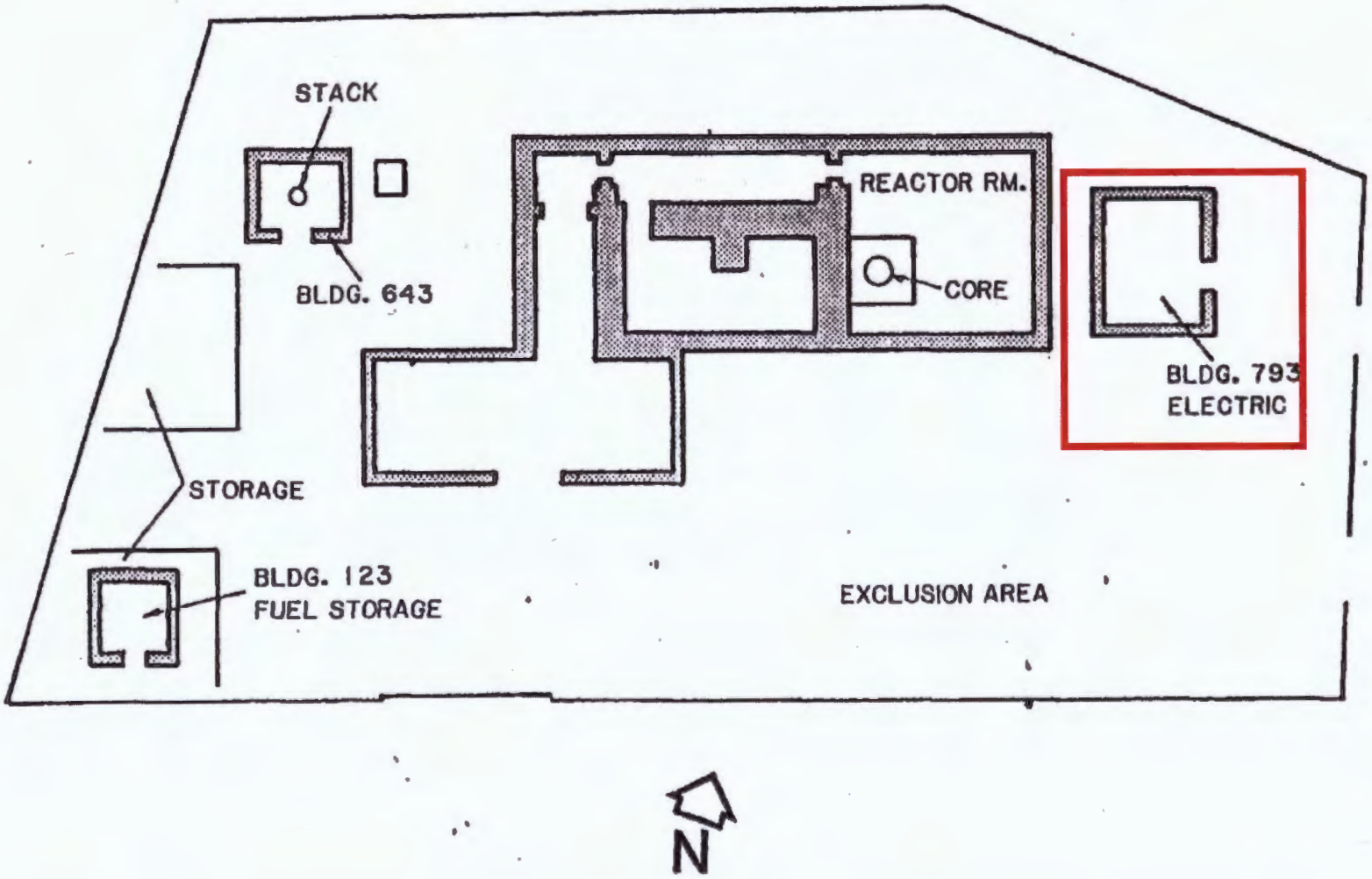
U.S. EPA Region 9

Figure 2.2.8d
Building 4643
KEWB Reactor
Facilities Photograph

Y:/Santa_Susana/EP9038/TM/HSA_5A (2-2-9a)bldg4793AP.cdr
Project:EP9038
Revised: 09/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.2.9a
Building 4793
Site Photograph



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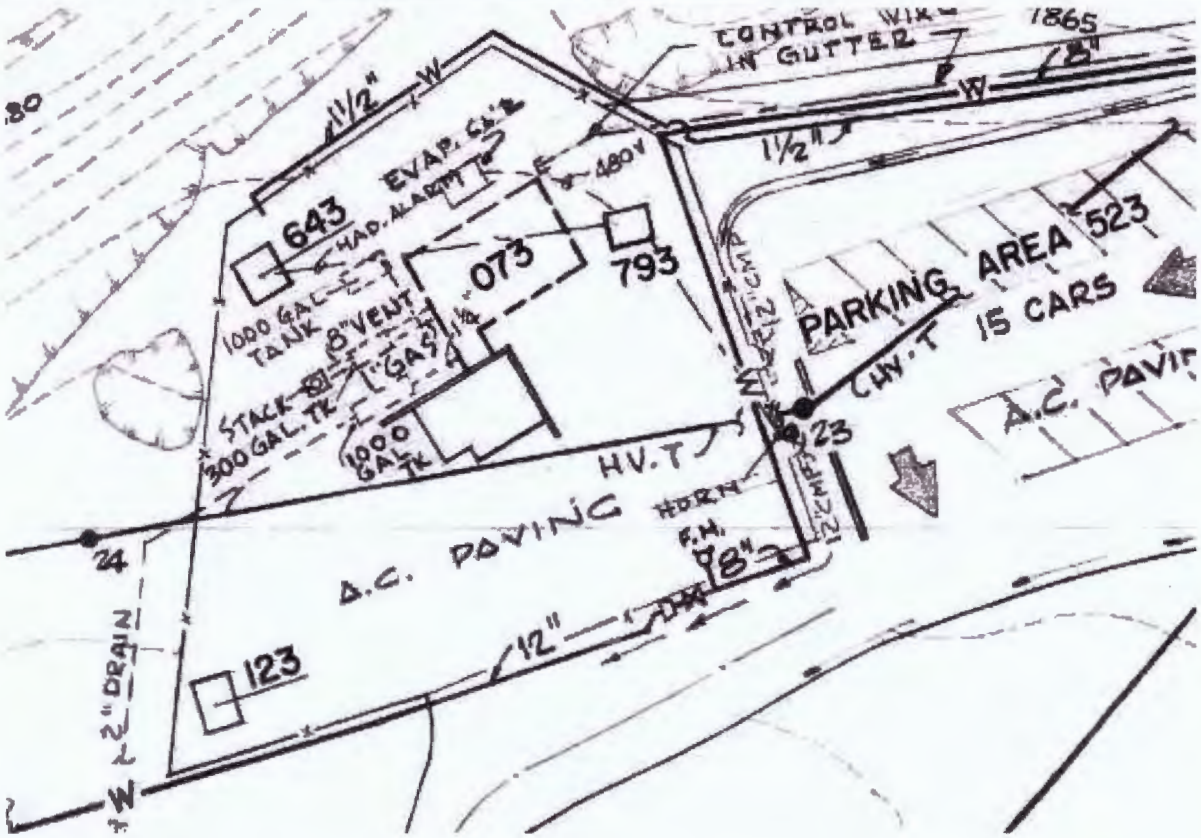
Project:EP9038
Revised: 10/19/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.2.9b
Building 4793
Floor Plan



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8900 DESOTO AVENUE, CANOGA PARK, CALIF.

SANTA SUSANA FACILITY
PLOT PLAN

DRAWN	HAMMAN	DWG. SIZE E	303-GEN.-C 38
CHECKED			
ENGINEER	R.P. HAMMAN	SCALE 1" = 40'	SHEET NO. 4 OF 14
APPROVED			

FORM NA-R-3 REV. 12-61

Y:/Santa_Susana/EP9038/TM/HSA_5A (2-2-9c)bldg4793PP.cdr
Project:EP9038
Revised: 09/23/2010 TJ
Source: Boeing Company, 2008

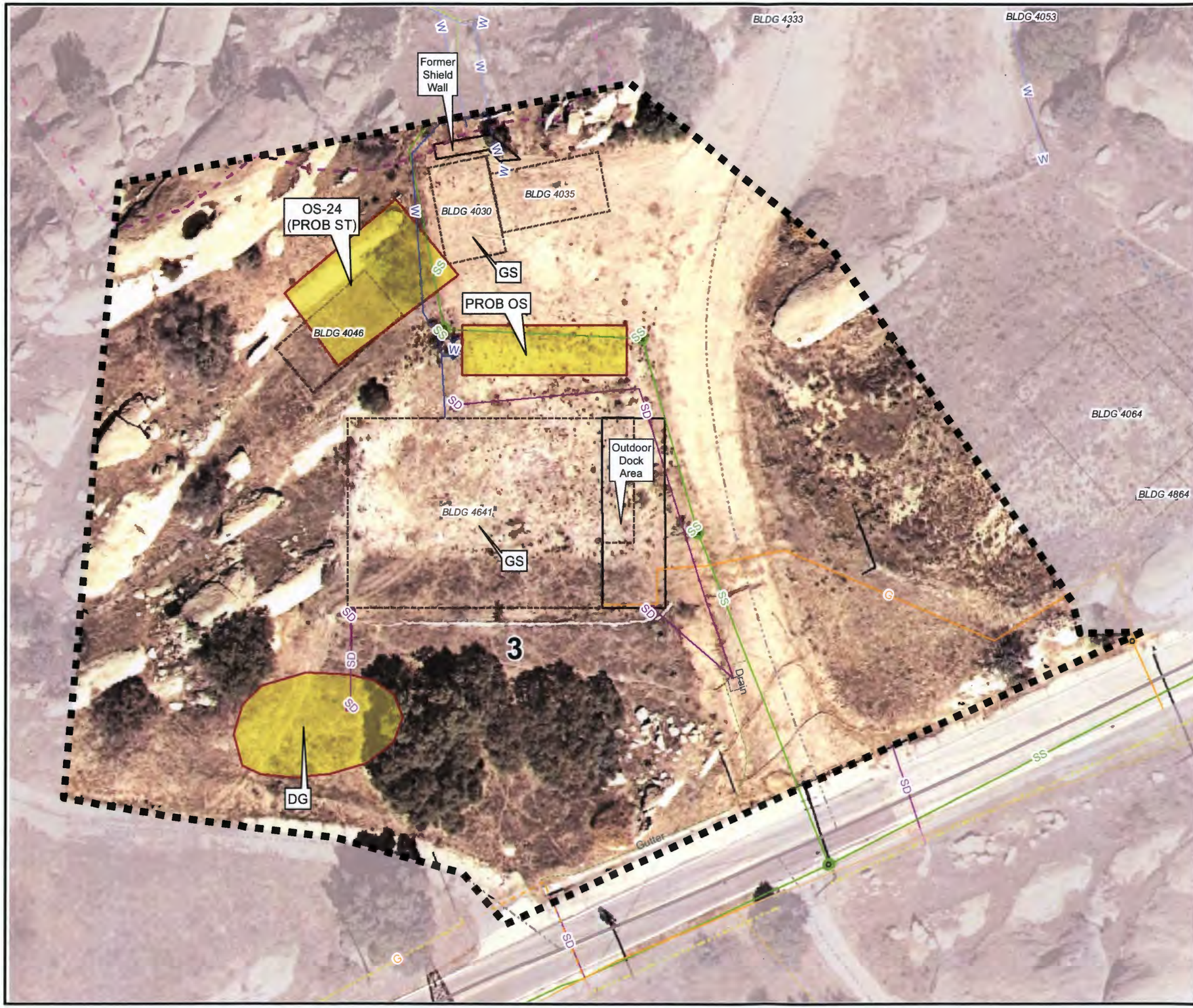
U.S. EPA Region 9

Figure 2.2.9c
Building 4793
Plot Plan

Y:/Santa_Susana/EP9038/TM/HSA_5A (2-2-9d)bldg4793KRFP.cdr
Project:EP9038
Revised: 08/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.2.9d
Building 4793
KEWB Reactor
Facilities Photograph



Historical Site Assessment
Final Technical Memorandum - HSA-5A

Figure 2.3
Area IV Subarea 5A-3
Santa Susana Field Laboratory

U.S. EPA Region 9

Legend

- Subarea 5A-3 Boundary
- Primary Roads
- Secondary Roads
- Underground Storage Tank
- Unknown Tank Type
- Sump
- Dry Well
- Tank Footprint
- Above ground Storage Tank
- Demolished Bldg.
- Existing Bldg.
- Parking Lots
- Drainage
- Drain
- Well

Aerial Photo Features
- Aerial Photography Features
- Leach Field
- Other

Surface Water
- Intermittent Stream
- Permanent Stream
- Surface Water
- Lined Channel
- French Drain
- Drainage
- Leach Field
- Septic System

Utilities
- Channel
- Drain
- Drain
- Drainage Divide
- Gutter
- Tank
- Tank
- Vault
- Well
- Gas
- Storm Drain
- Sanitary Sewer
- Water

B	Building
CONT	Container
CR	Crates
DB	Debris
DG	Disturbed Ground
DTM	Dark Tone Material
EX	Excavation
FA	Fill Area
GS	Ground Scar
HT	Horizontal Tank
IM	Impoundment
MTMM	Medium Toned Mounded Material
OS	Open Storage
PA	Processing Area
PL	Parking Lot
POSS	Possible
PROB	Probable
S-T	Storage Tank
SS	Smoke Stack
ST	Storage
UO	Unidentified Object
VT	Vertical Tank
WDA	Waste Disposal Area

N

0 25 50 100
Scale In Feet

Filepath: Y:\Santa_Susana\EP9038\TM\HSA_5A\(2-3)5BA-3.mxd
Project: EP9038
Created: TJansen
Revised: 10/19/2010 TJ
Sorce: Boeing Company, 2008
CIRGIS, 2007

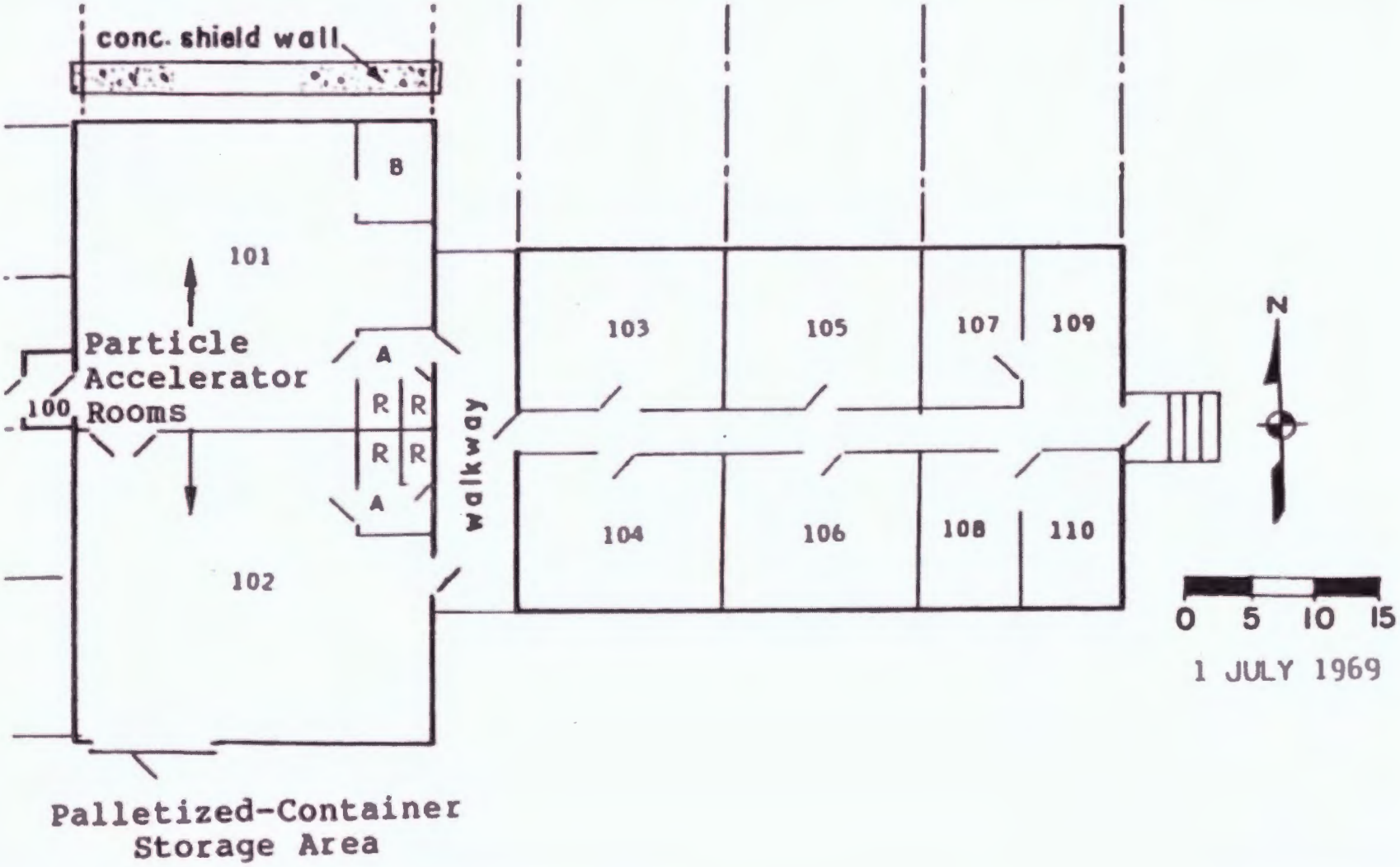
HGL HydroGeoLogic, Inc.

Redacted

Y:/Santa_Susana/EP9038/TM/HSA_5A (2-3-1a)bldg4030AP.cdr
Project:EP9038
Revised: 09/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.3.1a
Building 4030
Site Photograph



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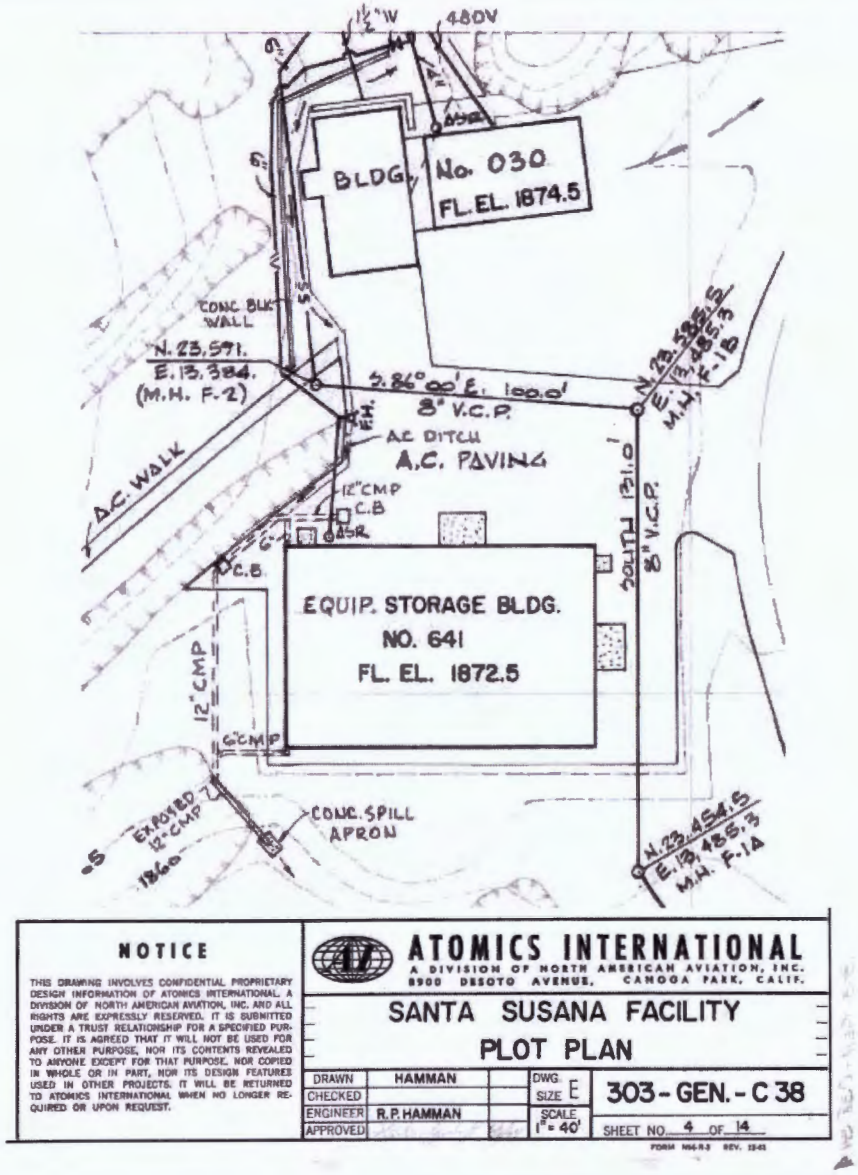
Revised: 09/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.3.1b
Building 4030
Floor Plan



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Project:EP9038
Revised: 09/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.3.1c
Building 4030
Plot Plan

Pre-Demolition

Post-Demolition

Y:/Santa_Susana/EP9038/TM/HSA_5A (2-3-1d)bldg4030PDP.cdr
Project:EP9038
Revised: 08/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.3.1d
Building 4030
Pre- and Post-Demolition
Photograph

Y:/Santa_Susana/EP9038/TM/HSA_5A (2-3-2a)bldg4046AP.cdr
Project:EP9038
Revised: 10/19/2010 TJ
Source: Boeing Company, 2008

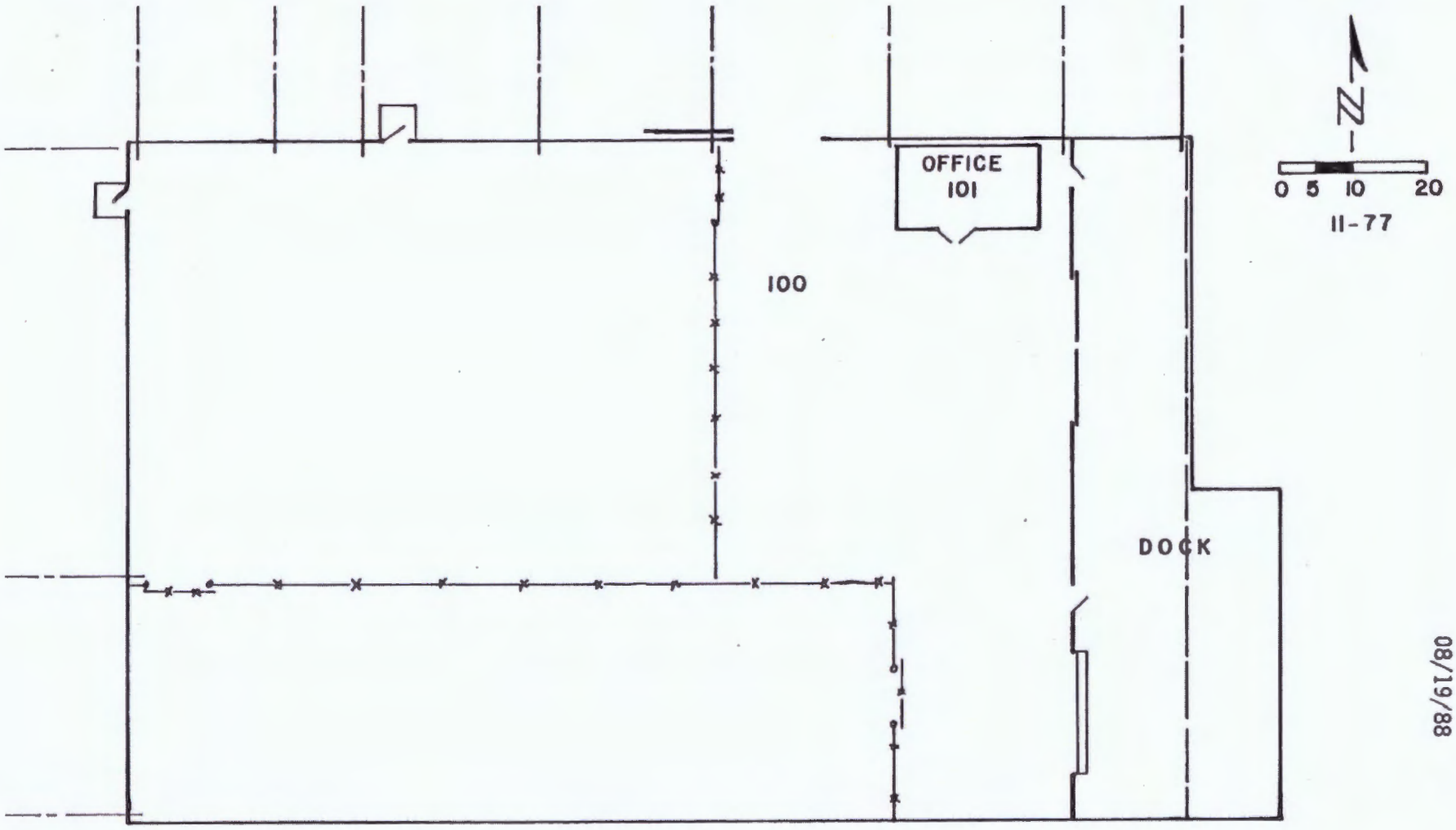
U.S. EPA Region 9

Figure 2.3.2a
Building 4046
Site Photograph

Y:/Santa_Susana/EP9038/TM/HSA_5A (2-3-3a)bldg4641AP.cdr
Project:EP9038
Revised: 10/19/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.3.3a
Building 4641
Site Photograph



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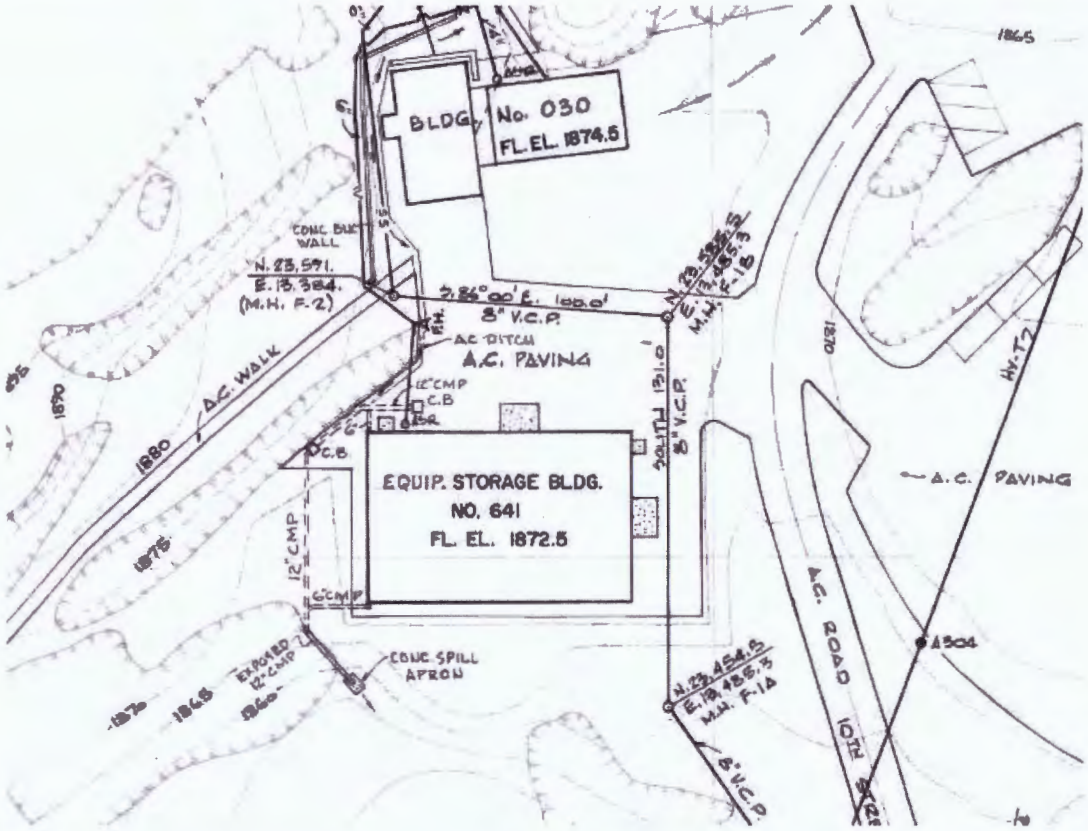
Project:EP9038
Revised: 10/19/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.3.3b
Building 4641
Floor Plan



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SANTA SUSANA FACILITY
PLOT PLAN

DRAWN	HAMMAN	DWG. SIZE E	303 - GEN. - C 38
CHECKED			
ENGINEER	R.P. HAMMAN	SCALE 1" = 40'	SHEET NO. 4 OF 14
APPROVED			

FORM M94-R-1 REV. 12-61

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Project:EP9038
Revised: 10/19/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.3.3c
Building 4641
Plot Plan

Y:/Santa_Susana/EP9038/TM/HSA_5A (2-3-3d)bldg4641BP.cdr
Project:EP9038
Revised: 10/19/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.3.3d
Building 4641
Building
Photograph

Historical Site Assessment
Final Technical Memorandum - HSA-5A

Figure 2.4
Area IV Subarea 5A-4
Santa Susana Field Laboratory

U.S. EPA Region 9

Legend

- Subarea 5A-4 Boundary
- Primary Roads
- Secondary Roads
- Underground Storage Tank
- Unknown Tank Type
- Sump
- Dry Well
- Tank Footprint
- Above ground Storage Tank
- Demolished Bldg.
- Existing Bldg.
- Parking Lots
- Drainage
- Drain
- Well

B	Building
CONT	Container
CR	Crates
DB	Debris
DG	Disturbed Ground
DTM	Dark Tone Material
EX	Excavation
FA	Fill Area
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HT	Horizontal Tank
IM	Impoundment
MTMM	Medium Toned Mounded Material
OS	Open Storage
PA	Processing Area
PL	Parking Lot
POSS	Possible
PROB	Probable
S-T	Storage Tank
SS	Smoke Stack
ST	Storage
UO	Unidentified Object
VT	Vertical Tank
WDA	Waste Disposal Area

Aerial Photo Features
- Aerial Photography Features
- Leach Field
- Other

Surface Water
- Intermittent Stream
- Permanent Stream
- Surface Water
- Lined Channel
- French Drain
- Drainage
- Leach Field
- Septic System

Utilities
- Channel
- Drain
- Drain
- Drainage Divide
- Gutter
- Tank
- Tank
- Vault
- Well
- Gas
- Storm Drain
- Sanitary Sewer
- Water

0 25 50 100
Scale In Feet

N

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Created: TJansen
Revised: 10/19/2010 TJ
Sorce: Boeing Company, 2008
CIRGIS, 2007

HGL HydroGeoLogic, Inc.

Redacted

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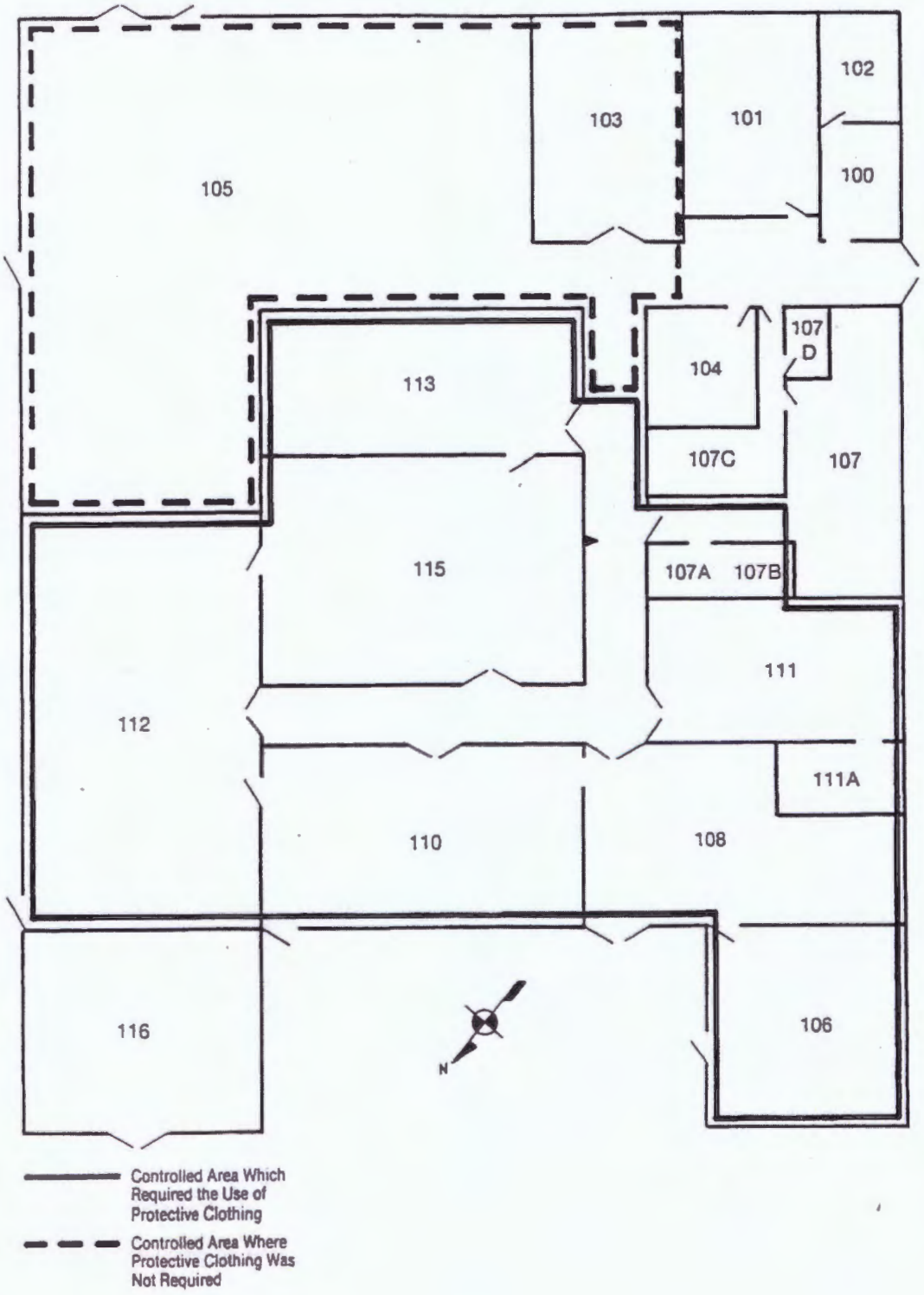
Project:EP9038
Revised: 09/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.4.1a
Building 4005
Site Photograph



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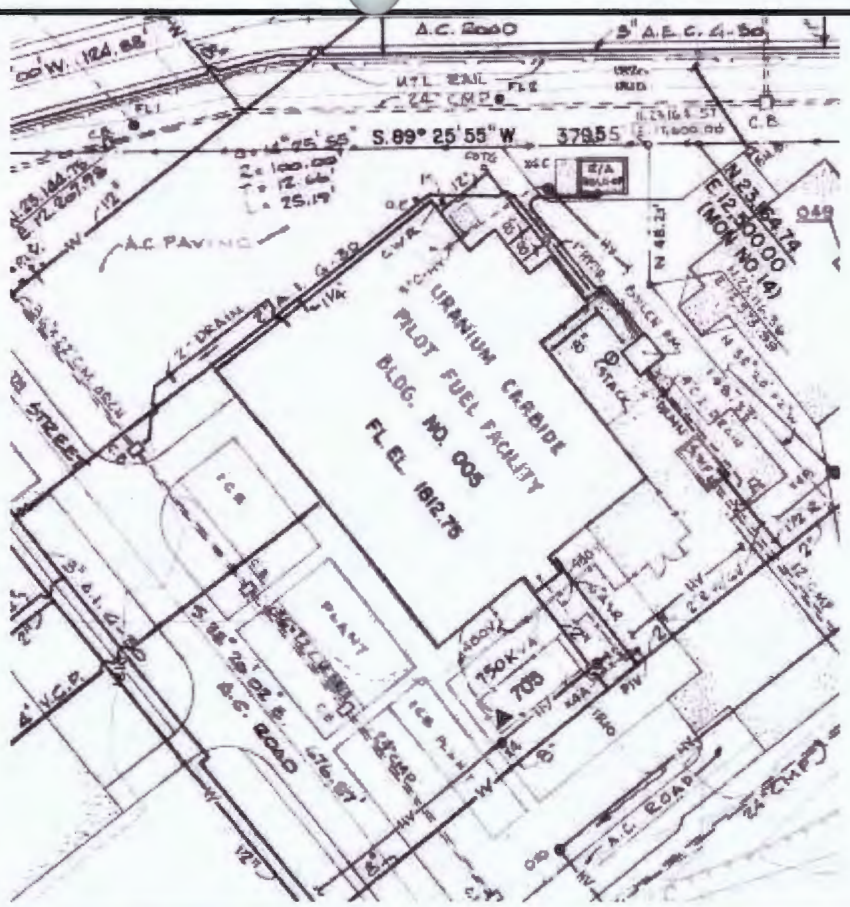
Project:EP9038
Revised: 08/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.4.1b
Building 4005
Floor Plan



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SANTA SUSANA FACILITY
PLOT PLAN

DRAWN	HAMMAN		DWG. SIZE E	303-GEN.-C40
CHECKED				
ENGINEER	R PHAMMAN		SCALE 1"=40'	SHEET NO. 6 OF 14
APPROVED				

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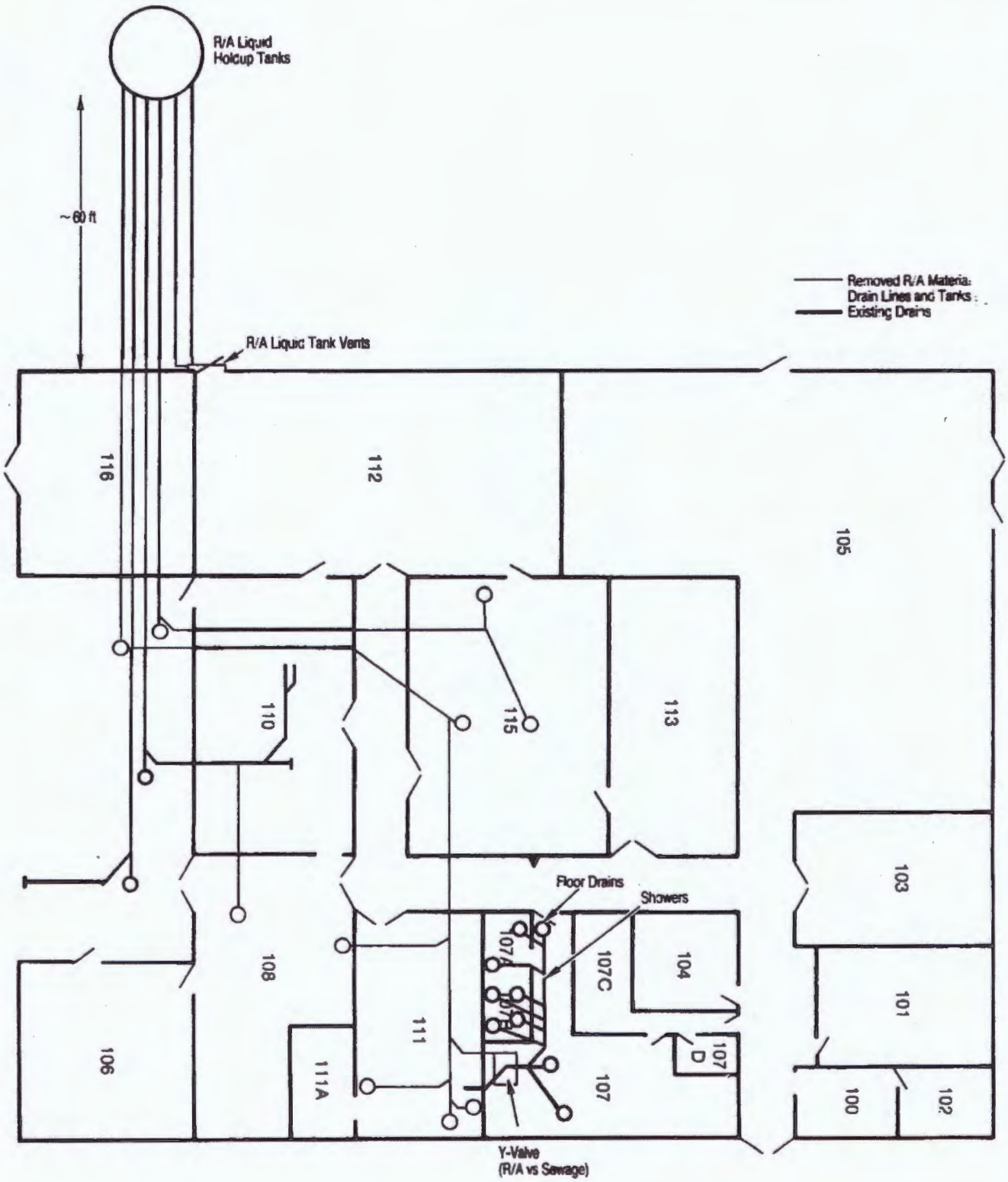
Project:EP9038
Revised: 09/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.4.1c
Building 4005
Plot Plan



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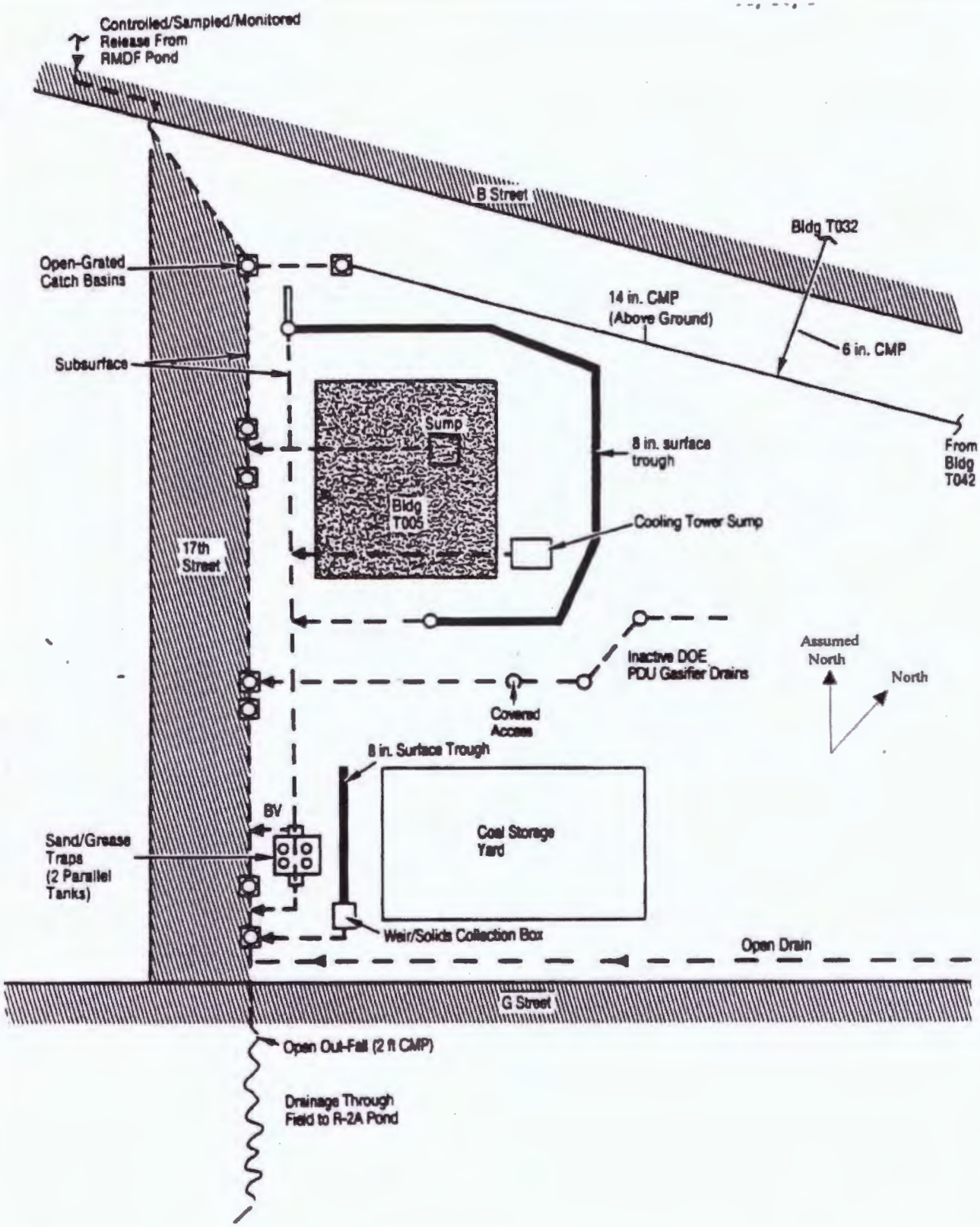
Project:EP9038
Revised: 08/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.4.1d
Building 4005
Radioactive Liquid
Drain System



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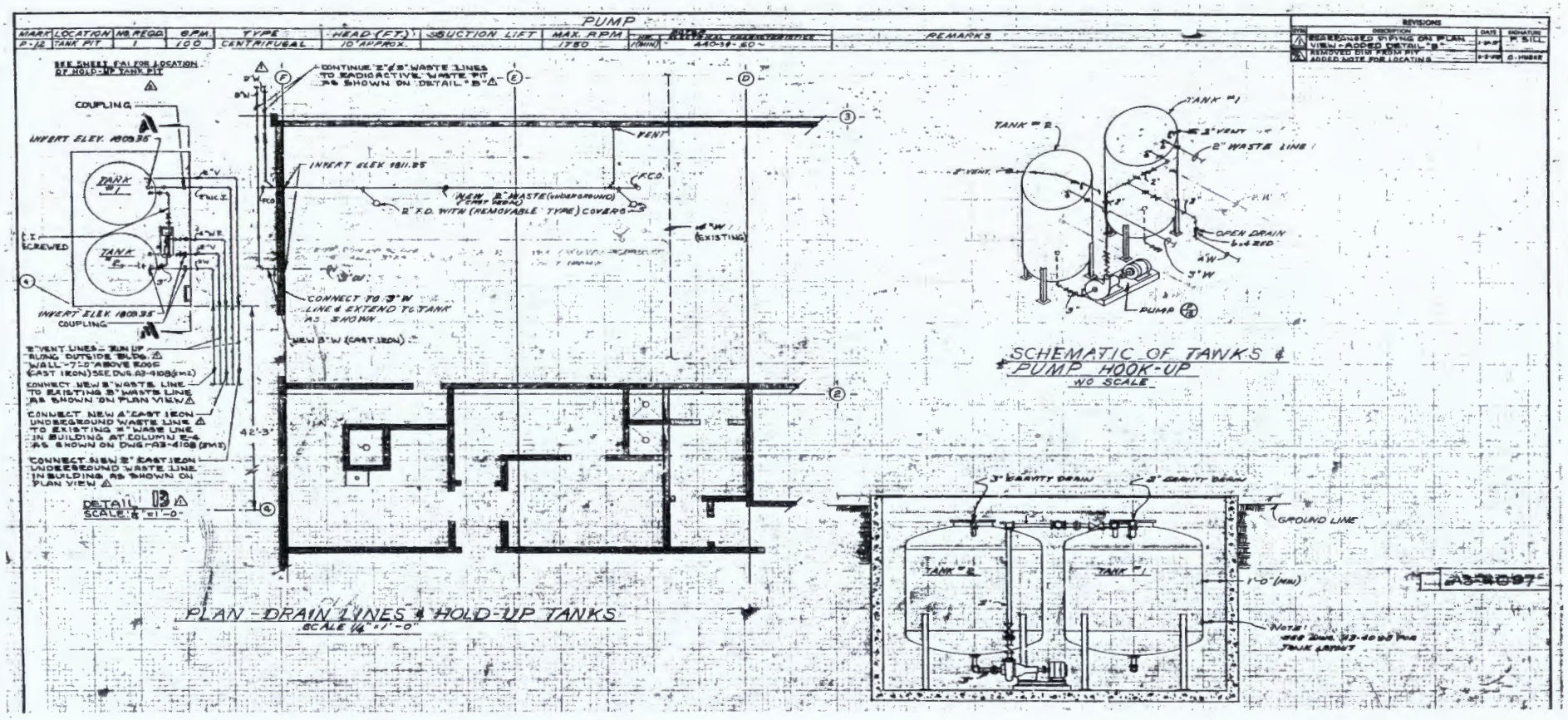
Project:EP9038
Revised: 08/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

BV: Bypass Valve
CMP: Convoluted Metal Pipe
DOE: Dept. of Energy
PDU: Process Demonstration Unit
RMDF: Radioactive Materials Disposal Facility

Figure 2.4.1e
Building 4005
Surface Drainage



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Revised: 10/18/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.4.1f
Building 4005 Drain Lines and Hold-Up Tanks

REDACTED

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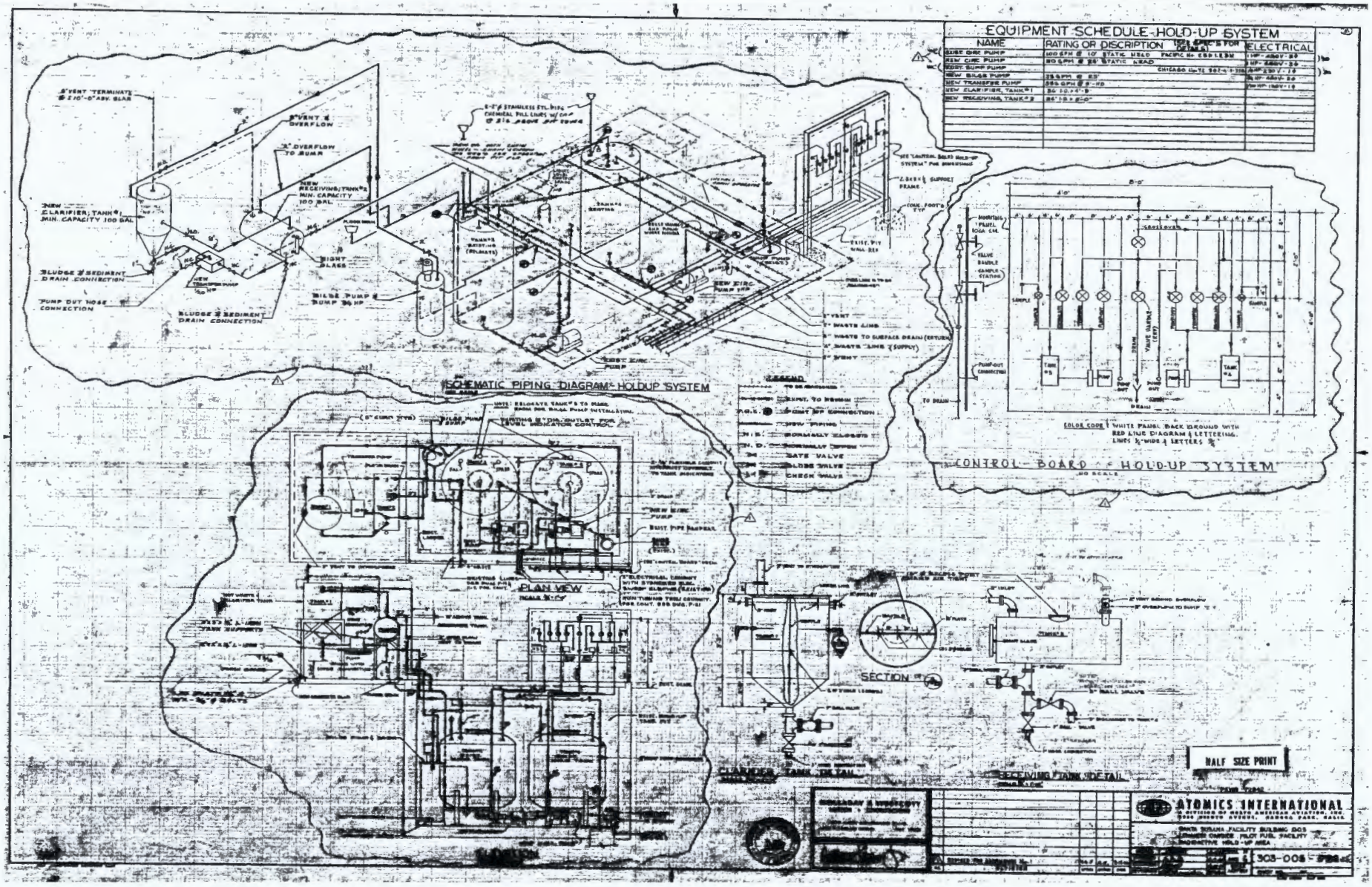
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.4.1g
Building 4005
Uranium Carbide
Pilot Fuel Facility
Floor Plan



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Project:EP9038
Revised: 10/18/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.4.1h
Building 4005
Uranium Carbide
Pilot Fuel Facility
Radioactive Hold-Up Area

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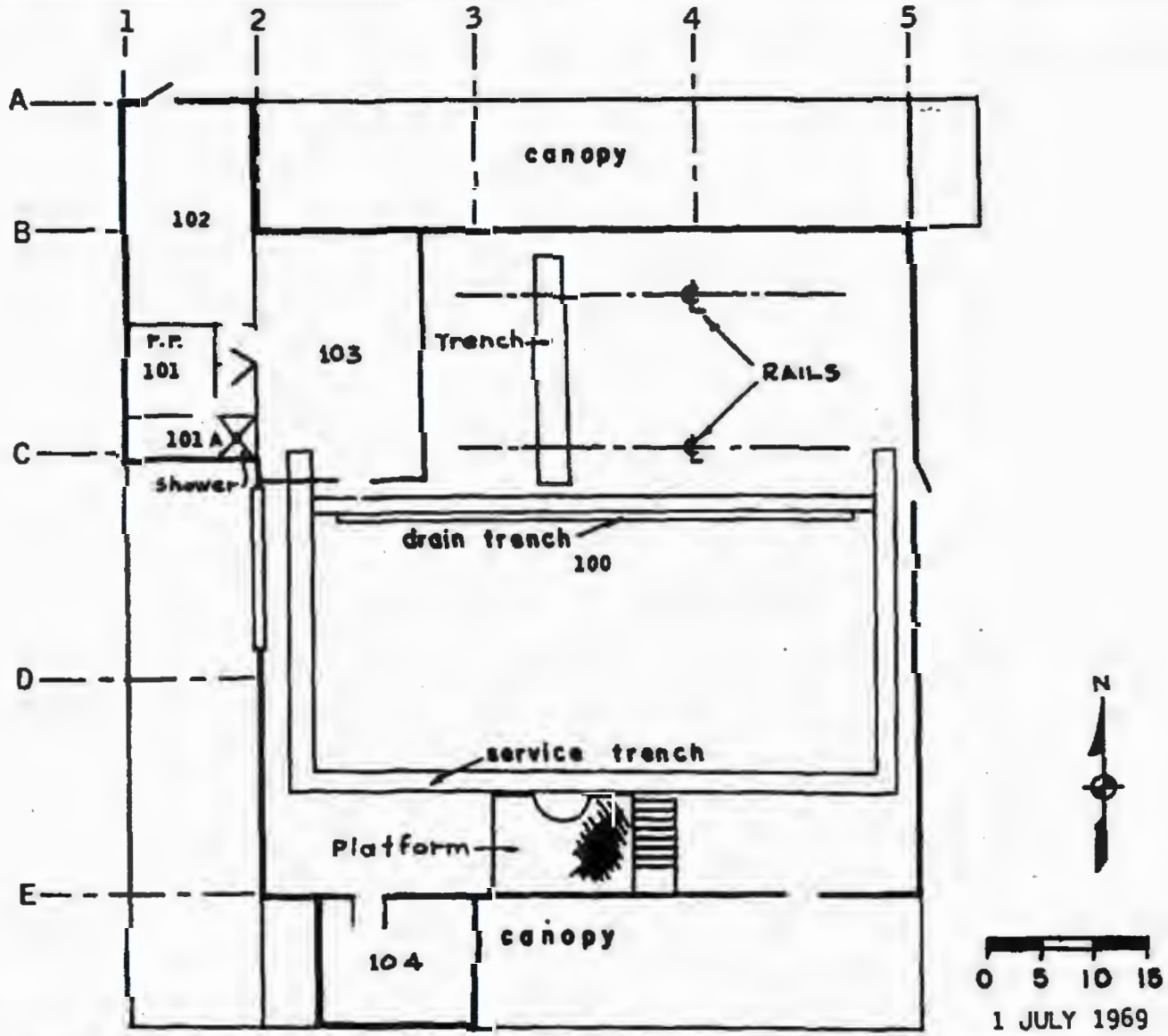
Project:EP9038
Revised: 09/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.4.2a
Building 4042
Site Photograph



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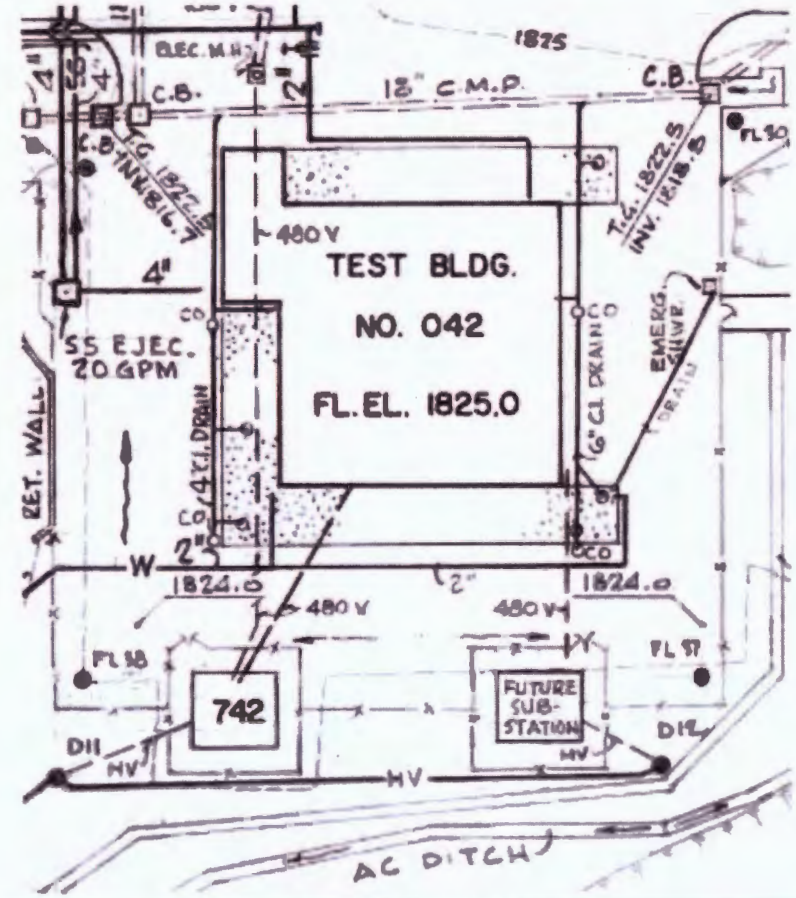
Project:EP9038
Revised: 10/19/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.4.2b
Building 4042
Floor Plan



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SANTA SUSANA FACILITY
PLOT PLAN

DRAWN	HAMMAN	DWG. SIZE E	303-GEN.-C 38
CHECKED			
ENGINEER	R.P. HAMMAN	SCALE 1" = 40'	SHEET NO. 4 OF 14
APPROVED			

Y:/Santa_Susana/EP9038/TM/HSA_5A (2-4-2c)bldg4042PP.cdr
Project:EP9038
Revised: 09/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.4.2c
Building 4042
Plot Plan

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Revised: 09/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.4.3a
Building 4048
Site Photograph

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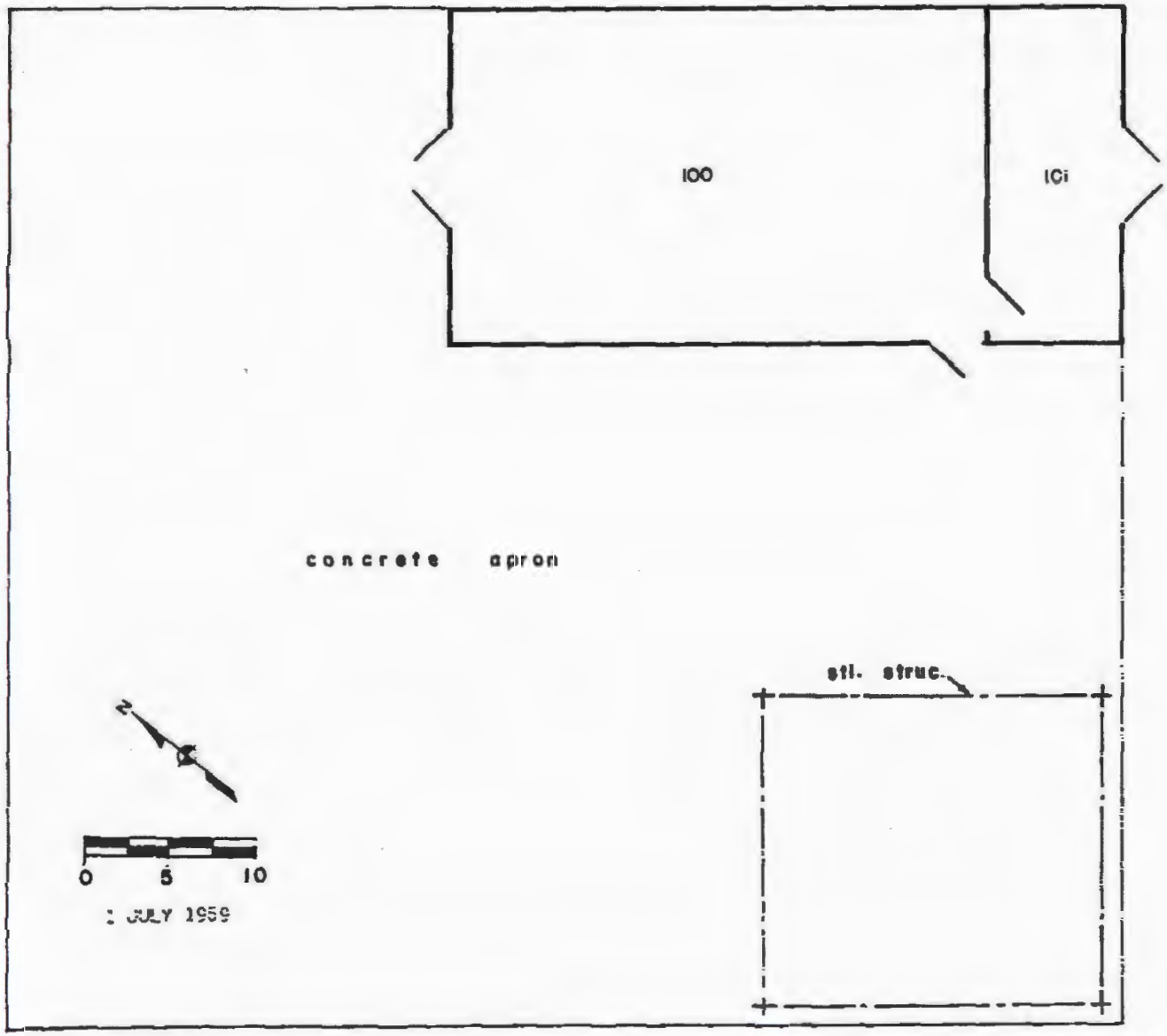
U.S. EPA Region 9

Figure 2.4.4a
Building 4049
Site Photograph



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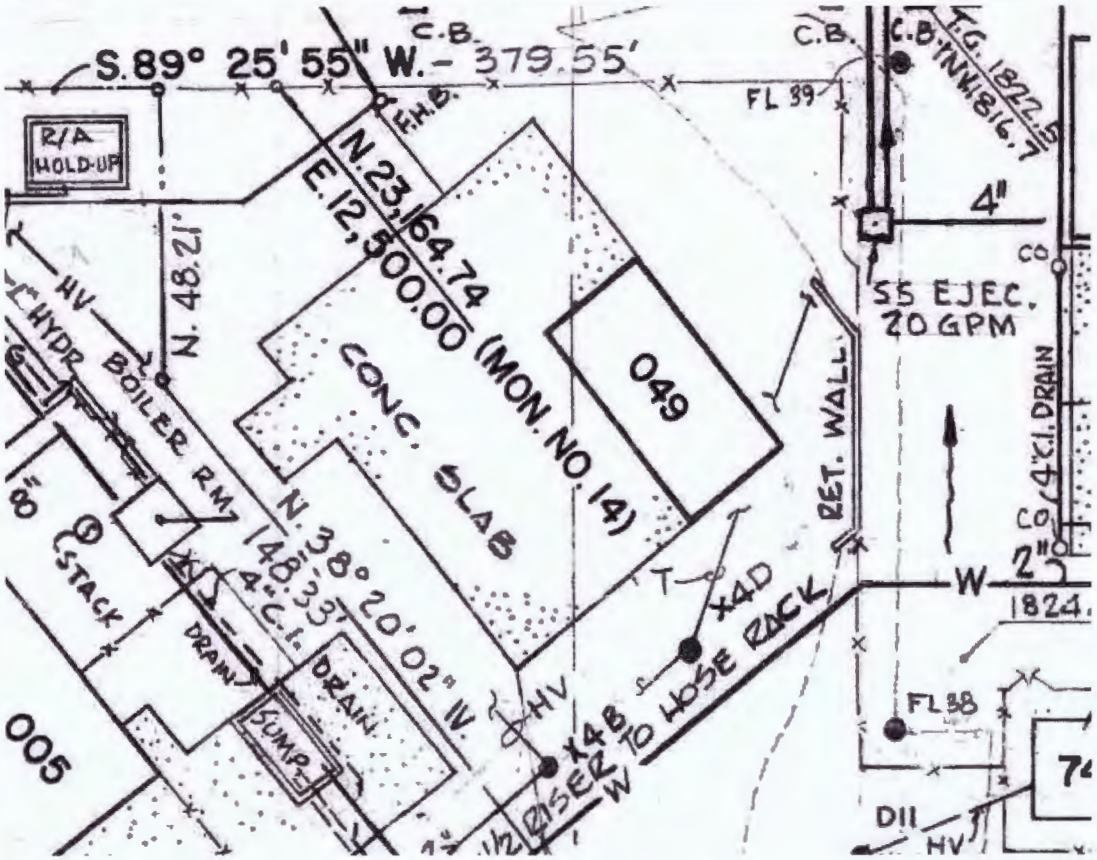
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.4.4b
Building 4049
Floor Plan



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SANTA SUSANA FACILITY
PLOT PLAN

DRAWN	HAMMAN	DWG. SIZE E	303 - GEN. - C 38
CHECKED			
ENGINEER	R.P. HAMMAN	SCALE 1" = 40'	SHEET NO. 4 OF 14
APPROVED			

FORM NH-R-3 REV. 12-61

Y:/Santa_Susana/EP9038/TM/HSA_5A (2-4-4c)bldg4049PP.cdr
Project:EP9038
Revised: 09/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.4.4c
Building 4049
Plot Plan

Y:/Santa_Susana/EP9038/TM/HSA_5A (2-4-5a)bldg4185AP.cdr
Project:EP9038
Revised: 10/06/2010 TJ
Source: Boeing Company, 2008

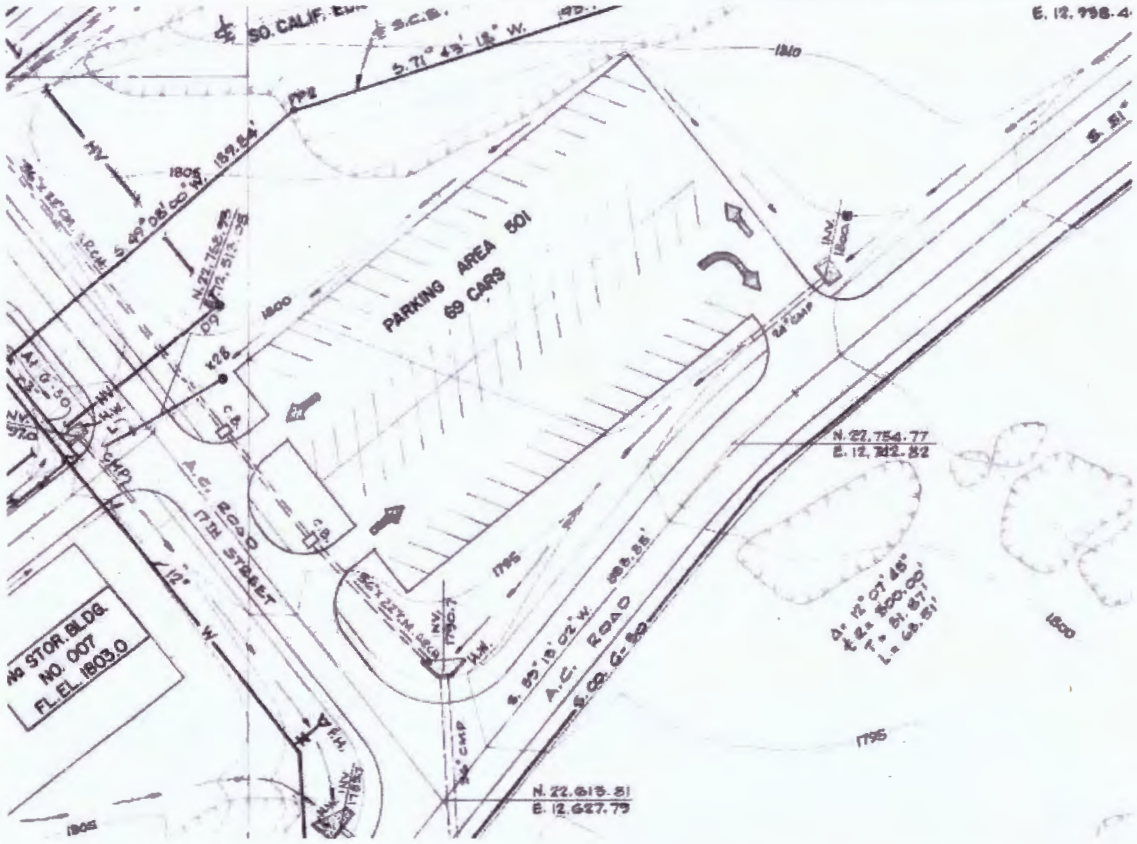
U.S. EPA Region 9

Figure 2.4.5a
Building 4185
Site Photograph

Y:/Santa_Susana/EP9038/TM/HSA_5A (2-4-6a)ParkingLot4501AP.cdr
Project:EP9038
Revised: 10/06/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.4.6a
Parking Lot 4501
Site Photograph



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SANTA SUSANA FACILITY
PLOT PLAN

DRAWN	HAMMAN	DWG. SIZE E	303-GEN.-C 38
CHECKED			
ENGINEER	R.P. HAMMAN	SCALE 1" = 40'	SHEET NO. 4 OF 14
APPROVED			

FORM H94-R-3 REV. 12-61

Y:/Santa_Susana/EP9038/TM/HSA_5A (2-4-6c)ParkingLot4501PP.cdr
Project:EP9038
Revised: 09/23/2010 TJ
Source: Boeing Company, 2008

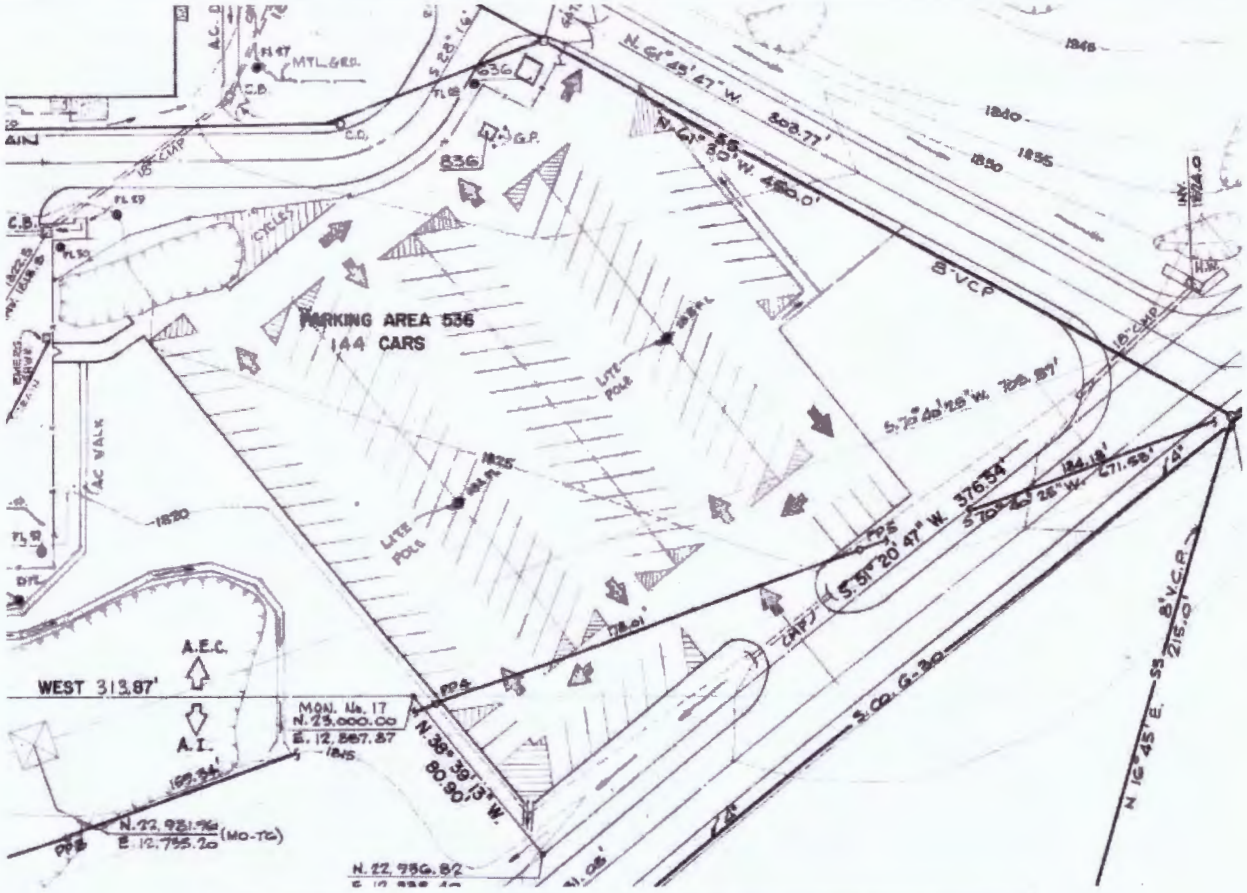
U.S. EPA Region 9

Figure 2.4.6c
Parking Lot 4501
Plot Plan

Y:/Santa_Susana/EP9038/TM/HSA_5A (2-4-7a)ParkingLot4536AP.cdr
Project:EP9038
Revised: 10/19/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.4.7a
Parking Lot 4536
Site Photograph



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SANTA SUSANA FACILITY
PLOT PLAN

DRAWN	HAMMAN	DWG. SIZE E	303-GEN.-C 38
CHECKED			
ENGINEER	R.P. HAMMAN	SCALE 1" = 40'	SHEET NO. 4 OF 14
APPROVED			

FORM NA-N-3 REV. 12-61

Y:/Santa_Susana/EP9038/TM/HSA_5A (2-4-7c)ParkingLot4536PP.cdr
Project:EP9038
Revised: 10/19/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.4.7c
Parking Lot 4536
Plot Plan

Historical Site Assessment
Final Technical Memorandum - HSA-5A

Figure 2.5
Area IV Subarea 5A-5
Santa Susana Field Laboratory

U.S. EPA Region 9

Legend

- Subarea 5A-5 Boundary
- Primary Roads
- Secondary Roads
- Underground Storage Tank
- Unknown Tank Type
- Sump
- Dry Well
- Tank Footprint
- Above ground Storage Tank
- Demolished Bldg.
- Existing Bldg.
- Parking Lots
- Drainage
- Drain
- Well

Aerial Photo Features

- Aerial Photography Features
- Leach Field
- Other

Surface Water

- Intermittent Stream
- Permanent Stream
- Surface Water
- Lined Channel
- French Drain
- Drainage
- Leach Field
- Septic System

Utilities

- Channel
- Drain
- Drain
- Drainage Divide
- Gutter
- Tank
- Tank
- Vault
- Well
- G Gas
- SD Storm Drain
- SS Sanitary Sewer
- W Water

B	Building
CONT	Container
CR	Crates
DB	Debris
DG	Disturbed Ground
DTM	Dark Tone Material
EX	Excavation
FA	Fill Area
GS	Ground Scar
HT	Horizontal Tank
IM	Impoundment
MTMM	Medium Toned Mounded Material
OS	Open Storage
PA	Processing Area
PL	Parking Lot
POSS	Possible
PROB	Probable
S-T	Storage Tank
SS	Smoke Stack
ST	Storage
UO	Unidentified Object
VT	Vertical Tank
WDA	Waste Disposal Area

0 25 50 100
Scale In Feet

N

Filepath: Y:\Santa_Susana\EP9038\TM\HSA_5A\(2-5)5BA-5.mxd
Project: EP9038
Created: TJansen
Revised: 10/19/2010 TJ
Sorce: Boeing Company, 2008
CIRGIS, 2007

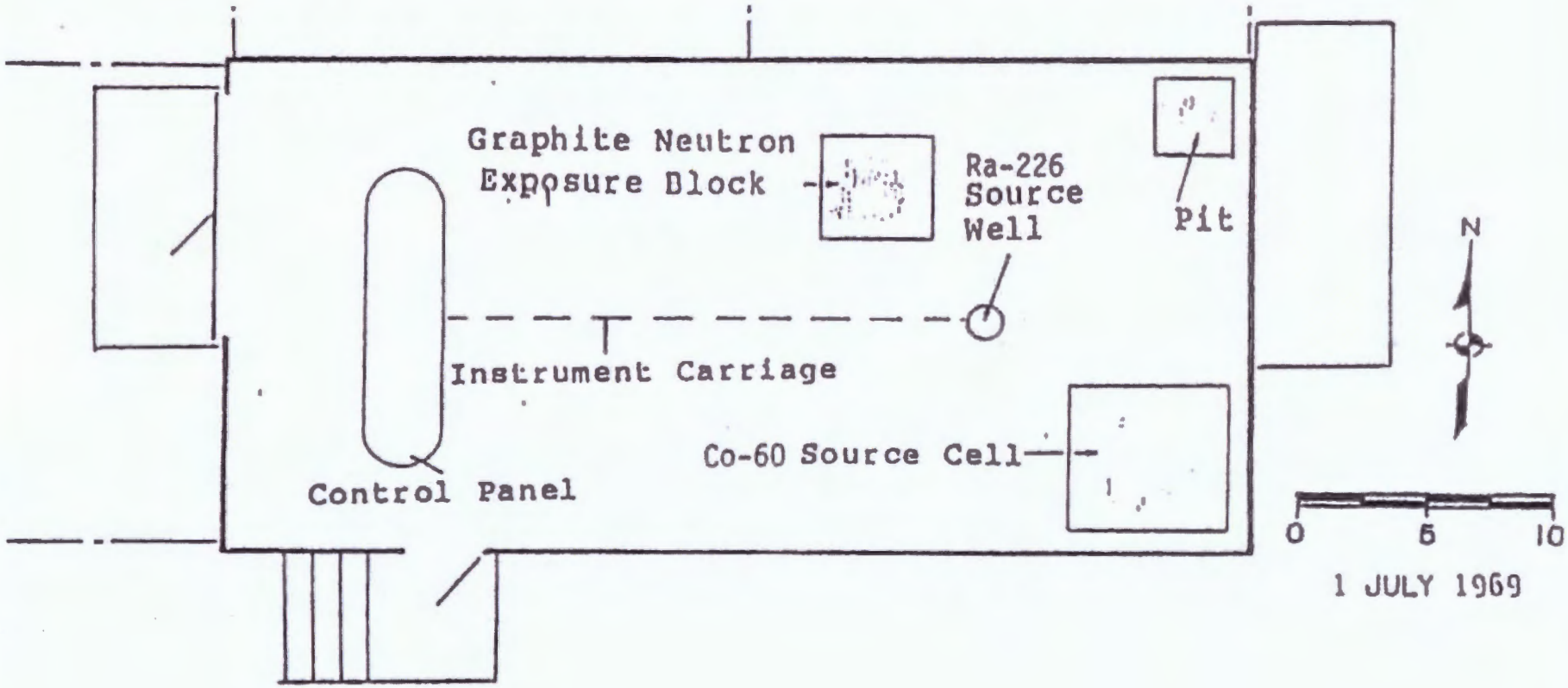
HGL HydroGeoLogic, Inc.

Redacted

Y:/Santa_Susana/EP9038/TM/HSA_5A (2-5-1a)bldg4029AP.cdr
Project:EP9038
Revised: 09/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.5.1a
Building 4029
Site Photograph



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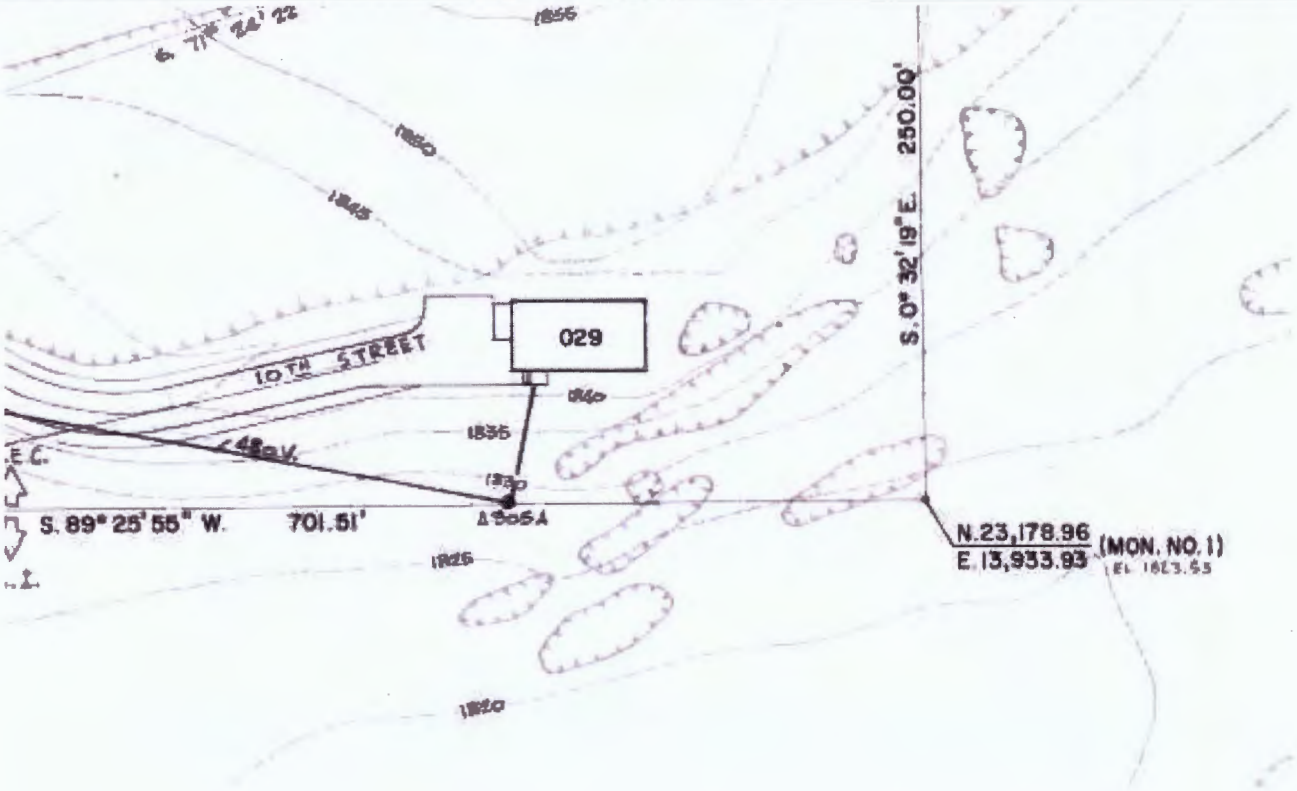
Project:EP9038
Revised: 10/19/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.5.1b
Building 4029
Floor Plan



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SANTA SUSANA FACILITY
PLOT PLAN

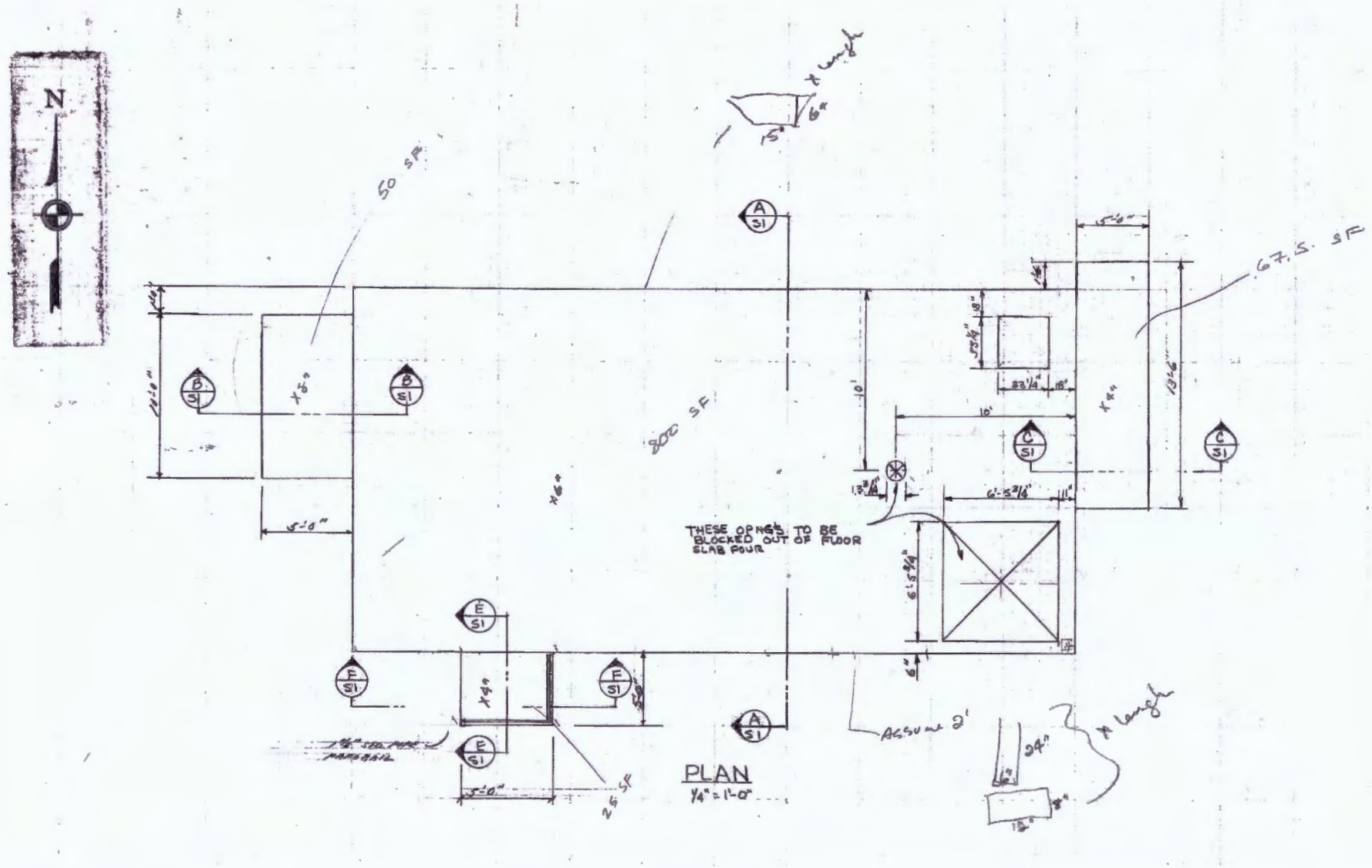
DRAWN	HAMMAN	DWG. SIZE E	303-GEN. C-36
CHECKED			
ENGINEER	R.P. HAMMAN	SCALE 1"=40'	SHEET NO. 2 OF 14
APPROVED			

FORM NAA-R-2 REV. 12-61

Y:/Santa_Susana/EP9038/TM/HSA_5A (2-5-1c)bldg4029PP.cdr
Project:EP9038
Revised: 09/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.5.1c
Building 4029
Plot Plan



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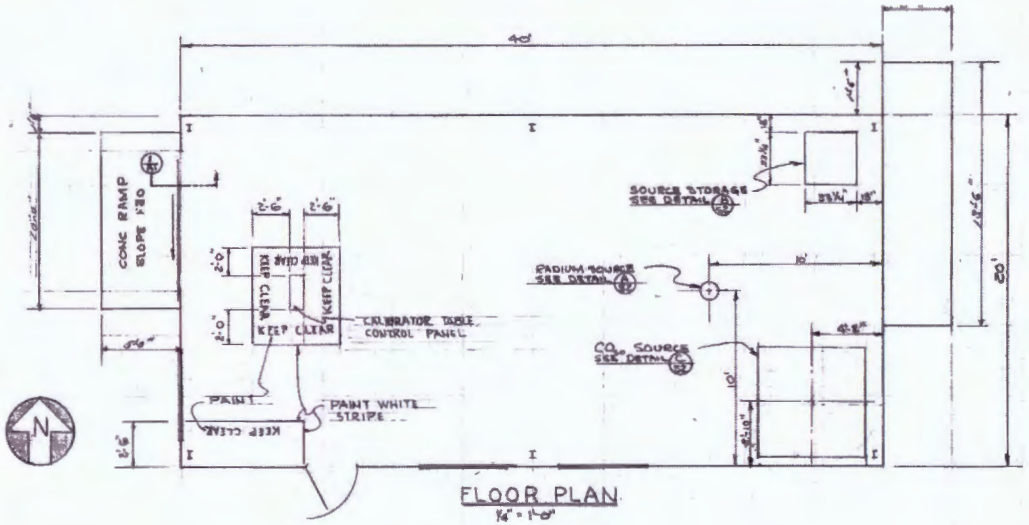
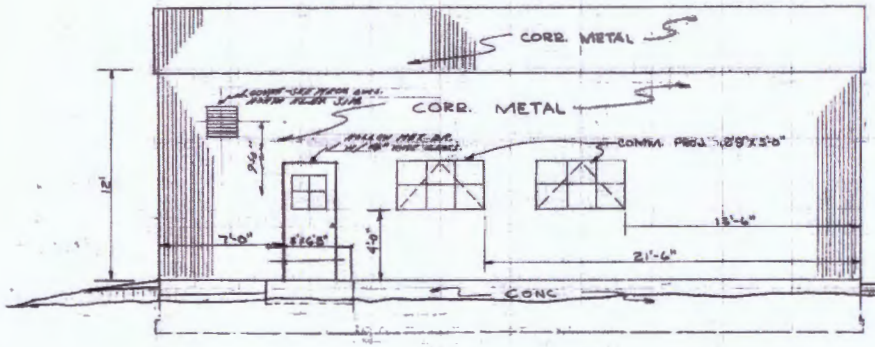
Project: EP9038
Revised: 10/19/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

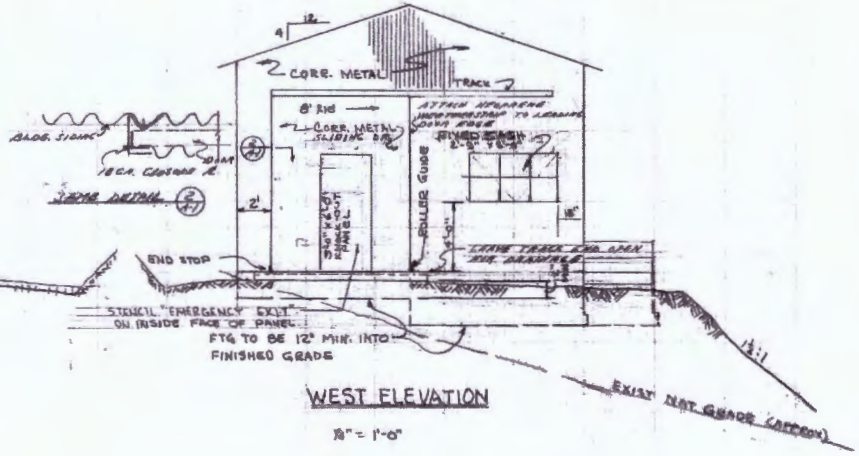
Figure 2.5.1d
Building 4029
Foundation Plan



FLOOR PLAN
1/4" = 1'-0"



SOUTH ELEVATION
1/4" = 1'-0"



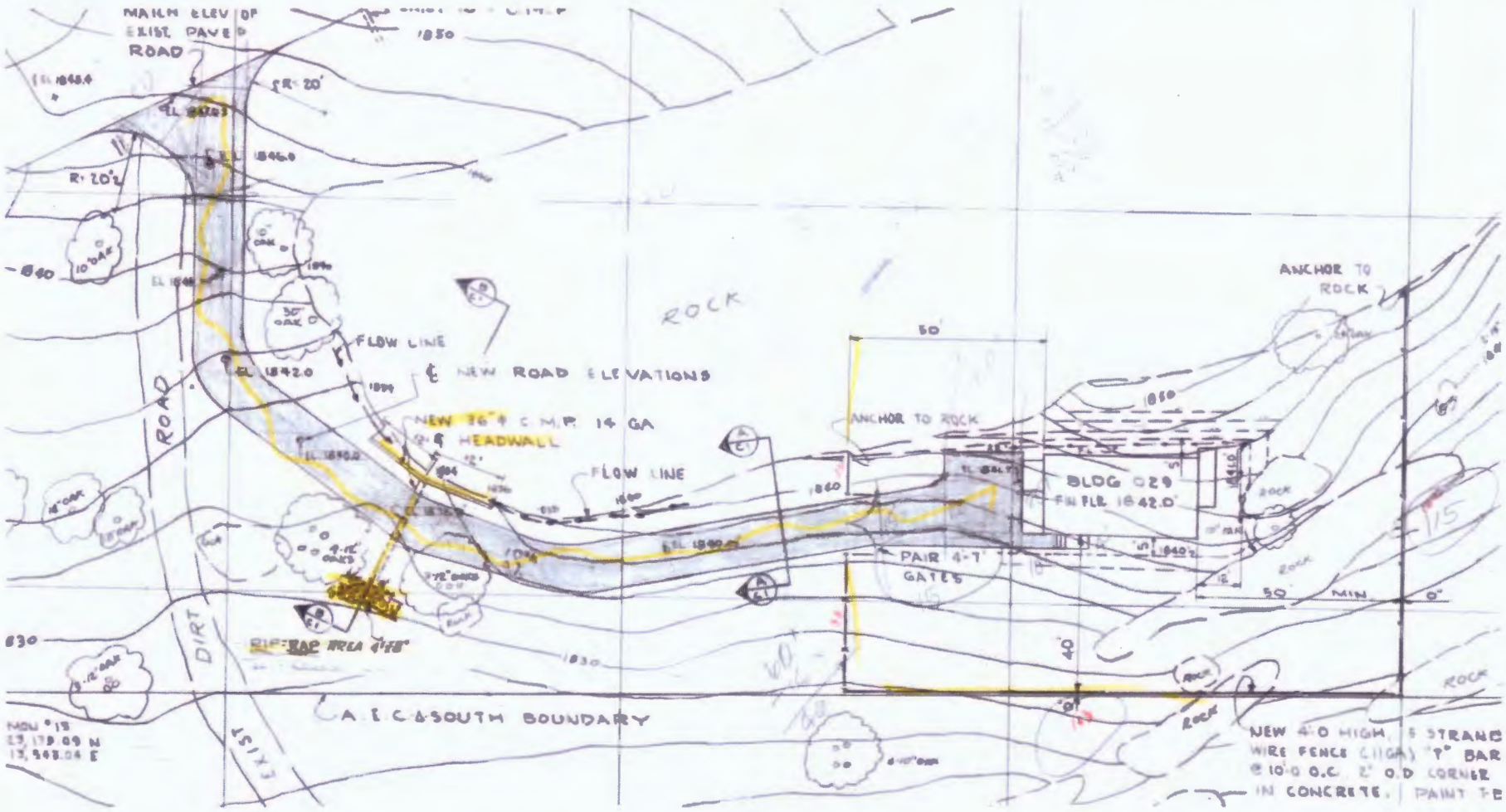
WEST ELEVATION
1/8" = 1'-0"

Y:/Santa_Susana/EP9038/TM/HSA_5A (2-5-1e)Bldg4029BEP.cdr
Project:EP9038
Revised: 10/19/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.5.1e
Building 4029
Building Elevation Plan

Redacted



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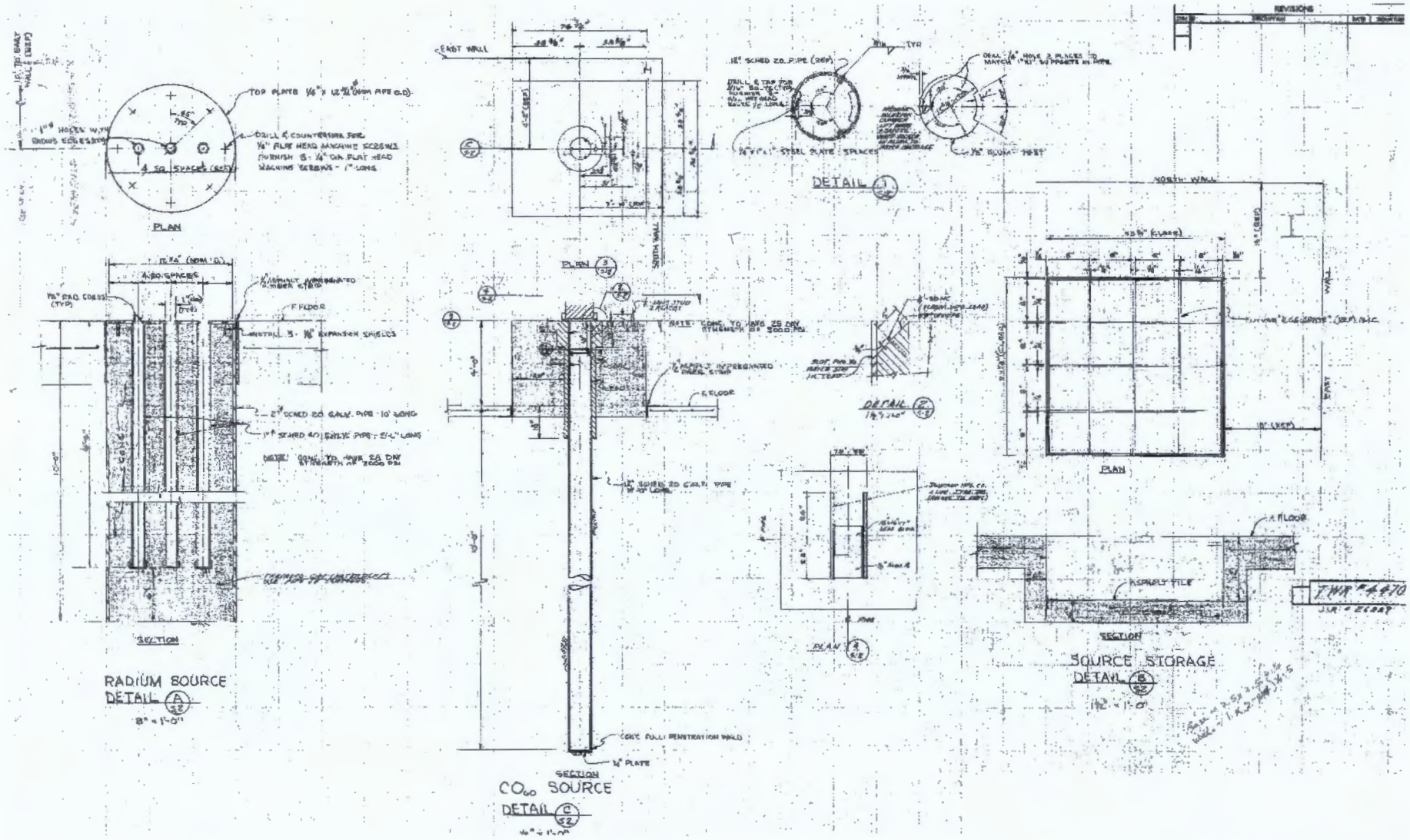
(2-5-1f)Bldg4029SGP.cdr
Project:EP9038
Revised: 10/19/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.5.1f
Building 4029
1959 Site and
Grading Plan



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Project:EP9038
Revised: 10/19/2010 TJ
Source: Boeing Company, 2008

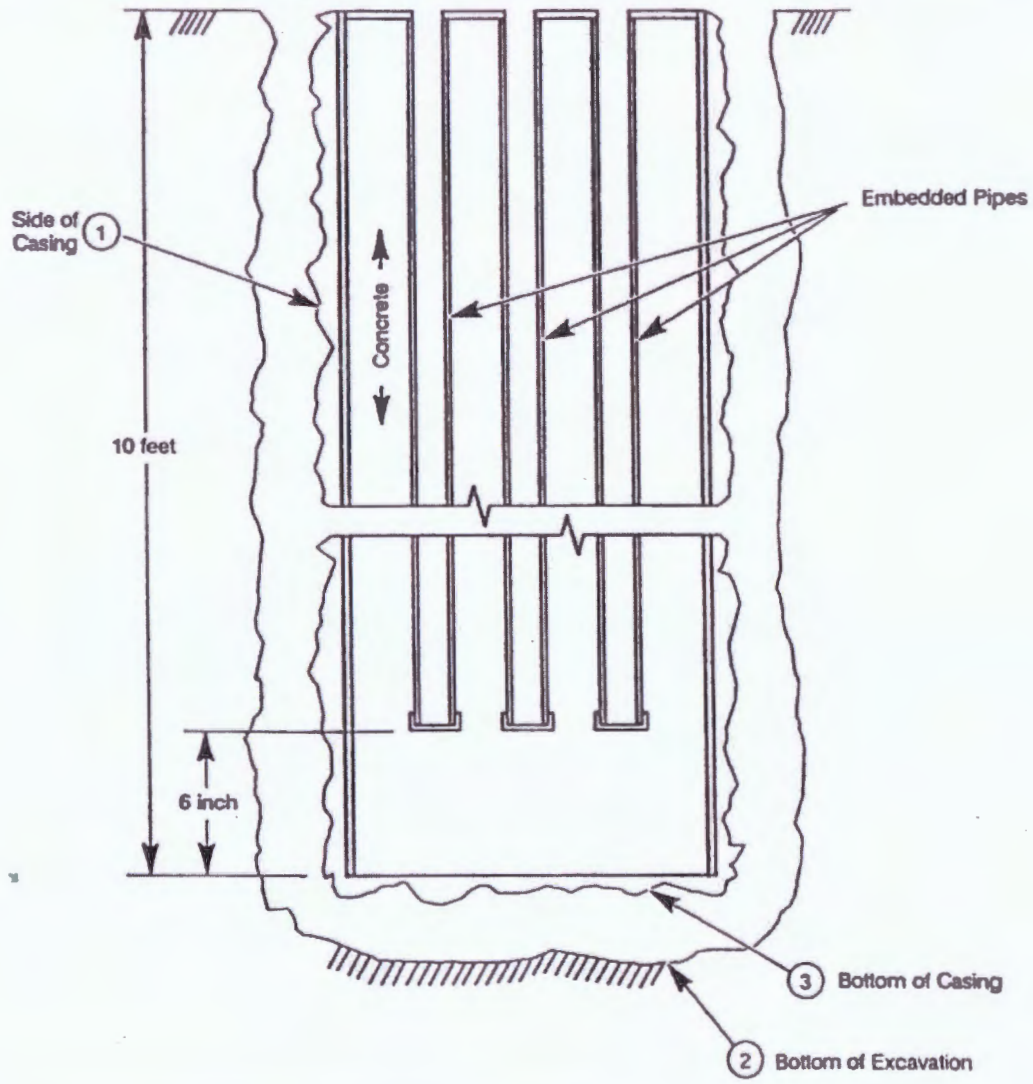
U.S. EPA Region 9

Figure 2.5.1g
Building 4029
Source Storage
Details

Y:/Santa_Susana/EP9038/TM/HSA_5A (2-5-1h)Bldg4029BSY.cdr
Project:EP9038
Revised: 10/19/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.5.1h
Building 4029
Barrel Storage Yard



Y:/Santa_Susana/EP9038/TM/HSA_5A (2-5-1i)Bldg4029RSSE.cdr
Project:EP9038
Revised: 10/19/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.5.1i
Building 4029
Radium Source
Storage Excavation

RESPONSE TO COMMENTS

Response to Comments on Draft HSA-5A Technical Memoranda Issued on January 19, 2011
Historical Site Assessment, Santa Susana Field Laboratory Site
Area IV Radiological Study, Ventura County, California

Item	Comment	Response
1	The **RMHF** must be included in the EPA study. If not this group, which group will it be in?	Agreed. This facility will be addressed in EPA's HSA Tech Memo for Subarea 7.
2	There is **missing information** which is needed. EPA needs to file two 2 FOIA requests from DOE. Also make this request from Boeing who appears to have the majority of the old AI/Rockwell International records. 1) That they find by FOIA where the KEWB (T073) and Van de Graaff (T030-attachment) Accelerator were disposed of. Were these components buried in the 1960s in the Area IV which was the designated NDFL (Nuclear Field Development Laboratory) waste disposal area located in lower Area IV of the burn pit area? 2) By FOIA, EPA request from DOE the Atomic International environmental monitoring records missing for the years of 1957,1958 and 1959. On the web site, ETEC has posted them all but these years. The two preceding years were investigating a nuclear waste disposal area for AI. Then, ETEC is missing a few years. We need the missing years.	Agreed; however instead of using FOIA, EPA used Section 104(e) under CERCLA to obtain site operational information from DOE, Boeing and others. Based on EPA's review of the site records we received, there is no evidence to indicate that the KEWB reactor from Building 4073 and the Van De Graff accelerator in Building 4030 were disposed of at the waste disposal area located in the burn pit area. However, it should also be noted that the disposal of the KEWB and Van de Graff could not be determined based on currently available documents. Based on information from interviewees, the KEWB reactor was taken to the RMHF; however this has not been verified by historical information. It is possible additional information may be made available during the research relating to the RMHF. EPA continues to work with Boeing and DOE to obtain all pertinent documents relating to the SSFL. EPA will determine whether environmental monitoring reports from 1957, 1958, and 1959 are available.

Response to Comments on Draft HSA-5A Technical Memoranda Issued on January 19, 2011
Historical Site Assessment, Santa Susana Field Laboratory Site
Area IV Radiological Study, Ventura County, California

Item	Comment	Response
3	**Gamma scans**: That they do gamma scans over every area in Area IV if they plan for these areas to be opened as a future public for public access. What isn't safe, becomes wildlife corridor only. It is o possible to say its safe until every are is gamma scanned because of past operational history with accidents. The rocks also need to be swiped or whatever is the best method to test the permeable rock formations to rule out that they have not picked up radiation over the years of sloppy nuclear work. One resident who lives nearby who has thyroid problems as does her daughters believes that the contamination will continue to leach out of these rock formations. I need to let her know that her requests to test the rocks is being done to protect health concerns on this as a possible source of future off site contamination.	Agreed. The gamma scan survey of the Area IV and NBZ is well underway with four different state-of-the –art technologies. As you know, the most sensitive is the large sensor mounted on the forklift, but since it can only scan flat terrain, the other three devices mounted on a cart, a mule, or hand held are also used in the more rugged and often rocky terrain. In April 2011, the survey capability was enhanced by adding a track-mounted sensor that can be used to scan over rugged and steep surfaces. A scan team is being trained in use of rappelling techniques to add capability of safely lowering personnel over very steep terrain in areas surrounding significant radiological facilities such as the RMDF, allowing us to reach what normally would be considered inaccessible areas. In summary, every reasonable effort is being made to survey as close to 100% of the Area IV and NBZ terrain as possible without compromising the health and safety of workers performing the survey tasks.
4	**EPA Approved Grids**: Should be done on all areas of Area IV for soil sampling.	Noted. The EPA soil sampling approach will be applied over all areas within Area IV and the Northern Buffer Zone.
5	**Clean Closure of all impoundments/pond areas** because of the potential of continued groundwater contamination.	Noted: EPA is conducting radiological study only; DTSC is the lead regulator guiding cleanup actions site wide at SSFL
6	**Soil sampling** panels need to include **all SSFL specific rads** as listed in the ETEC report in every area in Area IV. (see attachment)	Noted. As decided upon during a previous Stakeholder meeting, all soil samples will be analyzed for the "default" analytical suite, which consist of the 53 most likely SSFL-specific radiological contaminants. Depending on the location of the sampling and its proximity to certain facilities additional contaminants will be tested for.

Agree – Comment will be integrated in HSA and soil testing program as appropriate. **Noted** – Comment will not be integrated into HSA or soil testing program

Response to Comments on Draft HSA-5A Technical Memoranda Issued on January 19, 2011
Historical Site Assessment, Santa Susana Field Laboratory Site
Area IV Radiological Study, Ventura County, California

Item	Comment	Response
7	**Waste Drainage from Area IV**-upper area appears to have gone to Simi (attachment- Contamination Control Map 1972). Mid Area IV appears to drain to Area III. Were pipelines/ditches added much later than the dates given in this report? When for sure did the drainage from Area IV get sent to the R2 Pond?	Agreed. The commenter is correct that much of Subarea 5A drains to the south through man-made channels, culverts, and natural drainage pathways into Areas II and III. The eastern portions of Area IV drain to Silvernale Pond located in Area III while the western portions of Area IV drain to the R2 Pond located in Area II. EPA has placed numerous drainage samples in these manmade and natural drainage pathways as they traverse Area IV. In addition, EPA is in the process of negotiating permission to access Areas II and III additional sediment sampling in the drainage pathways and within the Silvernale and R2 Ponds. We will keep Stakeholders informed of our efforts to sample these drainages and ponds.
8	**Correction: 1.3 page 4. Groundwater** underneath SSFL could potentially be emanating to the groundwater serving the source water wells in Simi for drinking water. (Niles and Sycamore) Please change because this could be happening now not some time in the future. It's unfortunate but private off site wells were used for drinking water. In one case, there is a very sick young adult who as a child along with her family unknowingly drank well water near the lab. Are the private off site wells still being unknowingly used? Has off site every land owners within a certain distance from the lab been officially told not to use the well water for drinking for humans as well as animals? The Sycamore and Niles wells, wells used for drinking water in Simi, need to be tested for all SSFL specific rads and chemicals. These wells used as source water wells could be potentially contaminated now with the some 40 year movement of SSFL chemicals from hilltop SSFL emanating into the groundwater used by these wells located a mere 4 miles from SSFL.	Noted. As part of EPA's radiological study groundwater samples are being collected during two phases of samplings (one during the dry season and one during the wet season). Phase 1 sampling was conducted in August 2010 and consisted of sampling 65 onsite monitor wells. Phase 2 groundwater sampling was performed in March 2011 and consisted of collecting samples from 76 onsite monitor wells and 19 of offsite wells. Once the analytical data has been received and validated a final groundwater report summarizing the findings from both phases of groundwater sampling will be prepared. DTSC is the regulatory lead at SSFL including responsible for informing off site landowners of health risks posed by contamination at SSFL.
9	Back in 1989 in a Daily News article, it appeared to be cost prohibitive to clean up the **Reactor Building 024** which housed the SNAP reactors. What changed? Do we trust that back then that the confirmatory sampling was done accurately with the right methods? (attachment)	Agreed. Re-testing the completeness of past cleanup work including the former reactor in Building 024 is one of the reasons for the current EPA radiological study.

Agree – Comment will be integrated in HSA and soil testing program as appropriate **Noted** – Comment will not be integrated into HSA or soil testing program

Response to Comments on Draft HSA-5A Technical Memoranda Issued on January 19, 2011
Historical Site Assessment, Santa Susana Field Laboratory Site
Area IV Radiological Study, Ventura County, California

Item	Comment	Response
10	Please do a public announcement soliciting **more interviews** from former workers. EPA needs more of these interviews and the workers must be told that they will not in any way be penalized for their information.	Noted. EPA interviewed approximately 50 former workers and DOE interviewed 100 former workers. Information from both interview programs have been shared with the EPA soil testing team. EPA believes that we have interviewed a sufficient number of former workers and this work assisted our soil sampling program. EPA will issue a final report regarding its former worker interview program in the summer of 2011.
11	Comment clarification question: if the doe website says nuclear operations ceased in 1988 and converted to remediation and decommissioning activities after that, what were they doing between 1972 (as noted in TM) and 1988?	Agreed. To the extent possible, all EPA's Tech Memos address pre-1972 and post-1972 site operations and building designs. As-built drawings are being used to guide soil sample locations to former site features of radiological interests.
12	Based on our many conversations about this, it is greatly appreciated that you requested and finally received the as built pipe drawings and diagrams as I believe these documents are critical to understanding the potential effluent fate and transport mechanisms as well as understanding where liquid was stored and what the engineered holdup mechanisms were (if any) in place.	Agreed. This information will be used as much as possible. Building designs and as-built drawings are being used to guide soil sample locations to former site features or radiological interest.
13	I am very appreciative of the historical aerial photography study done, which is both very impressive in its quality and understanding/interpretation of detail, and by considering this level of detail against the historical operations data will truly bring the best possible and most complete and thorough investigation of the study area.	Noted. Thank you for the comment.
14	Building features - thank you for providing the clarification and consistency in terminology, and attention to details here since these are truly the details that tell us where potential contamination might have migrated to.	Noted. Thank you for the comment.

Item	Comment	Response
15	Section 2.1.1. Group 1 Building 23 sample focus at waste holdup tank location. Also, what was the waste disposal practice at this building prior to the installation of the waste holdup tank in 1976? The sodium loop was in operation from 1962 and there doesn't appear to be a waste disposal practice defined for the entire operational history of the test loop. Not until the second section was built in 1976, did they have an operational waste hold up practice so it is important to understand where the pipes and doors were prior to 1976.	Agreed. This comment was discussed during the February 2, 2011, stakeholder meeting regarding the HSA-5A TM. EPA has reviewed drawings for Building 4023 and has not been able to identify the disposal practices prior to 1976. EPA continues to work with DOE and Boeing to receive additional information, and will incorporate any new information that becomes available into the FSP.
	This is a facility where radioactive contamination transport was tested, so fission products would likely be present. Special care should be taken in this area as transuranic waste was also stored in this area and there are employee records that describe accidents during transport loading and/or unloading of waste "pigs" (d. Kurowski testimony and application for NIOSH compensation, reference to employee "Waco" who suffered radiation poisoning as a result)	Agreed. With respect to comment concerning loading and unloading transuranic (TRU) waste, EPA default suite includes all potential TRU waste contaminants of concern. EPA attempted to locate soil samples at the former Building 4023 loading where such loading/unloading actively would most likely occur.
	There also seems to be a long history of private sector operations including Japanese pyrochemical activities where records of chemicals and radionuclides of use are not available so special care to run full suite of analytes should be taken. Uranium, neptunium237, americium241, plutonium239 sampling as well.	Agreed. The operations chronology in Building 4023 includes activation product migration as well as other radionuclide separation technology research. The soil samples targeted for collection at this location include mixed fission and activation products, as well as plutonium and uranium isotopes, including Np-237 and Am-241.
	Considering the finding of cesium here, the sampling fiasco in 1993 should not be considered sufficient and since the building has already been removed, sampling across entire building footprint and down gradient area may be necessary to adequately assess the current conditions.	Agreed. EPA first round soil sampling program at Building 4023 included 9 surface and 9 subsurface soil samples within the building footprint.
	Among likely releases, a release of 5 grams of radioactively hot sodium leaked and burned (co60 and Mn54) in 1981 which is during the private sector period where records are unavailable.	Agreed. Co-60 and Mn54 are included in EPA's default suite of radiological analytes.

Response to Comments on Draft HSA-5A Technical Memoranda Issued on January 19, 2011
Historical Site Assessment, Santa Susana Field Laboratory Site
Area IV Radiological Study, Ventura County, California

Item	Comment	Response
15 Cont'd	Plate 1 is extremely useful for cross reference of all data for sampling designation.	Noted. EPA agrees Plate 1 provides a good locate map and summary of past events to guide our Round 1 targeted soil sampling program
16	2.1.3. Building 4027 Page 57 [47] describes a very disturbing exposure of workers because a drinking water bottle was used to store radioactive water which was then moved by an unknown person to the drinking water area and then placed on the drinking water system where in one day, half the bottle was inadvertently consumed by approximately 30 workers. I am also aware of a video made where volatile chemicals were stored in a refrigerator used for lunch, and a rope was used to open from a distance in case of explosion. Mixing food and chemical areas is an extremely hazardous practice. Clearly by this description, there were many potential exposures to the workers simply by the level of hazardous materials used and the seemingly relaxed attitude about these hazards.	Noted.
	Special attention to the area between 4024 and 4027 should receive additional targeted sampling due to the container leak described.	Agreed. EPA placed 9 subsurface samples between Buildings 4024 and 4027.
	The hold up tank is mentioned related to exposure pathways. Please note that in earlier photographs, releases ran into an unlined pond prior to the existence of the tank. Please add targeted sampling to delineate potential outline of original pond during years of potential over flow.	Agreed. The pond the commenter is referring to is located west of the RMHF in Subarea 7 and soil samples will be located at this former pond location as part of the Subarea 7 FSP Addendum.
	Please add targeted sampling in the area of the trench and sump pit as the use of these areas can not be confirmed to be non-radiological.	Agreed. EPA will review existing plans of the trench and sump system and ensure that samples have been placed in the vicinity of these former structures.

Agree – Comment will be integrated in HSA and soil testing program as appropriate. **Noted** – Comment will not be integrated into HSA or soil testing program.

Item	Comment	Response
17	2.1.4 building 4032 Due to the sodium use and known contamination of cobalt 60, please add cobalt sampling to perimeter and within the former building footprint. Because of the extremely high levels of cobalt found, it is believed that the catch pan from building 59 wound up here. This is troubling on several levels. Please add nickel to the sampling as a decay product of the cobalt. Since iridium192 was also used as a source for the rod tests, sampling for iridium192 as well as platinum should be made since iridium has such a short half-life (74 days) This was the X-ray building where several incidents of accidental exposure of employees during the radiography process in the 70s where special care to sample for all possible daughter products of these isotopes should be taken. Samples should be added in the area of the pipeline observed between 4023 and 4042 in the aerial photographs.	Agreed. Co-60 is included in EPA's default suite of analytes. Co-60 will be tested for at 7 soil samples within the former Building 4032 footprint and perimeter. Ni-63 is also included in the default suite of analytes and will be analyzed for if C0-60 is detected above background. Ir-192 is not being tested for due to its short half life. EPA is not clear as to the source of the platinum. There are no plans to analyze soil samples for this constituent at this time. In the X-ray building the primary radiological contaminant of concern is Co-60, and this radionuclide and decay products is addressed by analyzing soil samples within this building footprint for the default suite which includes C0-60 and thereafter for Ni-63 if the Co-60 concentrations exceeds the corresponding background value. Four samples were added in areas next to these buildings where the results of the geophysical survey indicated the presence of linear anomalies that could represent a pipeline between these two buildings.
18	2.1.6 building 4927 Typo - plat plan should be plot plan Also the title heading says 5c even though this is the 5a report.	Agreed. These typos will be corrected in the final HSA document.
19	2.1.7 [2.2.1] KEWB Two inch drain flowed to an open channel. Please add targeted sampling here. Since only 30% of KEWB operational history is known because the balance was done under other programs under the control of outside organizations, additional delineation is needed of these impacts.	Agreed. A soil sample was placed where the 2-inch drain flowed in the open channel. Agreed. EPA placed 19 samples at and in the vicinity of the KEWB reactor. We believe this sample density, the lines of evidence used to place on Round 1 samples, and our broad range of analytical suite provide a sufficient level testing for the operational history of KEWB.

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Item	Comment	Response
19 Cont'd	It is important to note that several incidents exposing employees to radiation above limits occurred. Several spills and accidental releases occurred that show that radiation was not well controlled in this area. Please add targeted sampling of cesium, europium, cobalt, manganese54, pb210, radium 226, and chromium	Agreed. Cs-137, Eu-152, Co-60, and Ra-226 are included in the default suite of analytes to be tested for at KEWB. Mn-54 is not being tested for due to its short half life. Chromium will be addressed under the DTSC/DOE chemical testing program.
	General comment about report structure and ease of use: I am pleased at the ease of use and detailed descriptions of each of the facilities and they interrelate to each other, adding to the understanding of how these facilities were used. I also appreciate the detailed descriptions of potential release pathways. In the past there was an unwillingness to include anything unproven or where documents are incomplete. The potential pathways as described will benefit the sampling placement decisions and will likely further improve the quality of the resulting data and investigative conclusions.	Agreed. Thank you for the comment.
	2. It is apparent through this documentation as well as prior records, that the radioactive waste generated through the demolition process was later transferred to the RMHF for packaging and final handling and ultimate disposal whether through repackaging, shipping or land burial. The RMHF is even described repeatedly as causing potential "sky-shine" affecting the contamination level of other buildings in the area as an acceptable reason for the findings described. Yet RMHF continues to be excluded from this investigation. I believe it is appropriate to examine the outdoor areas within the fenced RMHF perimeter as week as the adjacent escarpment and drainage channels (to the north, west and south) should be core sampled, gamma scanned for evidence of residual contamination during this investigation to ensure funding remains available to investigate the most important and likely contaminated area at the site. It is understood that all radionuclide categories would be present including activation and fission products, so added sampling may be redundant, but the perimeter is extremely important to understand, especially surrounding the outfall dam, former pond and tank areas. I ask that funding and process mechanisms be described in detail for final investigation, characterization, demolition and remediation and environmental restoration the RMHF and the related facilities since it appears to be excluded from this investigation and no other investigation appears to be planned.	Agreed. RMHF stored and managed a significant amount of radioactive materials. Under the December 2010 AOC between DTSC and DOE, EPA will be responsible for both radiological characterization and post-cleanup confirmation sampling. At facilities such as RMHF that will have D&D and subsequent soil cleanup, EPA recommends a phased testing program. During characterization, EPA will extensively test around the perimeter of RMHF and drainage pathways emanating from RMHF. EPA will be fully involved in the development and review of DOE's work plans to characterize the RMHF structures and D&D the entire RMHF area within the fence line. EPA will conduct an extensive soil confirmation testing program post D&D and post removal of contaminated soils. We believe this is the most efficient and complete manner to ensure all radiological contamination is removed from RMHF.

Agree – Comment will be integrated in HSA and soil testing program as appropriate

Noted – Comment will not be integrated into HSA or soil testing program

Item	Comment	Response
19 Cont'd	Since U235 highly enriched uranium was used in the reactor core for the KEWB project, please add to list of radionuclides to be sampled. Additionally, since the processing was done onsite to make the highly enriched uranium, please sample for the related rads such as the possible daughter product thorium 231. Special attention should be given to the fuel and gas handling room where the contamination levels were high according to interviewed worker #5.	Agreed. Radiological contaminants of concern associated with highly enriched uranium (U233-238), are included in EPA's default suite of analytes. Th-231 is not on the list of analytes because of its short half-life (1 d), however, Th-228, Th-229, Th-230, and Th-232 are on this list and will be analyzed for in all soil samples. EPA placed two samples at fuel and gas handling room due to statements by Interviewee #5.
20	2.2.3 Due to conflicting information about the year demolished (15 year discrepancy) and the lacking data available, please consider adding targeted samples at effluent drainage points and one center footprint. There appears to be some questions surrounding the nuclear licensing of the L85 reactor and I believe there are also unknowns on the final disposal of that reactor and request that it be included in the upcoming meeting discussion with the technical workgroup.	Agreed. The Subarea 5A Addendum to the FSP for Soil Sampling included 5 target soil samples at effluent drainage points in the vicinity of Building 4083. No samples were collected within the footprint because the concrete foundation and pad are still present and therefore will be subject to DOE's future D&D cleanup work and EPA soil confirmation sampling under the December 2010 AOC. Based on discussion during a Technical Stakeholder meeting on Subarea 5A (held 2/2/2011), please let us know if you have any further questions about EPA's soil sampling strategy at and near the L85 reactor.
21	2.2.4 building 4093 ae6 and L85 reactors Please add targeted sampling in the leach field area for u235, thorium231 Due to the many incidents related to this facility, please add targeted sampling of all activation and mixed fission products.	Agreed. The leach field location is targeted with a high sample density design and the samples will be analyzed according to our default suite (Table 2-4 of the Master Soil FSP) which includes U-235. The decay product Th-231, although included in the U-235 decay chain, has a 1 day half life and therefore will not be included in the analysis list.

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Item	Comment	Response
22	2.2.5 building 4123 KEWB Please describe the intended sampling of storage pit area as little information appear to be available. This section further demonstrates the need for full characterization of RMHF within this process. According to worker interviews, they modified the shape of the reactor vessel half way through the program and moving the former spherical vessel to the RMHF resulted in worker dosing for the entire year. That explains the high "sky-shine" since this vessel was sitting inside RMHF for a long period of time.	Agreed. The KEWB reactor building is targeted with a high sample density design and the samples will be analyzed according to Table 2.4 of the Master Soil FSP. EPA's recommended approach for soil radiological characterization of the RMHF is described in our response to comment #19.
23	2.2.6 building 4453 L85 reactor Because use of non sealed radiological sources was not reported, sampling was only done every other 9 sq meters, 1 sq meter was sampled. So inadequate sampling and safety protocols were used based on important information being omitted. The exhaust blower and filter plenum were radioactively contaminated and sent to RMHF for disposal indicating ambient contamination within the building footprint. Please add targeted sampling in effluent drainages leaving this facility as well as within the footprint.	Agreed and Noted. A concrete pad is still present at the former location of Building 4453; thus, soil samples will not be taken directly within the footprint. The Subarea 5A Addendum to the FSP includes several sample locations around the Building 4453 footprint and existing concrete pad and drainage samples at locations identified as important surface runoff points. It is EPA understands that the concrete pad will be subject to DOE's future D&D cleanup work and EPA soil confirmation sampling per the December 2010 AOC.
24	2.3.1 van de Graaf accelerator According to the factual perspective, there were two van de graaf accelerators. Please clarify discrepancy.	Agreed. Van de Graaf was first located at Building 4009 (in Subarea 8) and then moved to Building 4030/4035 in Subarea 5A. The final HSA document will clarify this point.
25	2.3.3 Building 4641 was shipping and receiving for area 4 and included radioactive materials through the mid eighties. During mobilization is where most mishaps occurred - loading and unloading so special attention to this area with targeted sampling of all radiological COCs. Please add sampling for beryllium 7 due to uncontrolled shipment incident described and concur with the recommendation ton add targeted sampling specifically to the dock area.	Agreed. Be-7 is not on the list of analytes due to its short half-life of 53 days. However, EPA placed 2 subsurface samples in the vicinity of the Building 4641 loading dock.

Item	Comment	Response
26	2.4.1 building 5 Coal gasification and uranium fires are among the incidents related to this building as well as uranium carbide. Targeted uranium sampling would be appreciated here. Since machining of uranium carbide fuel pellets using both depleted and enriched uranium. Please sample for fission products and c14, mn54, cesium, protactinium, s35, th231,c60.	Agreed and Noted. The Building 4005 area is targeted with a several soil sample locations in these areas of interest and the samples will be analyzed according to Table 2.4 of the Master Soil FSP (the default suite) which include uranium isotopes, Cs-137, Pa-231, and Co-60. This site does not meet the criteria for C-14 testing and Mn-54, S-35 and Th-231 are not radiological contaminants of concern in EPA study at SSFL.
27	2.4.2 building 4042 UO2 15000 lbs of this powder form of uranium with many related incidents. Because of the trenches within the building, please add sampling of uranium isotopes in the trenching area.	Agreed. One subsurface sample location was placed within this building footprint and three subsurface locations were placed immediately adjacent to the footprint, largely because the review of gamma surface scan results and review of the geophysical survey data, as well as an evaluation of past soil radiological test results along with review of the findings of the HSA TM did not collectively justify placing more samples in this area. The analysis for these four samples will include Uranium isotopes 233-238.
28	3.0 radionuclide list The quantities within these permits are crucial and greatly appreciated in this context as it helps to weigh priorities based on likely impacts more efficiently.	Agreed.
29	The HSA 5A is very important as Building 4093 (Section 2.2.4) Housed the L-85 Nuclear Experimentation Reactor as well as the SNAP AE-6 which suffered a major radiological incident.	Agreed; Building 4093 is an important building.
30	Located in this reporting area and back under the Atomic Energy Commission (AEC) option is the Kinetic Energy Water Boiler (KEWB) reactor (Shown Above). This was a 50 kilowatt research reactor starting operation since it's completion in mid-1956. This solution-type reactor was constructed for the AEC to investigate transient behavior by providing data to base a design of a water boiler reactor safety concerns and predict dynamic behavior of solution-type reactors. This area was graded upon graded during several incarnations and more at-depth sampling needs to occur.	Agreed. The former KEWB is targeted with a high sample density design which is described in the Subarea 5A Addendum to the FSP. Our soil samples included both surface and subsurface sample intervals. Sample depths, per the Master Soil FSP, is generally 10 feet except near former reactor vaults where samples will be collected deeper than 10 feet, if possible.

Agree – Comment will be integrated in HSA and soil testing program as appropriate. **Noted** – Comment will not be integrated into HSA or soil testing program

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31	The AE-6 research reactor (Shown Above) was used by Atomics International, a division of North American Aviation, the parent to The Boeing Co. in connection with the AEC. It was utilized for the performance of exponential experiments, lattice, buckling and other physics studies. There were many accidents associated with this and other research reactors throughout the Santa Susana Field Laboratory (SSFL) and the work that the Environmental Protection Agency (EPA) is doing is very important to ensuring a proper cleanup.	Noted. Thank you for the comment.
32	In Section 2.1.1 Site Description of Building 4023 indicates that this facility was used for the 1987 Rocky Flats Plutonium Recovery Project should be investigated further. The words "Additional information regarding these operations could not be located" should be indicate in such a document, this needs a follow up.	Agreed. EPA continues to work with Boeing and DOE to identify and obtain additional information regarding the data gaps identified in the HSA-5A TM. If EPA concludes that the additional information received from Boeing or DOE changes EPA's soil sampling strategy, EPA will revise and re-issue our FSP addendum for Subarea 5A prior to any additional sample collection.
33	In Section 2.1.2 Site Description of Building 4024 there was no mention of the water intrusion via groundwater. Here is a sealed reactor building 3 stories underground with a 9 foot thick door that seals the reactor room yet groundwater finds its way into this facility (Photos Below). Was EPA able to get permission to sample this water intrusion? If groundwater is getting in, then fission products have the potential to impact groundwater.	Agreed. A discussion of the water found inside the vault at Building 4024 is included under the current uses and previous investigations sections of the HSA-5A TM. EPA believes that the water intrusion in Building 4024 be addressed by DOE during its D&D planning effort. Pursuant to the December 2010 AOC, EPA will be present to provide technical assistance during the D&D process and post- D&D soil confirmation sampling.
34	Moving on into Section 2.1.4 Site Description of Building 4032, EPA needs to make Every Effort in finding the location of the 5500 gallon Below-Ground sodium drain tank (UT-23). The reports claim that this tank is in an "Unknown Location", when the Santa Susana Field Laboratory property gets turned over to any other park-like agency to be used as Open Space, any unknown UST's could pose a potential threat to the communities who will use this space for recreation, hiking, biking, horse riding etc.	Agreed. EPA will double-check drawings for additional information, and will continue to work with Boeing and DOE to resolve this data gap. This tank was likely removed since the results of the geophysical survey did not identify it, or its former location, however, 4 sample locations were placed within and around the building footprint to assess potential impacts from past leaks from this tank.

Agree – Comment will be integrated in HSA and soil testing program as appropriate. **Noted** – Comment will not be integrated into HSA or soil testing program

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Item	Comment	Response
35	In Section 2.1.5 Site Description of Building 4036/4037 it is very concerning that there were no Radiological Use Authorizations recovered in addition to no recovery of incident reports when this facility was used for ETEC Advanced Programs. These documents need to be presented and investigated to help ensure a proper cleanup.	Agreed. EPA continues to work with Boeing and DOE to identify and obtain additional information regarding the data gaps identified in the HSA-5A TM. Should additional information be obtained, EPA will include the pertinent information and any changes to our soil sampling program via a revision to our FSP addendum for subarea 5A.
36	In Section 2.2.1, 2.2.2, 2.2.3 – Buildings 4073/4074/4083/4103 located in an area of early Nuclear Experimentation and should be investigated thoroughly as there were no safety practices or requirements of safe handling as it was all research in the early stages. Portions of the foundation and piping still exist and sampling under these foundations need to be sampled. There is also a pipeline that crosses over the rocks into this area from the Sodium Reactor Experiment (SRE) area and should be investigated thoroughly.	Agreed. The sample design for this area, described in the Subarea 5A Addendum to the FSP, includes soil samples to address this concern.
37	In Section 2.2.6 Site Description of Building 4453 – was used to measure background levels for the L-85 reactor. Are these background levels available?	Agreed. The source document identified the background level as being 11.9 μR/hr.
38	In Section 2.3.3 Site Description of Building 4641 – Shipping & Receiving is an area where many incidents recalled by former employees have taken place and should be investigated.	Agreed. The sample design for Building 4641, described in the Subarea 5A Addendum to the FSP, soil sampling to address this concern.
39	In Section 2.4.1 Building 4005 known mainly as the Plant Development Unit or PDU, A.K.A. the Molten Salt Test Facility, yet it was also used by ETEC for Coal Gasification and the associated radionuclides should be considered in investigation.	Agreed. The sample design for Building 4005 described in the Subarea 5A Addendum to the FSP, includes soil samples to address this concern. Radiological contaminants of concern associated with coal gasification (including U-235, U-238, Th-232) are included in our default analytical suite.

Agree – Comment will be integrated in HSA and soil testing program as appropriate. **Noted** – Comment will not be integrated into HSA or soil testing program.

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Item	Comment	Response
40	In Section 2.5.1 Building 4029 is a GREAT CONCERN as the many violations of RCRA storage regulations. It was also constructed behind a large sandstone boulder, bigger than the facility itself to shield itself from the rest of the immediate AREA IV reporting area. In 1996 an excavation was back filled we need to get these locations and subsequently sample these areas. There is a storage-well at this facility that had several radiological incidents associated with it and the location of this well needs to be investigated at depth.	Agreed. EPA agrees with the commenter's concerns about contamination at Building 4029. Pursuant to the December 2010 AOC, EPA understands that all above and below ground structures, components, and ancillaries at Building 4029 will be removed during the D&D of this facility. Confirmation sampling of the excavation areas will be conducted by EPA and DTSC after the facility D&D to ensure that impacted soils are not left behind. Potential contamination currently below facility structures, if encountered, will be removed during facility cleanup work.
41	In Section HSA Subarea 5A Section SS 17 and SS 16 was an area of early Nuclear Experimentation and should be investigated thoroughly as there were no safety practices or requirements of safe handling as it was all research in the early stages.	Agreed. The sample design for this Group 5 area, described in the Subarea 5A Addendum to the FSP, features high density sampling in large part to address this concern.
42	In Section HSA Subarea 5A Section SS 21 and SS 22 need to be looked into as this was a transport area to Chemical Storage Building 259 in AREA III and this should be treated as a step out area outside of AREA IV for investigation. This area shows another linkage to areas outside of AREA IV that are clearly linked.	Agreed. At least seventeen soil samples have been place in or along roadways and drainages leading from Subarea 5A into Area III.
43	In Section HSA Subarea 5A Section SS 19 we notice a dead-end road and these areas were typically used for on-site disposal of Radiological and Chemical Waste. After several interviewees have explained, "Where a road ends, is where the dumping begins".	Agreed. EPA agrees that roads ending abruptly into open space areas are suspicious. If one or more of the many lines of evidence suggest soil sampling is warranted at the end of the road (i.e. gamma anomaly, geophysical anomaly, disturbance noted in historical aerial photography, former worker interview, etc) then soil samples were located at this location.
44	We need to keep into consideration that ALL the drainage pathways lead off AREA IV into AREA III then into AREA II R2A pond, which drains into Bell Creek, the Headwaters to the Los Angeles River, this pathway needs to be followed, characterized and cleaned up.	Agreed. EPA is committed to sampling SW drainages from Area IV into the Silvernale pond (Area III) and R2A and R2 ponds (Area II). EPA is in the process of negotiating permission to access Area II and Area III to conduct such sampling.

Agree – Comment will be integrated in HSA and soil testing program as appropriate. **Noted** – Comment will not be integrated into HSA or soil testing program

Item	Comment	Response
45	I have not had a chance to read the whole document yet. However, I was at the site for the EPA tour last week. Our guide was Stuart, and he said that the AE6 and the KEWB were in HSA 5A. So I looked up the AE6 on the ETEC website, and **it looks as if the foundation was not removed.** http://www.etec.energy.gov/history/Major-Operations/AE6-L85.html	Agreed. The commenter is correct that the foundation for the AE-6 building, Building 4093, has not been removed and remains at the site, today. EPA understands that the remainder of Building 4093 and its associated infrastructure will be subject to removal and cleanup pursuant to the December 2010 AOC.
46	**"The remaining building, excluding the foundation, was demolished in 1995.** The sanitary leachfield for Building 4093 was removed in 1999. Soil samples collected at the time of the removal of the septic tank confirmed that the area was free of radioactive contamination." I emailed Stephie, and she said she would get that information for me.	Agreed. EPA is interested in obtaining soil testing data collected during Building 4093 septic tank removal.
47	Your HSA 5 A states this: "19, 1987.382 **The rest of the building, excluding the foundation, was demolished in 1995; however, D&D records from 1995 could not be located. The sanitary leach field for Building 4093 was removed in 1999; however, detailed information of the removal could not be located.383,384"** I assume that your ground penetrating surveys could detect a foundation if it is still there. Just an FYI - there could be something there (foundation)? that needs to be removed? To me this is an area of concern.	Agreed. The concrete foundation and pad are present and currently visible. Soil samples will not be collected through the concrete pad. It is EPA's understanding that the remainder of Building 4093 and its associated infrastructure will be subject to removal and cleanup. Even though details regarding the removal of the leach field were not located eleven soil sample locations have been located at its former location.
48	I also want to say that these site visits are very important to my ability to comment. I would appreciate the chance to visit at least twice a month. We really don't see very much in one hour. We do find things - we point out objects of concern when we hike - like pipes, wells, and seeps and springs, etc. We should be up there again next Wednesday, but I have not gotten confirmation of that.	Agreed. In coordination with DTSC, EPA conducts twice monthly Area IV and NBZ site visits for the general public.
49	Page 133 of the 5A tech memo states that the team has not located a report on the removal of the 4005 leachfield/septic tank. The 4005/4006 septic tank binder is located in the Reference Library (that you refer to as the Compliance Library).	Agreed. Subsequent to issuance of the HSA-5A TM, EPA has located the report on the Building 4005 septic system removal. Two samples were placed in the former location of the septic tank.

Agree – Comment will be integrated in HSA and soil testing program as appropriate. **Noted** – Comment will not be integrated into HSA or soil testing program

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Item	Comment	Response
50	The TM reads too much like EPA agrees with the sweeping conclusions that Rockdyne (et al) made in the past.	Noted. EPA HSA TMs describe the site operational histories and test results of other parties. In our TMs we do not necessarily agree or disagree with conclusions by other parties and EPA will add additional caveats in future TMs to clarify.
51	EPA did not sufficiently highlight a few places were Rocketdyne data was actually high.	Noted. EPA feels all pertinent Rocketdyne data was disclosed. Where elevated readings were identified, EPA is taking additional samples.
52	The TM uses a variety of Rad Units forcing the reader to convert by hand to a common set of units.	Agreed. In future TMs EPA will attempt to convert units of measurement to coincide with units of measurement used to present the EPA background study data where possible.
53	Now that the DOE/DTSC AOC is in place, we need to update the statement early in the TM (and all TMs) about what SB990 means.	Agreed. In subsequent HSA TMs, EPA has updated the language concerning SB990 and the December 2010 AOC.
54	EPA should have unfettered access to the 1.4M docs in the O'Conner Lawsuit database.	Agreed. Although EPA does not have the legal right to have unfettered access to the Boeing 1.4M document database, we do have the right to obtain information pertinent to our radiological study. Boeing's database contains information protected under The Privacy Act, Export Control, Confidential Business Information and Gant classifications that require review prior to release to EPA and the public. EPA and Boeing has agreed to a set of protocols that allow EPA to gain access to all information pertinent to our HSA program.

VOLUME III

FINAL
TECHNICAL MEMORANDUM
SUBAREA HSA-5B
HISTORICAL SITE ASSESSMENT
SANTA SUSANA FIELD LABORATORY SITE
AREA IV RADIOLOGICAL STUDY
VENTURA COUNTY, CALIFORNIA

Prepared for:

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LIST OF ATTACHMENTS

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LIST OF ACRONYMS AND ABBREVIATIONS

AEC	U.S. Atomic Energy Commission
ARRA	American Recovery and Reinvestment Act
Atomics International	Atomics International Division of North American Aviation, Inc.
CDPH	California Department of Public Health
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
Ci	Curie
COC	Contaminant of Concern
D&D	decontamination and decommissioning
DCGL	derived concentration guideline limit
DHS	Department of Health Services
DOE	Department of Energy
dpm/100 cm^2	disintegrations per minute per 100 square centimeters
DTSC	Department of Toxic Substances control
EPA	U.S. Environmental Protection Agency
EPIC	Environmental Photographic Interpretation Center
ETEC	Energy Technology Engineering Center
FA	fill area
HSA	Historical Site Assessment
HGL	HydroGeoLogic, Inc.
HMSA	hazardous material storage area
HR	House Resolution
kWth	kilowatt thermal
LCTL	Large Component Test Loop
LMEC	Liquid Metal Engineering Center
µR/hr	micro roentgen per hour
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
mR/hr	milli roentgen per hour
mrad/h	milli rad per hour
MWd	megawatt days
NaK	sodium potassium
NBZ	Northern Buffer Zone
NRC	Nuclear Regulatory Commission
ORISE	Oak Ridge Institute for Science and Education
OS	open storage
PA	processing area
pCi/g	picocuries per gram
RCRA	Resource Conservation and Recovery Act

Redacted

RFI	RCRA Facility Investigation
RHB	Radiologic Health Branch
RMHF	Radioactive Material Handling Facility
S2ER	SNAP 2 Experimental Reactor
S8ER	SNAP 8 Experimental Reactor
SER	SNAP Experimental Reactor
SB	Senate Bill
SBZ	Southern Buffer Zone
SCTI	Sodium Component Test Installation
SCTL	Small Component Test Loop
SHEA	Safety Health and Environmental Affairs
SNAP	Systems for Nuclear Auxiliary Power
SSFL	Santa Susana Field Laboratory
TM	technical memorandum
TO	task order
UPS	uninterruptible power supply
UST	underground storage tank
WDA	waste disposal area

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TEXT

FINAL
TECHNICAL MEMORANDUM
SUBAREA HSA-5B
HISTORICAL SITE ASSESSMENT
SANTA SUSANA FIELD LABORATORY SITE
AREA IV RADIOLOGICAL STUDY
VENTURA COUNTY, CALIFORNIA

1.0 INTRODUCTION

This technical memorandum (TM) presents a summary of the identified environmental concerns associated with past radiological operations within a portion of Area IV at the Santa Susana Field Laboratory (SSFL) site located in eastern Ventura County, California (Figure 1.1). The SSFL site consists of four areas: Areas I, II, III, and IV; and two buffer zones: the Northern Buffer Zone (NBZ) and the Southern Buffer Zone (SBZ). The U.S. Environmental Protection Agency (EPA) is conducting a radiological characterization study of SSFL Area IV and the NBZ pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). EPA's study consists of a Radiological Historical Site Assessment (HSA), gamma scanning of accessible areas, geophysical surveys, soil and water testing. EPA's gamma scanning, geophysical, soil and water testing investigations are being developed and presented in separate work plans and data reports.

HydroGeoLogic, Inc. (HGL) has been tasked by EPA to conduct the radiological characterization study within SSFL Area IV/NBZ (hereafter called the "Area IV Study"). Figure 1.2 illustrates the location of Area IV and the NBZ. EPA has elected to subdivide the Area IV Study Area into subareas. Subarea boundaries are based on existing Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) areas for the SSFL site. EPA has further subdivided some RFI areas based on features such as roads, drainage pathways, building use, and number of buildings.

Table 1.1
Area IV Study Area
Subarea Designations

Area Designation	Number of Sites
HSA-3	1
HSA-5A	26
HSA-5B	46
HSA-5C	23
HSA-5D	21
HSA-6	38
HSA-7	18
HSA-8	8
BZ-NE	2
BZ-NW	2

The objective of the HSA component of the radiological study is to provide a comprehensive investigation that identifies, collects, organizes, and evaluates historical information relevant to nuclear research operations as it pertains to radiological contamination in the Area IV Study Area. Once these areas have been identified, potential areas where radiological contamination may exist at the site will be identified for sampling.

This work is being executed by HGL under EPA Contract EP-S7-05-05, Task Order (TO) 0038 under the technical direction and oversight of EPA Region 9. In accordance House Resolution (HR) 2764, the Department of Energy (DOE) is funding EPA's Area IV Study. DOE elected to fund EPA's study with funding allocated under the American Recovery and Reinvestment Act (ARRA) of 2009. On December 6, 2010, the DOE and the State of California Department of Toxic Substances Control (DTSC) signed an Administrative Order on Consent (AOC) for cleanup of the Area IV and the NBZ. Under this AOC, radiological contaminants will be cleaned up to background concentrations as defined by EPA's July 2011 radiological background study.

1.1 Technical Memoranda and the Radiological Historical Site Assessment

This TM presents information relating solely to sites and buildings located within Subarea HSA-5B. This TM, along with subsequent TMs prepared for the subareas identified in Table 1.1, will be compiled into EPA's Radiological HSA for the Area IV Study Area. Each TM has been made available in draft for review and informal comment by SSFL stakeholders and the general public. EPA is responding to each comment via draft "Response to Comment" tables, which are also made available to SSFL stakeholders. Each draft TM will be edited as described in the Response to Comment tables, and these edits along with any new information made available to EPA will be compiled into EPA's official Radiological HSA for the Area IV Study Area.

The content of each TM will be based on guidance provided in the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM, Revision 1, August 2000). MARSSIM is used as an investigative tool to gain an understanding of the nature and extent of radiological contamination left at a site. The TMs provide preliminary recommendations for MARSSIM classifications based solely on historical information, which may be incomplete. The preliminary classifications identified in the TMs will be used to guide the subsequent gamma scanning and multimedia sampling effort. Once more complete historical environmental data has been obtained, and the results of geophysical surveys, gamma radiation scanning surveys, field observations, and the results of soil sampling and laboratory analyses are available, the preliminary classifications presented in the TMs will be revised.

1.2 Goals and Methodology of this TM

This TM is focused on radiological information within Subarea HSA-5B and the drainage channels that lead to and from this area. The location of Subarea HSA-5B is shown on Figure 1.3. Plate 1 presents a summary of the features related to potential radiological sources identified within the HSA-5B subarea. Detailed information pertaining to the use of radioactive materials and the potential release of radionuclides at sites and buildings within HSA-5B are provided in Sections 2 and 3 of this TM. Preliminary findings specific to Subarea HSA-5B presented in this TM include:

- Descriptions and locations of potential, likely, or known activities that involved radioactive material, radioactive waste, or mixed waste;
- Initial MARSSIM classifications (e.g., Class 1, 2, 3) of potentially impacted areas;
- A site-by-site assessment of the likelihood or "weight of evidence" of radiologically contaminated media;
- An assessment of the likelihood of potential migration pathways; and,
- Identification of, confirmation of, and, if appropriate, addition or subtraction to, the list of the potential radiological contaminants of concern.

As specified in MARSSIM, a "site" is defined as any installation, facility, or discrete, physically separate parcel of land, or any building or structure or portion thereof, that is being considered for survey and investigation (MARSSIM, Revision 1, August, 2000). MARSSIM guidance defines all sites as either "non-impacted," or "impacted" by radiological operations. All of the sites at the Area IV Study Area are considered to have a reasonable potential for residual contamination, so none is classified as "non-impacted." Impacted areas of the Area IV Study Area are divided into one of three classifications.[1]

- *Class 1 Areas:* Areas that have, or had prior to remediation, a high potential for radioactive contamination (based on site operating history) or known contamination (based on previous radiation investigations).
- *Class 2 Areas:* Areas that have, or had prior to remediation, a medium potential for radioactive contamination or known contamination.
- *Class 3 Areas:* Areas that have a low potential for radioactive contamination.

The information provided in this TM together with comments and recommendations provided by SSFL stakeholders and the general public will be used in the EPA's investigation strategy for sampling and analysis for residual radiological contamination in surface and subsurface soil within Subarea HSA-5B. As noted above, EPA will continue to obtain and receive information relating to use and possible releases of radionuclides within the Area IV Study Area. Some of the information presented in this TM may change as new information is obtained, or further evaluation of current information results in changes. In addition to the HSA, information gathered by EPA's Area IV and NBZ gamma scanning program and targeted geophysical investigation will assist EPA in fine-tuning the overall investigation strategy for the Area IV Study Area, and in making the final determination of the appropriate MARSSIM classifications.

1.3 Brief Description and History of SSFL Area IV and the NBZ

The SSFL site occupies 2,850 acres of rocky terrain with approximately 700 feet of topographic relief near the crest of the Simi Hills. The Area IV Study Area comprises approximately 465 acres. Though some of the study area is relatively flat, some portions of the area exhibit steep relief and rugged terrain. The site elevation is between 1,880 feet and 2,150 feet above sea level. The overlying soils of the Area IV Study Area consist of weathered bedrock and alluvium that

[1] *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), Revision 1*, NUREG-1575, Rev. 1, EPA 402-R-97-016, Rev. 1, DOE/EH-0624, Rev. 1, August 2000, pp. 2-5.

have been eroded primarily from the surrounding Chatsworth and Santa Susana formations. Several geological faults cross this area.

The climate in the vicinity of the SSFL site is classified as Mediterranean Subtropical, corresponding to an average temperature of 50 degrees Fahrenheit in the winter and 70 degrees Fahrenheit in the summer. Rainfall averages approximately 18 inches per year.

A shallow groundwater system exists in the surface soils at small isolated locations. A regional groundwater system exists in the deeper fractured Chatsworth Formation. In some areas, groundwater from the Chatsworth Formation flows through fractures in the rock and emerges at the ground surface as seeps or springs. Groundwater underlying the SSFL site is not currently used, or anticipated to be used, as a source of drinking water for the nearby communities or at SSFL, but nearby residents may in the future consume groundwater emanating from this site

In addition to rocket and small engine testing facilities in other portions of the SSFL, North American Aviation, Inc., had facilities at Area IV for researching, developing, and constructing equipment to use nuclear energy through its Atomics International Division (AI).[1] According to a 1959 company brochure, AI maintained a nuclear field test area covering approximately 300 acres at the SSFL site.[2] Under contract to DOE and private customers, AI supported the development of civilian nuclear power, as well as the testing of non-nuclear components related to liquid metals within 90 acres of Area IV of the SSFL site. The facilities within these 90 acres would later be referred as the Energy Technology Engineering Center (ETEC).[3]

Nuclear facilities at ETEC included 10 nuclear research reactors over the period July 1956 through February 1980. These research reactors are listed in Table 1.2.

[1] North American Aviation, Inc., *The North American Story,* December 1960, p. 7
[2] Atomics International, A Division of North American Aviation, Inc., *Atomics International,* December 1959, p. 5.
[3] http://www.etec.energy.gov/History/Area-IV-History.html

Table 1.2
Research Reactors Located at the Santa Susana Field Laboratory[1]

Reactor Acronym	Building No.	Facility Name	Power Level (kW)	Period of Operation	Power Generated (MWd)	Radioactivity at End of Operation (10^3 Ci)
KEWB	4073	Kinetics Experiment Water Boiler	1	7/1956 to 11/1966	1	6
L-85/AE-6	4093	L-85 Nuclear Experimentation Reactor	3	11/1956 to 2/1980	2	18
SRE	4143	Sodium Reactor Experiment	20,000	4/1957 to 2/1964	6,700	120,000
SER	4010	Systems for Nuclear Auxiliary Power (SNAP) Experimental Reactor Facility	50	9/1959 to 12/1960	13	300
S2DR	4024	SNAP Environmental Test Facility	65	4/1961 to 12/1962	13	390
STR	4028	Shield Test Irradiation Facility	50	12/1961 to 7/1964	1	300
S8ER	4010	S8ER Test Facility	600	5/1963 to 4/1965	215	3,600
STIR	4028	Shield Test Irradiation Facility	1,000	8/1964 to /1974	28	3,714
S10FS3	4024	SNAP Environmental Test Facility	37	1/1965 to 3/1966	16	6,000
S8DR	4059	SNAP Development Reactor Facility	619	5/1968 to 12/1969	182	220

Seven criticality test facilities (i.e., facilities housing operations involving masses of fissionable material capable of sustaining a nuclear chain reaction) were also located on Area IV.[2] These are listed in Table 1.3. Other nuclear facilities within Area IV included the Radioactive Materials Disposal Facility and the Hot Laboratory, as well as the Sodium Disposal Facility, or Area IV burn pit. Each of these facilities will be addressed as a site within the appropriate TM along with supporting buildings and open areas.

According to the DOE ETEC web site, most nuclear research related programs and operations ceased in 1988 and were replaced with decontamination and decommissioning operations.[3]

[1] Oldenkamp, R.D. and Mills, J. C., *Nuclear Operations at Rockwell's Santa Susana Field Laboratory – A Factual Perspective*, Rockwell International; Report No. N001ER000017, September 6, 1991, p. 23.
[2] Atomics International, A Division of North American Aviation, Inc., *Atomics International,* December 1959
[3] http://www.etec.energy.gov/History/Area-IV-History.html

Table 1.3
Criticality Test Facilities at the Santa Susana Field Laboratory[1]

Facility Name	Building No.	Period of Operation	Notes
SNAP Critical Test	4373	1957 to 1963	First SNAP-2 criticality tests
Organic Moderated Reactor	4009	1958 to 1967	Basic tests of reactor concept
Sodium Graphite Reactor	4009	1958 to 1967	Basic tests of reactor concept
SNAP Critical Equipment	4012	1961 to 1971	Later SNAP criticality tests
Fast Critical Experiment	4100	1961 to 1972	Started as Advanced Epithermal Thorium Reactor (AETR)
SNAP Flight Systems	4019	1962	SNAP flight system criticality
SNAP Transient Test	4024	1967 to 1969	SNAP transient response tests

The NBZ is a 175-acre parcel of land that abuts the SSFL property (Figure 1.2). The NBZ is a naturally vegetated area containing drainage channels that transport surface water from the SSFL downslope to surrounding populated areas.[2] The NBZ was purchased by the Rocketdyne Division of Rockwell International (Rockwell) in 1998 from the adjoining Brandeis-Bardin Institute because an environmental contractor found that the NBZ contains radioactive and chemical contamination that had migrated from the SSFL.

With the exception of 452 acres owned by the U.S. Government in Areas I and II, which are outside of the Area IV Study Area, the entire SSFL site, including the NBZ, is owned and operated by The Boeing Company.

1.4 Brief Description and History of HSA-5B

Subarea HSA-5B is approximately 23.2 acres of flat land. Over the years, 41 buildings have been situated within HSA-5B. It includes B, F, G, and 17th through 20th streets. Drainage is generally to the south. An impoundment was located at the intersection between G and 17th Street in Subarea HSA-5B. This impoundment retained water during the mid- to late-1960s. Radiological operations in Subarea HSA-5B related to the SNAP and SNAP 8 programs.

1.5 Sites in HSA-5B

During the peak of operations, Subarea HSA-5B comprised 46 primary sites, most of which were buildings, and 22 associated sites, such as electrical substations, power supplies, electrical equipment pads, and time clocks. This TM addresses each of these 46 sites within Subarea HSA-5B. Of the 46 sites, one was a reactor building (Building 4010), two were criticality test facilities (Buildings 4012 and 4019), and others housed operations involving radioactive materials. One site was a drainage area that became radioactively contaminated. It is important to note that EPA and HGL continue to obtain and receive information that may alter the findings of this TM. Of the 46 sites in Subarea HSA-5B, only 4 buildings remain today.

[1] Oldenkamp, R.D. and Mills, J. C., *Nuclear Operations at Rockwell's Santa Susana Field Laboratory – A Factual Perspective*, Rockwell International; Report No. N001ER000017, September 6, 1991, p. 25.
[2] Agency for Toxic Substances and Disease Registry, *Draft Preliminary Site Evaluation, Santa Susana Field Laboratory*, Atlanta, GA, December 3, 1999, pp. 2-5.

1.6 Site Summary Methodology

In preparing this TM, the following types of documents were reviewed:

- radiological characterization reports;
- previous radiological surveys;
- decontamination and decommissioning (D&D) reports;
- environmental monitoring reports;
- license termination reports;
- aerial photographs dating back 50 years;
- building floor plans;
- piping diagrams and construction drawings;
- RFI reports;
- unusual occurrence reports;
- incident reports;
- plant operating reports and logs;
- safety analyses reports;
- facility surveillance and maintenance reports; and
- information obtained from interviews with former workers or other persons.

Numerous documents were obtained through information requests sent to Boeing, DOE, and other parties. EPA sent formal information requests to Boeing, DOE, the Nuclear Regulatory Commission (NRC) and the California Department of Public Health (CDPH) under § 104(e) of the CERCLA. In addition, EPA directed Boeing to identify and provide pertinent documents within a number of document databases comprising approximately 1.4 million documents relating to all areas of the SSFL site, including Area IV, as well as some offsite facilities. The information acquisition process is generally complete with one exception; monthly supplemental responses are received from the DOE. If pertinent information is later acquired by EPA, it will be added to this TM and integrated into our radiological characterization study process to ensure that all available, relevant information is considered by EPA prior to the completion of our study.

EPA sent Boeing its original information request letter on June 24, 2009. Boeing provided an initial response to this request on August 31, 2009, and a supplemental response on December 10, 2009. On June 8, 2010, Boeing provided relevant site drawings and maps as identified by EPA during a review of flat files at Boeing's Safety, Health, and Environmental Affairs (SHEA) building on site. Subsequently, on June 17, 2010, EPA sent Boeing a supplemental information request letter specifically requesting all maps, diagrams, and as-built drawings for past and current buildings in Area IV. On July 15, 2010, Boeing responded and provided additional documents, including maps and drawings. On November 15, 2010, Boeing provided a third supplementary group of documents. Additional information requests have been ongoing and during the months of December 2010 and January, March, April, May, June, July, and August of 2011, Boeing provided numerous additional documents in response to both EPA original information requests and EPA queries of Boeing's document database for the SSFL.

In October 2010, EPA also sent the National Aeronautics and Space Administration (NASA) a formal information request letter. On November 22 and December 2, 2010, EPA received information responsive to this request.

EPA sent DOE its original information request letter on June 24, 2009. DOE provided an initial response to this information request on August 31, 2009. Subsequently, DOE has provided supplemental responses to this initial information request on a monthly basis. Additional information responsive to the EPA's information request has been received in September, October, November, and December 2009, as well as January through December 2010 and January, February, March, April, May, June, and July 2011. On June 17, 2010, EPA sent DOE a supplemental request for information, specifically requesting maps, diagrams, and as-built drawings for past and current buildings in Area IV. Starting in its July 2010 supplemental response to EPA, DOE is providing information that is responsive to both of the EPA information requests letters.

Other requests for information pertaining to the site have included § 104(e) information request letter sent to the NRC and CDPH. The purpose of the inquiries to both the NRC and the CDPH was to identify and obtain any nuclear materials licenses pertaining to the site that may not have been captured via the information requests sent to other parties.

In preparing the HSA-5B TM, 669 individual documents and photographs were reviewed. The review process was conducted by first screening over 80,000 documents amassed for the project. This screening effort produced 669 documents relevant to past operations at facilities within HSA-5B and were therefore determined to warrant in-depth evaluation. Each of these 669 relevant documents was thoroughly evaluated for information considered useful for assigning MARSSIM classifications.

1.6.1 Contents of EPA's Site-by-Site Analyses

The subject areas considered and addressed for each site discussed in Section 2 of this TM are presented below. For each subject area, the list of criteria evaluated and the associated parameters for the evaluation are described. The most complete available information was used to evaluate the site; no known information was omitted from the description. In the event that known information did not conform to one of the listed subject areas, it was included in the most logical place.

Site Description
A physical description of the site including, at a minimum, the following data elements: building numbers of all buildings within the site; date of construction of building(s); buildings in the vicinity not associated with the site; location of site relative to street(s); site plan(s); and floor plan(s) from as-built or plan drawings, if available.

Building Features
Information related to dimensions or size of building(s), below-ground structures, vaults, pipelines, sumps, condensation lines, sewers, drains, swales, and leach fields. If none of these features were identified, the text "no information was located" was inserted.

Former Use(s)
Details of past use(s) of the site, including dates of activities.

Information from Interviewee(s)
This category includes information about the site provided by interviewee(s). If no information has been obtained for a particular site, the text "none to date" was inserted. Individuals who have been interviewed include:

- Former SSFL Employees (e.g., health physicists, electricians, mechanics, construction inspectors, nuclear technicians, etc.);
- Survivors of Former Employees;
- Former Contractors (and one survivor of a former Contractor);
- Community Stakeholders; and
- Residents in surrounding areas.

At the discretion of the Interviewee, each interview is conducted either by representatives of the EPA only, representatives of the DOE only or jointly by EPA and DOE representatives. EPA's primary objective of the interview program is to help direct the soil sampling crews to potential source areas of radiological contamination identified during the course of each interview. All information on potential source areas, corroborated or not, will be recorded in EPA's HSA process.

At the time of writing this TM, the EPA had completed forty-nine (49) interviews. Under the DOE/EPA joint interview program, eighteen (18) interviews have been conducted. Approximately 107 former employees have requested to be interviewed by DOE only and those interviews are complete. An additional eighty five (85) people were referred to EPA and DOE by interviewees during the course of the interviews, and of these, only twenty (20) could be located, which resulted in four (4) additional interviews. DOE has provided all of their interview transcripts to EPA for use in EPA TMs. For this TM, 16 interviews were relevant to the HSA-5B subarea.

The interview information obtained to date relevant to this TM is depicted on the relevant Plate 1 figure.

Radiological Incident Reports
Reports on any documented incidents at the site with the potential for release of radioactivity into the environment. If no incident reports were found, the text "none found" was inserted.

Current Use
Current use of the site, or date of demolition of building/structure.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s)
Previous radiological investigations such as surveys, decontamination activities, and cleanup activities were evaluated. The evaluation of previous investigations and cleanups addressed, at a minimum, the following elements:

- agency conducting the investigation;
- purpose of the investigation;
- dates of the investigation;
- details of releases inside building, to air, to soil, and to surface water, as applicable;
- decontamination/cleanup activities; and
- final survey results.

Radiological Use Authorizations
Use authorizations have been defined as issuance of a license for radioactive material(s) from an appropriate regulatory agency. All known licenses issued for the site were included; if none were found, the text "none found" was inserted.

Former Radiological Burial or Disposal Locations
A description of known burials and/or disposals of radiological materials on the site, including applicable dates, if known. If no documented burials and/or disposals were identified, the text "none found" was inserted.

Aerial Photographs
The applicable photographic analyses from the report prepared by the EPA's Environmental Photographic Interpretation Center (EPIC) in March 2010 were included for each site. These analyses include photographs from the following dates:

- December 22, 1952;
- August 19, 1957;
- August 21, 1959;
- Approximately 1960 plus or minus a year;
- March 1, 1965;
- August 13, 1967;
- April 20, 1972;
- May 16, 1978;
- October 21, 1980;
- August 21, 1983;
- October 10, 1988;
- June 19, 1995; and
- June 8, 2005.

Aerial photograph anomalies were interpreted as a trigger for assigning a higher scrutiny to a particular site than other information (such as historical documents) would indicate.

Radionuclides of Concern
Radionuclides used/generated at the site. This description includes, at a minimum, the types of radiological material(s) managed at the site; radionuclides known or suspected to have been handled or generated on the site; and how the identified radionuclides impact the list of radionuclides of concern in the background study. If no information was available, the text "none found" was inserted. It is important to note that not every radionuclide listed in this HSA will have a sample analysis. The radionuclides are listed for completeness, indicating that they have been mentioned or discussed in a cited document or report. However, many of the facility and site reports reflect the conditions at the time, thus every mention of a specific radionuclide does not mean it would be present now, due to decay. For this reason, the Radionuclides of Concern sections described for each facility or site list those found in historical records. The Radionuclides of Concern (Table 3.3) lists radionuclides that will be analyzed and does not include those that would have decayed in the years since operations ceased.

Drainage Pathways
This category includes information on the direction of surface water flow on the site and the presence of sanitary drains, storm drains, channels/ditches, septic systems, or leach fields on or near the site.

Radiological Contamination Potential
The potential for radiological contamination was evaluated for each site. Evaluations included consideration of the completeness of past cleanup and remedial operations. Many past clean-up efforts likely did not achieve the requirements of the DTSC/DOE AOC dated December 2010 that generally requires a cleanup to background levels for both radiological and chemical contaminants. Background studies for the site are nearing completion with EPA leading the radiological background study and the DTSC leading the chemical background study. The potential for radiological contamination is quantified in this TM by assigning a preliminary MARSSIM class describing the possibility for residual radiological contamination at the site based on all information collected to date. The basis for assigning the preliminary MARSSIM classification includes an examination of the following data elements:

- historical site operations;
- previous radiological investigations;
- reported incidents of releases;
- decontamination and remediation operations at the site;
- interviews with former workers;
- drainage pathways on or near the site;
- aerial photograph interpretation; and
- site reconnaissance.

Recommended Locations for Soil/Sediment Sampling

For each site, recommendations were made for possible targeted soil/sediment sampling locations. The selection of potential sampling locations was based on locations with the highest potential for radiological contamination as well as at the particular site based on all known information collected to date. The criteria evaluated for developing recommended soil/sediment sampling locations include the following:

- topography of the site;
- historical site operations;
- radiological investigations;
- reported incidents of releases;
- decontamination/cleanup operations at the site;
- interviews with former workers;
- storm drains on or near the site;
- sewer lines on or near the site;
- aerial photograph interpretation; and
- site reconnaissance.

2.0 FINDINGS

This section organizes the building areas within HSA-5B according to eight logical "clusters" (a.k.a. groups) based on operational characteristics and geographic locations. Plate 1 depicts the entire HSA-5B subarea and should be referenced while reading Section 2. Each HSA-5B group (discussed in Sections 2.1 through 2.8, below) is depicted in an accompanying group map, which serves as a guide for the text describing the building areas in that group and also as an index for the group's site photograph and building layout drawings.

2.1 Group 1

The Group 1 index map is presented in Figure 2.1. Following Figure 2.1, the site photograph and layout drawings for each building area within HSA-5B Group 1 are presented. HSA-5B Group 1 includes seven building areas containing the Building 4010 Systems for Nuclear Auxiliary Power (SNAP) reactors, the Building 4012 SNAP Critical Test Facility, the Building 4019 SNAP Flight Systems Facility, two non-nuclear SNAP support buildings, the Sodium Component Test Installation (SCTI) Power Pak building, and a portable change room. Note that Building 4310, the portable change room, was later moved to support the Small Component Test Loop (SCTL). As a result, Building 4310 will be discussed as appropriate in Group 1 and Group 6 of this section.

2.1.1 Building 4010 Area

Site Description: The Building 4010 area comprises Building 4010, Electrical Equipment Pads 4807 and 4808, Air Blast Heat Exchanger Pad 4809 and the land that surrounds these sites located off B Street. The small grade-level concrete pads allowed for the mounting of support equipment. Building 4010 was constructed in 1959 as the SNAP Experimental Reactor (SER).[1,2] Figures 2.1.1a through 2.1.1d provide a current photograph and the best available building-specific drawing(s) that the research team could find. Building 4010 was located east of SNAP Critical Test Facility Building 4012. No as-built drawings have been located for Building 4010. Plate 1 presents a summary of all identified features for this site.

Building Features: Building 4010 was a steel-framed structure with corrugated metal siding and roofing. The building measured 60 feet long by 24 feet wide with 17-foot ceilings. A buried radioactive gas holdup tank and a drainage sump were identified as support facilities exterior to Building 4010. The subsurface structure of Building 4010 was composed of three steel-reinforced concrete vaults with a maximum depth of 14 feet below grade. All three vaults were located in the reactor room, occupying the southern 34 feet of the building.[3,4] Figure 2.1.1d provides a schematic drawing showing the three vaults. Figure 2.1.1b provides a plot plan showing the water lines, sewer lines, and drain flow around Building 4010. Figure 2.1.1c

[1] Stelle, A.M., *S8ER Facilities Decommissioning Final Report, ESG-DOE-13237*, Rockwell International, Atomics International Division, Energy Systems Group, February 28, 1979, p. 17.
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[3] Stelle, A.M., *S8ER Facilities Decommissioning Final Report, ESG-DOE-13237*, Rockwell International, Atomics International Division, Energy Systems Group, February 28, 1979, pgs. 10-11.
[4] Ashley, R.L. et al., *Evaluation of the Atomics International Nuclear Development Field Laboratory as a Location for Reactor Facilities, NAA-SR-7300*, Atomics International, May 25, 1962, pgs. V-12 –V-14.

provides a floor plan of Building 4010 in 1962 showing the location of tanks and sumps. These figures provide details on the tanks and piping associated with Building 4010. A sanitary sewer line is identified at the north end of Building 4010.[1]

A leach field was located west of Building 4010 and received flow from a 750-gallon septic tank connected to the building (see Figure 2.1.1e). The leach field was constructed of 4-inch-diameter terra cotta clay piping surrounded by gravel and buried at depths ranging from 2 to 6 feet below ground surface. The leach field consisted of 90 linear feet of leach lines. In 1961, Building 4010 was connected to the sanitary sewer system and the leach field and septic tank were removed. The Building 4010 leach field was covered with compacted fill to support the construction of adjacent buildings.[2,3,4] A 2003 Resource Conservation and Recovery Act Facility Investigation (RFI) report on Area IV leach fields states that the Building 4010 leach field was mistakenly identified as a leach field for Building 4012 in a 1994 RFI report.[5] A 2008 RFI report suggests that the leach field and septic tank were abandoned in place; however geophysical surveys did not detect these features, and other sources cited above claim these features were removed.[6] Lines leading to the septic tank and leach field were exposed and surveyed during decommissioning. Contamination was below acceptable limits in 1978 and the sewer lines were left in place.[7,8] (See Previous Investigations below for acceptable limits.)

A 2008 RFI report identifies a 630-gallon underground storage tank (UST) located 23 feet from the north corner of Building 4010. The contents of this tank are unknown. A compressed gas aboveground storage tank is also noted on the east side of Building 4010, but the type of gas and tank capacity is unknown. Cooling water pipelines were located beneath Building 4010 and between Building 4010 and the air compressor pad east of the building.[9]

Former Use(s): Building 4010 housed the SER, also known as the SNAP 2 Experimental Reactor (S2ER), which was a prototype for the basic SNAP reactor and used for power demonstration and endurance tests. The SER/S2ER operated in Building 4010 from September 1959 to December 1960 at a power level of 50 kilowatt thermal (kWth). After completion of the

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[1] *Santa Susana Field Laboratory Site Development Plan, Existing Development, Sanitary Sewage System*, Rockwell International Corporation, Unknown date, HDMSE00688360.

[2] *Group 5 – Central Portion of Areas III and IV RCRA Facility Investigation Report, Santa Susana Field Laboratory, Ventura County, California, Volume VIII – RFI Site Reports, Appendix P, United States Department of Energy Leach Fields 2*, CH2M Hill, Draft in Progress November 2008, pgs. P.2-1, Table P.2-4.

[3] Wynveen, R.A. et al., *Interim Post Remedial Action Survey Report for Systems for Nuclear Auxiliary Power-8 (SNAP-8) Experimental Reactor Facility (Building 010), Santa Susana Field Laboratory, Rockwell International, Canoga Park, California*, Argonne National Laboratory, May 1983, p.1.

[4] Wallace, J.H., *Radiological Survey Results - Release to Unrestricted Use, Building 010 at SSFL, N704TI990041*, Rockwell International, Atomics International Division, August 28, 1978, p. 3.

[5] Montgomery Watson Harza, *DOE Leach Fields (Area IV AOC) RCRA Facility Investigation Report, Santa Susana Field Laboratory, Ventura County, California, Draft*, October 2003, pgs. 2-2–2-3.

[6] *Group 5 – Central Portion of Areas III and IV RCRA Facility Investigation Report, Santa Susana Field Laboratory, Ventura County, California, Volume VIII – RFI Site Reports, Appendix P, United States Department of Energy Leach Fields 2*, CH2M Hill, Draft in Progress November 2008, pgs. P.2-1, Table P.2-4.

[7] Stelle, A.M., *S8ER Facilities Decommissioning Final Report, ESG-DOE-13237*, Rockwell International, Atomics International Division, Energy Systems Group, February 28, 1979, pgs. 33, 36.

[8] *Long-Range Plan for Decommissioning Surplus Facilities at the Santa Susana Field Laboratories, N001TI000200*, Rockwell International, Unknown Date, p. 75.

[9] *Group 5 – Central Portion of Areas III and IV RCRA Facility Investigation Report, Santa Susana Field Laboratory, Ventura County, California, Volume VIII – RFI Site Reports, Appendix P, United States Department of Energy Leach Fields 2*, CH2M Hill, Draft in Progress November 2008, pgs. P.2-1, Table P.2-4.

SER/S2ER operations, the reactor and associated test equipment were removed from the building and sent offsite for disposal. In 1961, improvements and modifications were made to Building 4010 to allow for testing of the higher power level SNAP 8 Experimental Reactor (S8ER). The S8ER was a prototype for the SNAP 8 reactors. The S8ER operated in Building 4010 from May 1963 to April 1965 at a power level of 600 kWth.[1,2,3] Figure 2.1.1d presents a schematic drawing of the S8ER.

At the conclusion of the S8ER experiment in 1965, the reactor, primary and secondary sodium loops, and control panels were removed from the building. The primary vault, which still contained surface contamination, and the reactor containment vessel, which still contained induced radioactive materials, were covered with shielding blocks to restrict access and shield the remaining radiation. Plans for facility reuse did not materialize and Building 4010 remained unused for nine years until being declared surplus in 1974. Decommissioning and decontamination work occurred though the winter of 1977 and 1978.[4] A large structure consisting of four cooling towers (SCTI Power Pak Cooling Tower Building 4710) was constructed in the approximate location of former Building 4010 in the late 1980s and was operated until the mid-1990s. The cooling towers were removed during 2003.[5,6]

Information from Interviewees: A number of former employees were interviewed about their experience at the SSFL. Five remembered Building 4010. Excerpts from their interviews are included below.

Interviewee 8 was an employee of Atomics International and its successors from 1956 to 1997 and then worked as a contractor for another 10 years. The interviewee was a project administrator who primarily worked at the Van Owen facility, but occasionally visited the Santa Susana Field Laboratory. The following excerpts were pulled from the interview.

> *"The SNAP reactors at SSFL used beryllium reflectors. I don't know that they ever had any problems with that, but beryllium is pretty toxic stuff."*[7]

Interviewee 5 was a responsible engineer at Atomics International from 1958 to 1962. The following excerpts were pulled from the interview.

> *"Building 10 was a SNAP test facility.... During the testing of the SNAP 8 reactor, the cooling system for the containment vessel developed leaks and so we built a Bar's Leak injection system. Bar's Leak was a radiator sealant. It was*

[1] Brinkman, D.S., *S8ER Operations Manual, Volume 1, Description and Operating Procedures, NAA-SR-MEMO-7222*, Atomics International, November 1, 1962, pgs. 3-4.
[2] Stelle, A.M., *S8ER Facilities Decommissioning Final Report, ESG-DOE-13237*, Rockwell International, Atomics International Division, Energy Systems Group, February 28, 1979, p. 15.
[3] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 1 – Methodology*, May 2005, pgs. 2-5–2-6, 2-9.
[4] Stelle, A.M., *S8ER Facilities Decommissioning Final Report, ESG-DOE-13237*, Rockwell International, Atomics International Division, Energy Systems Group, February 28, 1979, pgs. 15, 27.
[5] Montgomery Watson Harza, *DOE Leach Fields (Area IV AOC) RCRA Facility Investigation Report, Santa Susana Field Laboratory, Ventura County, California, Draft*, October 2003, pgs. 2-2–2-3.
[6] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962-November 1992.
[7] Interview No. 8 conducted by DOE and EPA on July 14, 2010.

> *some kind of sodium solution product. We injected that into the cooling system to plug up the leaks and it did. There was residual sodium in the cooling system and it became radioactive. I suspect there may have been some contamination from leaks, but I don't have first-hand knowledge."*[1]

Interviewee 107 was an engineer at Atomics International from 1961 to 1973 and worked on the SNAP 2, SNAP 10/10A, and S8ER programs. The following excerpts were pulled from the interview.

> *"I worked on the S8ER in Building 10, which was much larger than the SNAP 10/10A reactors. But after 2 years, the S8ER was shut down."*[2]

Interviewee 155 started work at the Santa Susana Field Laboratory on February 2, 1959 as a fireman and then transferred to the Radiation Safety Department. The following excerpt was pulled from the interview.

> *Building 10 was the S8ER and was the second reactor they had in that building. The outside of the containment vessel was leaking water which was the vessel coolant. I was not aware if they were using lithium in this building. To stop that leak, Bar's Leaks was used. You may want to see if irradiation of that product would produce tritium. Building 28 was real close to Building 10 and they had a swimming pool reactor in that building. Look at the elevations of the two buildings – I bet the vessel in Building 28 was probably lower than the Building 10 vessel.*[3]

Interviewee 427 worked for Atomics International beginning in June 1957 and was initially assigned as a test engineer to the pyroprocessing refabrication experiment and later went on to work on zirconium hydride reactor systems at the Santa Susana Field Laboratory. The following excerpts were pulled from the interview.

> *"After we proved we could build a hydride reactor, the real work began on the SER, not to be confused with the SRE. We wore film badges and were monitored, and worked inside a security fence. There were health physicists onsite.*
>
> *I have transported enriched fuel elements, three at a time, in the back of my VW from the plant at the bottom of hill where they were constructed at Atomics International (the Van Owen Facility) up the hill to SSFL. Everything was contained within the fuel elements. NaK was the flowing coolant in the primary and secondary systems and heat exchangers.*
>
> *Any experimental reactor is always "off-normal"! We had a NaK leak inside the vault. There was a little water in the bottom of the vault that condensed from the concrete, and the heater leaked NaK which caused the metal membrane that sealed the vault to raise the concrete blocks rhythmically! We thought it was a leak in the primary, but it was actually in the exchanger. It was just gas created*

[1] Interview No. 5 conducted by EPA on August 23, 2010.
[2] Interview No. 8 conducted by DOE and EPA on July 14, 2010.
[3] Interview No. 155 conducted by DOE in 2010.

by the reaction of the NaK with the water, but it sure got our attention for the remainder of the test program! The DeSoto folks wrote up the reports.
For safety purposes, the reactor was located in a big steel tube way down at the bottom and controlled by long rods going down to the reactor reflector controls. We had an air-blast heat exchanger on the outside of the building to get rid of excess heat. You had to load the fuel, seal the reactor, and then load the liquid metal NaK. There were many steps to be followed.

The only radiation exposure would be coming through the shielding--it would not be airborne, but we had people coming through and monitoring us to ensure we hadn't been exposed. I was never involved in the disassembly of the SER...

The biggest disposal problem we had was getting rid of contaminated NaK coolant. For each test you had to drain and re-fill, so there was a lot of NaK you had to get rid of. You would wet the NaK with steam and it would "hiss" a little bit and then it would be gone. They did this on the outside of the test buildings.

For the hardware that was contaminated, we would turn it over to a group of guys that had a "sodium burn pit". A friend of mine who worked on the sodium component, QSU, learned that things can happen when mixing steam with alkaline metals. You can drain the sodium out, but there is still hardware contaminated with sodium that you have to clean up and what do you do with that? I never buried or hauled anything to the sodium burn pit.

The SNAP Program was a very fast-moving project. My principle job was to run and evaluate the engineering design of the integrated system so I got involved in designing the building to accommodate future SNAP tests. I went from being a Test Engineer on the SER to a Supervisor of non-nuclear testing in Building 32." [1]

Radiological Incident Reports: There have been several incidents associated with Building 4010 that could have resulted in a release to the environment. The following table provides information presented in an incidents database provided by Boeing. Summaries of only the incident reports that resulted or may have resulted in releases to the environment are provided following the table, when available. Summaries of all available incident reports are provided in Attachment A.

Building 4010 Incident Report Summary

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A0598	4/30/1961	SER BLDG 10		REFERS TO SAMPLES FROM APRIL INCIDENT AT SER.
A0277	1/1/1964	SNAP-8 CORE	MFP	FISSION PRODUCT RELEASE FROM CLADDING FAILURE OF SNAP 8 REACTOR FUEL.
A0349	10/19/1965	HIGH BAY	ACP	SAW CUTTING OF CONTROL RODS RESULTED IN

[1] Interview No. 427 conducted by DOE in 2010.

				CONTAMINATION OF BLDG.

- On April 30, 1961, an unknown incident occurred in Building 4010. Incident Report A0598 referenced the April incident when it indicated that the processing of samples from the incident would be delayed. The report states that three of the five samples resulting from the recent SER incident will be delayed due to a backlog of analyses for the gamma spectrometer. The three samples for which analysis was delayed were the "'coolie hat' smear, the smear of the upper grid plate, and the metallic fragments scraped from the core." Analysis of two samples following the incident was completed. The first sample was composed of dust removed from the constant air monitor filter. The air monitor had been operating inside the reactor at the time of the incident. The second sample consisted of smears taken of the interior sides of the reactor below the core. The following radioisotopes were found in both samples: cesium-137 (Cs-137), antimony-124 (Sb-124), cobalt-60 (Cp-60), scandium-46 (Sc-46), manganese-54 (Mn-54), strontium-90 (Sr-90), and yttrium-90 (Y-90). The air filter dust sample had a total activity of 2.20 x 10^{-1} microcuries per gram (uC/gm) and the smears below the core had a total activity of 1.23 x 10^{-1} uC (no units of weight were included since this was considered a surface sample) (Incident Report A0598).[1]

- On January 1, 1964, mixed fission product was released to the cover gas and sodium potassium (NaK) coolant as a result of cladding failure of SNAP 8 reactor fuel (Incident Report A0277).[2] A "substantial release of fission products due to cladding failure occur[ed] in about 80% of the fuel rods during the reactor's extended endurance run."[3] The uranium-zirconium fuel swelled stretching the cladding beyond its ductility limit. This caused cracks in the cladding that allowed fission products to diffuse into the NaK. There was no melting of the fuel or cladding and all fission products were completely contained within the reactor system.[4,5]

- A 2008 RFI report lists a July 5, 1961 and a June 11, 1964 incident related to Building 4010. The details of these incidents are unclear at this time. The documents referenced for this information in the RFI have been reviewed and do not suggest radiological incidents on these two dates. A review of Boeing's Radiological Incident Database does not include any incidents on these dates. It is unclear if the statements in the RFI are accurate. If any additional information comes to light regarding these possible incidents, this technical memorandum will be updated.[6]

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[1] Internal Correspondence from Copeland, A.A. to Carpenter G.D., Atomics International, *Re: Status Report on Analysis of Samples Resulting from the Incident at SER in April, 1961*, June 27, 1961.
[2] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. L-2.
[3] Zwetzig, G.B., *Survey of Fission- and Corrosion-Product Activity in Sodium- or NaK-Cooled Reactors, AI-AEC-MEMO-12790*, Atomics International, a Division of North American Rockwell Corporation, February 28, 1969, p. 10.
[4] Oldenkamp, R.D. and Mills, J.C., *Nuclear Operations at Rockwell's Santa Susana Field Laboratory – A Factual Perspective, N001ER000017*, Rockwell International, December 20, 1989, p. 86.
[5] *S8ER Fuel Failures*, Unknown Author, October 5 1999, HDMSp01708835.
[6] *Group 5 – Central Portion of Areas III and IV RCRA Facility Investigation Report, Santa Susana Field Laboratory, Ventura County, California, Volume VIII – RFI Site Reports, Appendix P, United States Department of Energy Leach Fields 2*, CH2M Hill, Draft in Progress November 2008, p. Table P.2-1.

- In addition to the incident reports, two leaks in cooling lines are known to have occurred. One leak occurred in the shield cooling water lines under the vault floor and another leak was identified in the reactor containment vessel cooling lines in the earth near the concrete shield. Both leaks were repaired, and no extensive decontamination was found to be required or performed.[1] These leaks may have promoted the release of tritium.[2] Building 4010 has been identified as the source of tritium in a neighboring groundwater well.[3]

- An additional, though unlikely, potential for release of tritium to surface water occurred upon removal of the S8ER reactor shield from the ground, for disposal as radioactive waste. The concrete shield was excavated and removed on February 16, 1978, and stored outside, presumably on a paved storage area, at the Radioactive Materials Handling Facility (RMHF). On or before May 22, 1978, the shield was reportedly thoroughly wrapped in plastic sheeting, isolating it from the environment. During the time it was exposed, rain fell on the shield and could have extracted a small amount of tritium from the concrete. Rainfall runoff from the RMHF is collected in a sump and pumped to surface drainage, which ultimately flows to Rocketdyne Retention Pond R-2A located in Area II.[4,5,6]

- On May 18, 1965, a NaK fire occurred in the reactor pit in Building 4010. The fire was extinguished by placing the cover on the reactor pit and flooding it with argon. No personal injury or property damage was reported to be sustained.[7]

Current Use: Demolished in 1978.[8] No structures remain at the building site and the area is paved over for use as a parking lot. A 1979 decommissioning report discusses excavation of Building 4010, but does not provide any excavation dimensions.[9] No other excavation information has been located.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): A chronology of radiological investigations at this building is as follows:

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[1] Stelle, A.M., *S8ER Facilities Decommissioning Final Report, ESG-DOE-13237*, Rockwell International, Atomics International Division, Energy Systems Group, February 28, 1979, pgs. 13, 15-16.
[2] Tuttle, R.J. *Tritium Production and Release to Groundwater at SSFL*, Rockwell International, Rocketdyne Division, September 25, 1992, pgs 61-62.
[3] The Boeing Company, Rocketdyne Environmental Affairs, *Building 4010 – SNAP-8 Experimental Reactor*, February 10, 2000, pgs. 1-2.
[4] Tuttle, R.J. *Tritium Production and Release to Groundwater at SSFL*, Rockwell International, Rocketdyne Division, September 25, 1992, pgs. 61-62.
[5] MWH Americas, Inc., *Standardized Risk Assessment Methodology (SRAM) Work Plan, Santa Susana Field Laboratory, Ventura County, California, Revision 2 – Final*, September 2005, pgs. Table 1-3, Table 1-4, Figure 1-5.
[6] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume I – Methodology*, May 2005, p. 3-13.
[7] Internal Correspondence from Wilmes, R. to Lang, J., Atomics International, a Division of North American Aviation, Inc., *Reference: Monthly Progress Report for Industrial Hygiene and Safety, Santa Susana, Period Ended May 29, 1965*, dated June 2, 1965, p. 3.
[8] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume I – Methodology*, May 2005, pgs. 2-5–2-6, 2-9.
[9] Stelle, A.M., *S8ER Facilities Decommissioning Final Report, ESG-DOE-13237*, Rockwell International, Atomics International Division, Energy Systems Group, February 28, 1979, p. 46.

- **Decontamination Limits**. Guide limits were established for decontamination of the Building 4010 area. The objective was to leave all decontaminated areas at radiation levels as low as practicable, but in all cases to levels below 0.1 millirad per hour (mrad/hr) at 1 centimeter for total beta-gamma emmiters, 100 disintegrations per minute per 100 square centimeters (dpm/100 cm^2) for removable beta-gamma emmitters, 100 dpm/100 cm^2 for total alpha emmiters, and 20 dpm/100 cm^2 for removable alpha emitters. Activated soil was to be removed as near as practicable to the natural background levels, but in all cases to less than 100 picocuries per gram (pCi/g) gross detectable beta activity.[1,2,3]

- **1978 Atomics International Radiological Survey**. In 1978, Atomics International conducted a radiological survey following decontamination and demolition. The survey included 200 smears for removable contamination along smooth surfaces (concrete, piping, and steel surfaces), a walk-through survey of surface contamination, soil sampling, concrete sampling, and water sampling. No smears were found to exceed 50 dpm/100 cm^2, including smears of the drains lines to the current sewer and to the previous leach field. Alpha contamination was not expected and none was detected. In a complete walk-through survey that included drain lines, the maximum surface contamination detected was 0.05 mrad/hr with an average background of 0.04 mrad/hr. All readings were below the 0.1 mrad/hr limit. Prior to backfilling, concrete samples were taken from a portion of the equipment vault wall. All samples were less than 50 pCi/g gross beta and all clean sampled concrete was used as backfill for ditch repair between Area I and Area II. Soil samples were collected after backfilling was complete. All samples were less than 50 pCi/g gross beta. During dismantling of the sump drain system and vessel pit, water samples were collected. No samples exceeded 4.5 x 10^{-8} microcuries per cubic centimeter (µCi/cc), below the limits of 3.0 x 10^{-7} µCi/cc for Sr-90. All results were below clean up guide limits (see above) for Building 4010 in 1978.[4,5]

- **1979 Argonne National Laboratory Radiological Survey**. In September 1979, Argonne National Laboratory conducted a radiological survey for post remedial assessment of the Building 4010 site to ensure that it met unrestricted release criteria. The building site consisted of an asphalt-paved parking lot at the time. A walkover survey indicated some elevated readings on the asphalt, ranging from 15 to 30 microroentgens per hour (µR/hr) with a natural background ranging from 9 to 15 µR/hr. Further investigation suggested these readings were a result of radioactive materials stored on the hill east of the Radioactive Materials Handling Facility. Soil borings through the asphalt did not detect any uranium-235 (U-235) or uranium-238 (U-238). Other radionuclides including: cesium-137 (Cs-137), thorium-232 (Th-232), radium-226

[1] Stelle, A.M., Facilities Dismantling Plan for Building 10 (S8ER), N704FDP990005, Rockwell International, September 1976, p. 3.
[2] Stelle, A.M., *S8ER Facilities Decommissioning Final Report, ESG-DOE-13237*, Rockwell International, Atomics International Division, Energy Systems Group, February 28, 1979, p. 20.
[3] Wynveen, R.A. et al., *Interim Post Remedial Action Survey Report for Systems for Nuclear Auxiliary Power-8 (SNAP-8) Experimental Reactor Facility (Building 010), Santa Susana Field Laboratory, Rockwell International, Canoga Park, California*, Argonne National Laboratory, May 1983, p.2.
[4] Wallace, J.H., *Radiological Survey Results - Release to Unrestricted Use, Building 010 at SSFL, N704TI990041*, Rockwell International, Atomics International Division, August 28, 1978, pgs. 6-7.
[5] Stelle, A.M., *S8ER Facilities Decommissioning Final Report, ESG-DOE-13237*, Rockwell International, Atomics International Division, Energy Systems Group, February 28, 1979, pgs. 33-34.

(Ra-226), and cobalt-60 (Co-60) were identified below clean up guide limits (see above) for Building 4010 in 1979.[1]

- **1979 and 1981 Post Remedial Assessment**. In November 1979 and October 1981, Argonne National Laboratory conducted radiological measurements for post remedial assessment of the Building 4010 site. The building site consisted of an asphalt-paved parking lot. Soil sampling analysis in 1979 found Co-60 contamination, primarily in the southwest quadrant of the building site. The maximum Co-60 level detected was 48.0 picocuries per gram (pCi/g), which was below the U.S. Department of Energy (DOE) criteria level of 100 pCi/g gross beta activity in 1979.[2]

- **1982 Release for Unrestricted Use**. The Building 4010 site was released for unrestricted use by the DOE in December 1982.[3]

Radiological Use Authorizations: Use Authorization No. 18 pertained to radiography in Building 4010.[4] Use Authorization No. 111 pertained to the decontamination and disposition of Building 4010.[5] The research team found no other Use Authorizations pertaining to Building 4010.

Former Radiological Burial or Disposal Locations: Radioactive waste produced by the test reactor was reported as quite small and, as a result, major waste collection or processing systems were not provided for the facility. Small tanks were provided for storage of liquid or gaseous wastes that might have been radioactive.[6] The research team found no other information regarding the small tanks.

Aerial Photographs: Building 4010 was first identified on a 1959 aerial photograph. Aerial photographs from 1965 and 1967 indicate an access road and disturbed ground north of Building 4010 in Subarea HSA-7. In 1967, the southwest portion of the disturbed ground area, north of and between Buildings 4013 and 4019, contains possible liquid waste. By 1972 the disturbed ground is re-vegetated, but ground scarring continues to be noted in aerial photographs through 2005 where the area becomes the subject of earth moving activity. A 1967 aerial photograph indicates that drainage flows southwest from an open storage (OS) area identified as OS-2 in Subarea HSA-7 toward Building 4010. In 1978, Building 4010 is no longer present, but a drainage pathway is noted flowing north from the former Building 4010 area to a liquid-filled impoundment, denoted IM-4, in Subarea HSA-7. In 1980, the drainage pathway to IM-4 is still visible and includes a pipeline, but the impoundment is dry. In 1988, a structure containing cooling fans (Building 4710) was identified near the former location of Building 4010. In 1995,

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[1] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. L-4.
[2] Wynveen, R.A. et al., *Interim Post Remedial Action Survey Report for Systems for Nuclear Auxiliary Power-8 (SNAP-8) Experimental Reactor Facility (Building 010), Santa Susana Field Laboratory, Rockwell International, Canoga Park, California*, Argonne National Laboratory, May 1983, pgs. 1-4.
[3] The Boeing Company, Rocketdyne Environmental Affairs, *Building 4010 SNAP-8 Experimental Reactor*, February 10, 2000, pgs. 1-2.
[4] Radiation Safety Records Management System Index, The Boeing Company, Reviewed November 8, 2010.
[5] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, pgs. L-2, L-5.
[6] Stelle, A.M., *S8ER Facilities Decommissioning Final Report, ESG-DOE-13237*, Rockwell International, Atomics International Division, Energy Systems Group, February 28, 1979, pgs. 13, 15-16.

a stain is visible near the southeast corner of the cooling fans. By 2005, the cooling fans had been removed and the stain was no longer visible.[1]

Radionuclides of Concern: The SNAP reactors were uranium-zirconium hydride reactors that used fully enriched uranium dispersed in fuel rods containing zirconium hydride. Radionuclides resulting from reactor operations in Building 4010 include: antimony-125 (Sb-125), americium-241 (Am-241), cesium isotopes (Cs-134, Cs-137) cobalt-60 (Co-60), europium isotopes (Eu-152, Eu-154), isotopes of plutonium (Pu-238, Pu-239, Pu-240, Pu-241), strontium-90 (Sr-90), tritiated titanium (H-3), and natural and enriched uranium (U-234, U-235, U-238).[2,3,4] All radionuclides of concern listed are included for analysis in the August 2009 *Final Field Sampling Plan, Radiological Background Study, Santa Susana Field Laboratory* (August 2009 Field Sampling Plan). Beryllium-10 (Be-10) is a potential radionuclide of concern at Building 4010 because beryllium reflectors were used in the SNAP reactor. Be-10 is not anticipated to be found at high concentrations and the decision to sample for Be-10 is being further evaluated. Table 3.3 presents a summary of radiological contaminants of concern.

Fission- and corrosion-product releases associated with a cladding failure in the S8ER that do not meet the criteria for analysis based on the August 2009 Field Sampling Plan include: argon-39 (Ar-39), barium-140 (Ba-140), cerium isotopes (Ce-141, Ce-144), cobalt-58 (Co-58), iodine isotopes (I-131, I-132), iron-59 (Fe-59), lanthanum-140 (La-140), manganese isotopes (Mn-54, Mn-56), niobium-95 (Nb-95), rubidium-86 (Rb-86), ruthenium isotopes (Ru-103, Ru-106), rhodium-106 (Rh-106), strontium-89 (Sr-89), tellurium-132 (Te-132), xenon-135 (Xe-135), and zirconium-95 (Zr-95).[5]

Drainage Pathways: Groundwater drainage for the entire vault complex was provided by a sub-foundation system consisting of circuits of perforated metal pipe surrounded by a gravel fill. The system drained into a pipewell sump located to the east of the building where the intercepted groundwater could be monitored. The water was then either pumped into a tank for controlled disposal if radioactive contamination was detected, or discharged to the site surface drainage system if no contamination was found.[6] The north end of Building 4010 is located near the surface drainage divide for the area. North of the drainage divide water drains northerly to Simi Valley. The general slope of Area IV is in a southerly direction. Water runoff is directed to the retention reservoirs, which are part of the SSFL industrial effluent control system. Liquid effluent discharge from the final retention pond into the Bell Canyon drainage occurs only after

[1] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.
[2] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 1 – Methodology*, May 2005, pgs. 2-6, 2-9.
[3] Zwetzig, G.B., *Survey of Fission- and Corrosion-Product Activity in Sodium- or NaK-Cooled Reactors, AI-AEC-MEMO-12790*, Atomics International, a Division of North American Rockwell Corporation, February 28, 1969, pgs. 5, 10.
[4] DOE/EPA Joint Interview 8, July 2010.
[5] Zwetzig, G.B., *Survey of Fission- and Corrosion-Product Activity in Sodium- or NaK-Cooled Reactors, AI-AEC-MEMO-12790*, Atomics International, a Division of North American Rockwell Corporation, February 28, 1969, pgs. 5, 10.
[6] Stelle, A.M., *S8ER Facilities Decommissioning Final Report, ESG-DOE-13237*, Rockwell International, Atomics International Division, Energy Systems Group, February 28, 1979, pgs. 11, 13.

controlled effluent holdup and sampling.[1,2] Aerial photographs from 1957 to 2005 indicate that drainage followed 17th Street to the south and continued to impoundments in Areas III and IV. The Area IV impoundment is identified as IM-5 on aerial photograph analysis and as the 17th Street Drainage in this technical memorandum.[3] The 17th Street Drainage is discussed later in this section.

Radiological Contamination Potential: Class 1 because of the former use of Building 4010.

Recommended Locations for Sediment/Soil Sampling:

Plate 1 and Figure 2.1 provide a convenient reference for the following recommendations.

Extensive soil sampling is recommended in the Building 4010 area. As discussed above, there were several radiological incidents at Building 4010 and documented evidence of radiological releases. Significant information is lacking regarding the excavation activities at Building 4010. In addition, previous characterization studies for the Building 4010 area were focused on delineating the extent of contamination to standards that were applicable at the time. Previous characterization studies for the Building 4010 area were focused on delineating the extent of contamination to standards that were applicable at the time and not to the standard required by the December 2010 Administrative Order on Consent. Therefore, additional characterization is recommended for the Building 4010 area. This includes the following Building 4010 areas and appurtenances:

- Former vault locations in the southern portion of the Building 4010 footprint. Leaks in the reactor and shield cooling lines may have left residual contamination in the area.

- Former radioactive gas holdup tank location exterior and northeast of the Building 4010 footprint. The known radioactive waste holdup tank may have left residual contamination in the area.

- Former septic tank location presumably located west of the Building 4010 footprint. If radioactive materials were released into the septic system, residual contamination may exist in the materials surrounding the former septic tank.

- Former leach field located west of the Building 4010 footprint. If radioactive materials were released into the septic system, residual contamination exist in the materials surrounding the former leach field.

- Former pipewell sump located east of the Building 4010 footprint. Groundwater for the entire Building 4010 vault complex drained into a pipewell sump where it could be

[1] Chapman, J. A., *Radiological Survey of Buildings T019 and T013; An Area Northwest of T059, T019, T013, and T012; And a Storage Yard West of Buildings T626 and T038, GEN-ZR-0010,* Rockwell International, Rocketdyne Division, August 26, 1988, p. 17.
[2] Map located at: http://www.dtsc-ssfl.com/files/maps/SSFL%20-%20Western%20Half.pdf.
[3] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2,* U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.

monitored. Leaks in the reactor and shield cooling lines may have left residual contamination in the area.

- Former UST located at north corner of the Building 4010 footprint. It is possible that this tank contained radioactive material and left residual contamination in the area.

- Sewer lines located north and west of the Building 4010 footprint. If radioactive materials were released into the sewer system, residual contamination may exist in the materials inside and surrounding the sewer lines.

- Drainage area east of Building 4010 depicted in aerial photograph from OS-2 in Subarea HSA-7 to former Building 4010 location. If radioactive materials were released from OS-2 and drained into the Building 4010 area, residual contamination may exist to the east of the building.

- Drainage pathways associated with the Building 4010 area and outside Area IV as proposed by the field sampling plan. Residual contamination may exist in drainages outside of Area IV.

2.1.2 Building 4012 Area

Site Description: The Building 4012 area comprises Building 4012, Electrical Substation 4713, and the land surrounding these buildings located on B Street. Building 4012 was constructed in 1962 as the Systems for Nuclear Auxiliary Power (SNAP) Critical Test Facility.[1,2] Figures 2.1.2a through 2.1.2b provide a current photograph and the best available building-specific drawing(s) that the research team could find. Building 4228, the Sodium Component Test Installation (SCTI) Power Pak facility, was built on top of Building 4012 and is discussed elsewhere in this section. Building 4012 was located near the northern property line of Area IV. The terrain near the northern property line becomes very rugged and there is a 40-foot drop in elevation.[3] No as-built drawings were located for Building 4012. Plate 1 presents a summary of all identified features for this site.

Building Features: The Building 4012 complex originally consisted of two sections connected by an enclosed walkway measuring 34 feet long by 6 feet wide. The southern portion of the building was a prefabricated, steel-framed structure on a concrete slab floor and measured 42 feet long by 28 feet wide. This building included an operations and control room. The northern portion of the building was a concrete structure on concrete floor slabs and measured 46 feet long by 28 feet wide. This building contained a 20 foot long by 20 foot wide critical cell and a 26 foot long by 18 foot wide equipment room.[4,1,2,3]

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[1] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. L-7.
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962-November 1992.
[3] Chapman, J. A., *Radiological Survey of Buildings T019 and T013; An Area Northwest of T059, T019, T013, and T012; And a Storage Yard West of Buildings T626 and T038, GEN-ZR-0010*, Rockwell International, Rocketdyne Division, August 26, 1988, p. 10.
[4] Pascolla, A.L., *Decontamination and Decommissioning of Building T012, ETEC No. 012-AR-0001*, Boeing North American Inc., Rocketdyne Division, May 8, 1997, pgs. 3, 8.

The critical cell (Room 110) was used to test SNAP critical assemblies. The room was sealed with steel-lined, 4-foot thick concrete walls with a ¼-inch steel liner and a mat-type concrete foundation.[4] The fuel storage and equipment room (Room 109) was located adjacent to the critical cell. The room was divided by a 20-inch thick concrete shield wall containing 1 percent boron by weight. Embedded in the wall were 110 cadmium-plated fuel storage tubes arranged 5 tubes high and 22 tubes wide.[5,6]

Liquid wastes were stored in a low-level radioactive storage tank fed by the sink, shower and floor drain in the change room. Water used in [water] immersion [critical] experiments was also dumped into the low-level storage tank. The Health and Safety Division was responsible for disposition of the storage tank contents.[7] The low-level radioactive storage tank is presumably the same radioactive liquid waste holdup tank located outside the change room (Room 104).[8] This radioactive waste retention tank was sampled and removed in 1973.[9,10] Figure 2.1.2b provides an original floor plan of Building 4012.

Building 4012 had a restroom and a sanitary sewer line is identified at the south end of Building 4012.[11,12]

Former Use(s): Building 4012 was a SNAP Critical Test Facility. Operations began in 1962 with experiments using three SNAP critical assemblies (SCA-4A, SCA-4B, and SCA-5). Clad reactor fuel elements (U-ZrH) were stored in the fuel storage tubes located in Room 109. The SNAP critical experiments continued intermittently through 1968, when the fuel was shipped to the Source and Special Nuclear Material Storage Vault (Building 4064) and the facility was placed in stand-by mode. Additional critical experiments for the NASA-sponsored Heavy Metal Reflected Fast Spectrum Reactor (HMRFSR) project occurred from 1970 to 1972. In 1979, the concrete portion of the facility was modified for use by Energy Technology Engineering Center (ETEC) Quality Assurance in performance of x-ray machine and source radiography. The major

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[1] Oliver, B.M., *Final Radiological Survey Report for Building T012,ETEC No. 012-AR-0002*, Energy Technology Engineering Center, June 14, 1996, p. 7.

[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962-November 1992.

[3] Ashley, R.L. et al., *Evaluation of the Atomics International Nuclear Development Field Laboratory as a Location for Reactor Facilities, NAA-SR-7300*, Atomics International, May 25, 1962, pgs. V-8 – V-10.

[4] Vitkus, T.J. and Morton, J.R., *Verification Survey of Building T012 Santa Susana Field Laboratory, Rockwell International, Ventura County, California*, Oak Ridge Institute for Science and Education, October 1996, p. 3.

[5] Pascolla, A.L., *Decontamination and Decommissioning of Building T012, ETEC No. 012-AR-0001*, Boeing North American Inc., Rocketdyne Division, May 8, 1997, pgs. 3, 8.

[6] Federal Register Vol. 62, No. 195, *Certification of the Radiological Condition of Building T012 at the Energy Technology Engineering Center Near Chatsworth, California*, U.S. Department of Energy, Office of Environmental Restoration, October 8, 1997, pgs. 52528-52529.

[7] Gavigan, F. X. et al., *Reactor Safety Survey Report, SNAP Critical Assembly -5 (SCA-5), Building 012*, February 23, 1965, pgs. 10-11.

[8] Unknown Author, *Facility Information, Building No. 012*, Unknown Date, HDMSP001828011.

[9] Internal Correspondence from Heine, W.F. to Remley, M.E., North American Rockwell, *Reference: Operational Safety and Waste Management Unit Weekly Highlights – Week Ending May 5, 1973*, May 11, 1973, p. 2.

[10] Begley, F.E., Radiation Survey of Building 012, SCTI Cogeneration Project, Rockwell International, Rocketdyne Division, May 30, 1985, p. 3.

[11] *Technical Site Information, Energy Technology Engineering Center (ETEC), GEN-AT-0027, Revision B*, Rockwell International Corporation, August 1993, p. b-30.

[12] *Santa Susana Field Laboratory Site Development Plan, Existing Development, Sanitary Sewage System*, Rockwell International Corporation, Unknown date, HDMSE00688360.

modification involved removal of four fuel storage tubes and enclosure of the fuel storage room to serve as a radiographic darkroom. This use was terminated in 1992 and all radioactive sources were transferred to the Radioactive Material Handling Facility (RMHF) for storage.[1]

Decontamination and decommissioning was performed in two phases. In 1986, the unattached operations and control building and the connecting walkway that were considered part of the Building 4012 complex were demolished in order to build the SCTI Power Pak section of the Co-Generation Project. The remaining concrete vault portion of the facility (Room 109 and 110) served as a structural support foundation for the Co-Generation Unit. Final decontamination and decommissioning of the remaining portion of the building was performed from February through June 1995.[2,3]

Information from Interviewees: A number of former employees were interviewed about their experience at the Santa Susana Field Laboratory. Two remembered specific information about Building 4012. An excerpt from this interview is included below.

Interviewee 107 was an engineer at Atomics International from 1961 to 1973 and worked on the SNAP 2, SNAP 10/10A, and S8ER programs. The following excerpts were pulled from the interview.

> *"I was an alternate engineer in the Building 12 critical facility, where all of the free plutonium in the world was located at one point."*[4]

Interviewee 255 was an atomic reactor inspector and x-ray technician at the Santa Susana Field Laboratory from 1967 to 1985. The following excerpts were pulled from the interview.

> *"Building 4012 was a reactor building that had some radiation in it at one time. It was cleaned up and we used it for an x-ray lab in later years when I was an x-ray technician. The walls in Building 4012 were 3 feet thick. If I was going to be x-raying in Building 4012 with cobalt or a 350 KV x-ray machine, I had to call security first so they would adjust the radiation monitors that were across the road and down the hill."*[5]

Radiological Incident Reports: None found.

Current Use: Demolished in 2003.[6] Based on available information, the dimensions of the excavation made during building demolition are unknown.

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[1] Pascolla, A.L., *Decontamination and Decommissioning of Building T012, ETEC No. 012-AR-0001*, Boeing North American Inc., Rocketdyne Division, May 8, 1997, pgs. 3-4, 10-11.
[2] Pascolla, A.L., *Decontamination and Decommissioning of Building T012, ETEC No. 012-AR-0001*, Boeing North American Inc., Rocketdyne Division, May 8, 1997, pgs. 3-4, 10-11.
[3] Federal Register Vol. 62, No. 195, *Certification of the Radiological Condition of Building T012 at the Energy Technology Engineering Center Near Chatsworth, California*, U.S. Department of Energy, Office of Environmental Restoration, October 8, 1997, p. 52529.
[4] Interview No. 8 conducted by DOE and EPA on July 14, 2010.
[5] Interview No. 255 conducted by DOE and EPA Joint Interview on July 9, 2010.
[6] The Boeing Company, Rocketdyne Propulsion & Power, *Site Environmental Report for Calendar Year 2003 DOE Operations at The Boeing Company Rocketdyne Propulsion & Power, RD04-170*, September 2004, p. 5-13.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): A chronology of radiological investigations at this building is as follows:

- **1973 Building Decontamination and 1979 Radiation Survey**. Building 4012 was decontaminated and surveyed during the period March through May 1973. Fixed contamination was painted over with an eggshell-colored paint and stenciled "Caution Fixed Alpha Radioactive Material." The holdup tank was also removed in 1973. In 1979, a follow-up radiation survey was performed identifying areas with alpha activity at or below the limit for uranium.[1]

- **1985 Rocketdyne Radiological Survey**. In 1985, a comprehensive radiological survey indicated the presence of alpha contamination in both Rooms 109 and 110 of the concrete vault. The equipment area of Room 109 exhibited alpha contamination at the entrance door (840-1,400 disintegrations per minute per 100 square centimeters (dpm/100 cm^2)), overhead light fixtures (2,800 dpm/100 cm^2), air conditioning duct (840-2,800 dpm/100 cm^2), radioactive exhaust duct (4,200 dpm/100 cm^2), and steel door frame between Rooms 109 and 110 (1,960 dpm/100 cm^2). Spot checks of the concrete floor surface under the floor tile revealed contamination levels of 1,400-2,800 dpm/100 cm^2). All of these are below the allowable limit for surface contamination, which is 5,000 dpm/100 cm^2). Survey of the fuel storage area of Room 109 revealed contamination of the concrete floor (up to 6,500 dpm/100 cm^2). Survey of the fuel storage tubes indicated contamination levels up to 6,000 dpm/100 cm^2) at the entrance of the tubes. Eight contaminated fuel storage tubes were identified and removed. The walls, ceiling, and floor of the critical cell (Room 110) were covered with paint, which prevented meaningful alpha surveying. However, the walls were stencil painted "CAUTION, FIXED ALPHA RADIOACTIVE MATERIAL." Contamination was indicated on the light fixtures (2,800 dpm/100 cm^2) and electrical boxes 280-840 dpm/100 cm^2). To allow the release of Building 4012, radioactive materials and hazards were removed from the building.[2]

- **1996 Rockwell Final Radiological Survey**. Rockwell/Rocketdyne performed a final radiological survey in 1996. Survey results indicated that Building 4012 was suitable for release without radiological restrictions in 1996.[3] Acceptable contamination limits and gamma exposure rates for releasing a facility for unrestricted use are prescribed in the U.S. Department of Energy (DOE), the U.S. Nuclear Regulatory Commission (NRC), and the State of California guidelines. The lowest, most conservative limits were chosen from these guidelines and incorporated into the final survey criteria for Building 4012. The surface contamination limits for alpha and beta were excerpted from DOE Order 5400.5 and NRC Regulatory Guide 1.86 (see table below). The ambient gamma exposure rate limits at 1 meter were excerpted from an NRC Dismantling Order because

[1] Pascolla, A.L., *Decontamination and Decommissioning of Building T012, ETEC No. 012-AR-0001*, Boeing North American Inc., Rocketdyne Division, May 8, 1997, pgs. 3-4, 10-11.
[2] Pascolla, A.L., *Decontamination and Decommissioning of Building T012, ETEC No. 012-AR-0001*, Boeing North American Inc., Rocketdyne Division, May 8, 1997, pgs. 3-4, 10-11.
[3] Federal Register Vol. 62, No. 195, *Certification of the Radiological Condition of Building T012 at the Energy Technology Engineering Center Near Chatsworth, California,* U.S. Department of Energy, Office of Environmental Restoration, October 8, 1997, p. 52529.

at 5 microroentgens per hour (μR/hr) it was more conservative than the DOE value of 20 μR/hr, and more consistent with as low as reasonably achievable principles.[1,2]

Surface Contamination Guidelines from DOE Order 5400.5 (1990) and NRC Regulatory Guide 1.86 (1974)

Allowable Total Residual Surface Contamination (dpm/100 cm^2)			
Radionuclides	**Average**	**Maximum**	**Removable**
Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-125, and I-129	100	300	20
Th-Natural, Th-232, Sr-90, Ra-223, Ra-224, U-232, I-126, I-131, and I-133	1,000	3,000	200
U-Natural, U-235, U-238, and associated decay products	5,000α	15,000α	1,000α
Beta-gamma emitters (radionuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above	5,000β-γ	15,000β-γ	1,000β-γ
External Gamma Radiation			
The average level of gamma radiation inside a building or habitable structure on a site that has no radiological restriction on its use shall not exceed the background level by more than 20 μR/h.			

Source: U.S. Atomic Energy Commission (now NRC) Regulatory Guide 1.86, Termination of Operating Licenses for Nuclear Reactors, June 1974, p. 1.86-5.
U.S. Department of Energy Order 5400.5, Radiation Protection of the Public and the Environment, February 8, 1990, p. IV-6.

- **1996 ORISE Verification Survey**. In July 1996, the Oak Ridge Institute for Science and Education (ORISE) performed a verification survey of Building 4012. ORISE's finding support Rockwell's final status survey that the radiological conditions of Building 4012 met DOE guidelines for unrestricted release in 1996. Residual radioactive material guidelines from DOE Order 5400.5 are summarized in Table 1 above. The DOE's exposure rate guideline is 20 microroentgens per hour (μR/h) above background; however, Rockwell elected to use a more restrictive guideline of 5 μR/h above background level. The total alpha surface activity ranged from less than 34 to 170 dpm/100cm^2 in soil. The total beta surface activity ranged from less than 230 to 480 dpm/100cm^2 in soil. The removable activity was less than 9 dpm/100cm^2 for gross alpha and less than 15 dpm/100cm^2 for gross beta. The Rockwell-determined average background exposure rate was 14 μR/hr and ORISE observed rates ranged from 12 to 15μR/hr.[3]

[1] Oliver, B.M., *Final Radiological Survey Report for Building T012,ETEC No. 012-AR-0002*, Energy Technology Engineering Center, June 14, 1996, p. 19.
[2] Rash, M., *Final Oversight Verification and Confirmation Radiological Survey Report for Buildings T-012, T-029, and T-363*, Tetra Tech EM, Inc., December 20, 2002, pgs. 2-3.
[3] Vitkus, T.J. and Morton, J.R., *Verification Survey of Building T012 Santa Susana Field Laboratory, Rockwell International, Ventura County, California*, Oak Ridge Institute for Science and Education, October 1996, pgs. 4,6-8, C-1.

- **1996 California DHS Confirmatory Survey**. On July 31, 1996, the California Department of Health Services (DHS), Radiologic Health Branch (RHB) completed a confirmatory survey of Building 4012.[1]

- **1997 Release Without Radiological Controls**. On October 16, 1997, the DOE granted approval for the release of Building 4012 without radiological controls.[2]
- **1997 Concurrent on Unrestricted Release**. On November 26, 1997, the California DHS, RHB stated it concurred with the assessment that Building 4012 may be released without radiological restrictions.[3]

- **2001 EPA Verification Survey**. In 2001, an independent oversight verification and confirmation survey funded by the Environmental Protection Agency (EPA) was conducted to compare results against previous surveys by Rocketdyne and ORISE. The 2001 survey showed good agreement with prior surveys and results below NRC radiological limits in 2001. See table above.[4]

Radiological Use Authorizations: Use Authorization No. 026 allowed for the operation of a neutron generator in Building 4012.[5] Use Authorization No. 165 pertained to the surveillance of Building 4012.[6]

Former Radiological Burial or Disposal Locations: Contaminated items were generally placed in cardboard "ice cream" cartons, tagged for identification, and placed in collection bins outside the facility.[7]

Fuel powder and waste material were generated in the fume hood during fuel handling operations and stored in a radioactive trash barrel. An estimated 1 gram of uranium-235 (U-235) was present for every cubic foot of trash. Periodically, the contents of this barrel were sent to the RMHF for burial or recovery.[8]

Aerial Photographs: Building 4012 is first identified in a 1965 aerial photograph. It was located just south of an escarpment. Aerial photographs from 1965 and 1967 indicate an access road and disturbed ground north of Building 4012 in Subarea HSA-7. In 1967, the southwest portion of the disturbed ground area, north of and between Buildings 4013 and 4019, contains possible liquid waste. By 1972, the disturbed ground is re-vegetated, but ground scarring

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[1] Correspondence from Wong, G., Department of Health Services, Radiologic Health Branch, to Barnes, J., Boeing North America, Inc., *Reference: Boeing's Request for Concurrence in Release for Use Without Radiological Restriction, Rocketdyne Santa Susana Field Laboratory, Building T012*, dated November 26, 1997.
[2] U.S. Department of Energy, Oakland Operations Office, Environmental Restoration, *Certification Docket for the Release of Building T012 at ETEC, DOE/CD-ETEC-012*, November 26, 1997, p. 5.
[3] Vitkus, T.J. and Morton, J.R., *Verification Survey of Building T012 Santa Susana Field Laboratory, Rockwell International, Ventura County, California*, Oak Ridge Institute for Science and Education, October 1996, pgs. 4,8.
[4] Rash, M., *Final Oversight Verification and Confirmation Radiological Survey Report for Buildings T-012, T-029, and T-363*, Tetra Tech EM, Inc., December 20, 2002, pgs. 1, 35.
[5] Review of Radiation Safety Records Management System, 2010.
[6] Radiation Safety Records Management System Index, The Boeing Company, Reviewed November 8, 2010.
[7] Gavigan, F. X. et al., *Reactor Safety Survey Report, SNAP Critical Assembly -5 (SCA-5), Building 012*, February 23, 1965, pgs. 10-11.
[8] Internal Correspondence from Heneveld, W.H. to Schaubert, V.J., North American Rockwell, *Reference: SS Material Control for Bldg 012*, March 30, 1971, pgs. 3-4.

continues to be noted in aerial photographs through 2005 where the area is the subject of earth moving activity. In 1978, an open storage (OS) area, identified as OS-7, and a possible waste disposal area (WDA), identified as WDA-6, are visible north of Building 4012. A probable stain was located at the west end of OS-7. Possible solid waste debris is noted in WDA-6. By 1988, Building 4228, the new SCTI Power Pak facility, has been constructed on top of Building 4012 and a structure containing cooling fans (Building 4710) is visible to the east of Buildings 4012 and 4228. An overhead pipe is also noted near the southwest corner of Building 4228. In 1995, overhead pipes, a vertical tank, and a probable stain are identified around Building 4012 and the cooling fan structure. A stain near the south end of the cooling fan structure is also noted. By 2005, all the structures associated with Building 4012 were gone.[1]

Radionuclides of Concern: Clad reactor fuel elements (uranium zirconium hydride (U-ZrH)) were stored in the fuel storage tubes located in Room 109.[2] Radiographic sources were also stored here.[3] Radionuclides resulting from reactor operations in Building 4012 include: americium (Am-241), cesium-137 (Cs-137), plutonium isotopes (Pu-238, Pu-239, Pu-240, Pu-241), strontium-90 (Sr-90), and natural and enriched uranium (U-234, U-235, U-238).[4] All radionuclides of concern listed are included for analysis in the August 2009 *Final Field Sampling Plan, Radiological Background Study, Santa Susana Field Laboratory*. Table 3.3 presents a summary of radiological contaminants of concern.

Drainage Pathways: The general slope of Area IV, including Building 4012, is in a southerly direction. Water runoff is directed to the retention reservoirs which are part of the SSFL industrial effluent control system. Liquid effluent discharge from the final retention pond into the Bell Canyon drainage occurs only after controlled effluent holdup and sampling. The north end of Building 4012 is near the surface drainage divide for the area. North of the drainage divide, water drains northerly to Simi Valley.[5,6] Aerial photographs from 1957 to 2005 indicate that drainage followed 17th Street to the south and continued to impoundments in Areas III and IV. The Area IV impoundment is identified as IM-5 on aerial photograph analysis and as the 17th Street Drainage in this technical memorandum.[7] The 17th Street Drainage is discussed later in this section.

Radiological Contamination Potential: Class 1 because of former use of Building 4012.

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[1] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.

[2] Pascolla, A.L., *Decontamination and Decommissioning of Building T012, ETEC No. 012-AR-0001*, Boeing North American Inc., Rocketdyne Division, May 8, 1997, pgs. 3-4, 10-11.

[3] Tuttle, R.J., Listing of Locations in SSFL Area IV Associated with Radioactive Materials, September 1989, p. 5.

[4] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume I – Methodology*, May 2005, p. 2-9.

[5] Chapman, J. A., *Radiological Survey of Buildings T019 and T013; An Area Northwest of T059, T019, T013, and T012; And a Storage Yard West of Buildings T626 and T038, GEN-ZR-0010*, Rockwell International, Rocketdyne Division, August 26, 1988, p. 17.

[6] Map located at: http://www.dtsc-ssfl.com/files/maps/SSFL%20-%20Western%20Half.pdf.

[7] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.

Recommended Locations for Sediment/Soil Sampling:

Plate 1 and Figure 2.1 provide a convenient reference for the following recommendations.

Extensive soil sampling is recommended in the Building 4012 area. As discussed above, previous investigation found radiological contamination in Building 4012 and significant information is lacking regarding the excavation activities at Building 4012. In addition, previous characterization studies for the Building 4012 area were focused on delineating the extent of contamination to standards that were applicable at the time. Previous characterization studies for the Building 4012 area were focused on delineating the extent of contamination to standards that were applicable at the time and not to the standard required by the December 2010 Administrative Order on Consent. Therefore, additional characterization is recommended for the Building 4012 area. This includes the following Building 4012 areas and appurtenances:

- Former critical cell (Room 110) and fuel storage room (Room 109) in the northern Building 4012 footprint. Past contamination of these rooms may have left residual contamination in the area.

- Former radioactive waste holdup tank outside Room 104 on the south side of the Building 4012 footprint. The known radioactive waste holdup tank may have left residual contamination in the area.

- Sanitary sewer line located south of the Building 4012 footprint. If radioactive materials were released into the sewer system, residual contamination may exist in the materials inside and surrounding the sewer lines.

- Former OS-7 and possible WDA-6 identified on aerial photographs north of the Building 4012 footprint. If radioactive materials were stored or disposed in OS-7 or WDA-6, contamination could migrate and/or drain into the Building 4010 area, residual contamination may exist to the east of the building footprint.

- Drainage pathways associated with the Building 4012 area and outside Area IV as proposed by the field sampling plan. Residual contamination may exist in drainages outside of Area IV.

2.1.3 Building 4013 Area

Site Description: The Building 4013 area comprises Building 4013, Electrical Substation 4713, Time Clock 4823, Uninterruptible Power Supply (UPS) Building 4413, and the land surrounding these buildings. Building 4013 was constructed in 1962 as a non-nuclear Systems for Nuclear Auxiliary Power (SNAP) component assembly and performance testing building. A paved area northwest of the building was used for equipment staging. Building 4013 was situated near the northwest property line of Area IV. The terrain near the northern property line is very rugged and there is a 40-foot drop in elevation.[1,1,2] Figures 2.1.3a through 2.1.3i provide a current

[1] Chapman, J. A., *Radiological Survey of Buildings T019 and T013; An Area Northwest of T059, T019, T013, and T012; And a Storage Yard West of Buildings T626 and T038, GEN-ZR-0010,* Rockwell International, Rocketdyne Division, August 26, 1988, p. 10.

photograph and the best available building-specific drawing(s) and photos that the research team could find. Building 4013 was located between SNAP Critical Test Facility Buildings 4012 and 4019. Plate 1 presents a summary of all identified features for this site.

Building Features: Building 4013 was constructed with a steel frame and siding. It had a 33-foot high bay with a 5-ton bridge crane and a 15-foot low bay. The building had a total area of 8,370 square feet. Ten aboveground tanks were associated with Building 4013, nine 6,000-cubic-feet gaseous nitrogen tanks, and one 250-gallon diesel oil tank. Building 4013 had restrooms and was attached to the site sewer system that runs south of the building.[3,4,5,6] Figure 2.1.3b provides a floor plan of Building 4013. Five as-built drawings for Building 4013 are included in this section. Figure 2.1.3c is an as-built plot plan, Figure 2.1.3d is an as-built foundation plan, Figure 2.1.3e is an as-built elevation and roof plan, Figure 2.1.3f is an as-built floor plan, and Figure 2.1.3g is an as-built reactor development equipment list plan.

Former Use(s): Building 4013 was a non-nuclear component assembly and performance test building supporting the SNAP program. Assembly and checkout of the following SNAP units were accomplished in the 1960s at Building 4013: PSM-1, PSM-3, PSM-1A, FSEM-2, PSM-1B, FSM-1, FSEM-2A, FS-3, FSM-4, FS-4, and FS-5. Figure 2.1.3f depicts the assembly and support areas including: the general assembly area, electronic assembly area, "T/C" assembly area with x-ray booth, mechanical area, shop support area with welding booth, and receiving and holdup area. In 1970, Building 4013 was re-designated as the Energy Technology Engineering Center Thermal Transient Facility. Half of the high bay was used for thermal testing since that time and the other half was used for seismic test equipment.[7] Authorization for building modifications and improvements to support SNAP programs was also granted in 1970. Improvements included installation of new partitions, floor tile, ceilings, doors, air conditioning equipment, ducting, utilities, diffusers and equipment pads for clean room and low bay cooling requirements, and a new paint job.[8]

Information from Interviewees: None to date.

Radiological Incident Reports: There has been one incident associated with Building 4013. The following table provides information presented in an incidents database provided by Boeing.

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[1] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. L-11.

[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962-November 1992.

[3] *Technical Site Information, Energy Technology Engineering Center (ETEC), GEN-AT-0027, Revision B*, Rockwell International Corporation, August 1993, pgs. b-30, b-41, b-45.

[4] Chapman, J. A., *Radiological Survey of Buildings T019 and T013; An Area Northwest of T059, T019, T013, and T012; And a Storage Yard West of Buildings T626 and T038, GEN-ZR-0010*, Rockwell International, Rocketdyne Division, August 26, 1988, pgs. 10, 17, 20, 24.

[5] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. L-11.

[6] *Technical Site Information, Energy Technology Engineering Center (ETEC), GEN-AT-0027, Revision B*, Rockwell International Corporation, August 1993, pgs. b-23, b-41, b-45.

[7] Chapman, J. A., *Radiological Survey of Buildings T019 and T013; An Area Northwest of T059, T019, T013, and T012; And a Storage Yard West of Buildings T626 and T038, GEN-ZR-0010*, Rockwell International, Rocketdyne Division, August 26, 1988, pgs. 2, 10, 17, 20, 24, 92.

[8] Correspondence from Pollman, A.P., U.S. Atomic Energy Commission, to Petersen, R.C., Atomics International, *Reference: Building 013 Modifications and Improvements, SNAP, Contract AT(04-3)-701*, dated October 16, 1970.

Summaries of only the incident reports that resulted or may have resulted in releases to the environment are provided following the table, when available. Summaries of all available incident reports are provided in Attachment A.

Building 4013 Incident Report Summary

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A0369	4/9/1963	X-RAY BOOTH		INVESTIGATION OF POSSIBLE OVEREXPOSURE APPEARS TO BE A MEDICAL EXPOSURE.

Current Use: Demolished in July 2003.[1] Based on available information, the dimensions of the excavation made during building demolition are unknown. Figures 2.1.3h and 2.1.3i show photographs of Building 4013 before and after demolition.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): A chronology of radiological investigations at this building is as follows:

- **1988 Rockwell Final Status Survey**. In 1988, Rockwell/Rocketdyne performed a final status survey of Building 4013 along with Building 4019 and two adjacent areas to determine if any radioactive material remained that required further surveying or decontamination. A walk-through survey for gamma exposure rates was performed and measurements were made at 75 locations inside Building 4013. The average gamma exposure rate was 6.8 microroentgens per hour (μR/hr). This was reported as considerably lower than the outdoor "natural background" levels ranging between 14 and 16 μR/hr. The survey concluded that none of the areas were contaminated with residual radioactivity. Acceptable limits adopted by Rocketdyne for this survey were based on enriched uranium used for SNAP programs. The maximum acceptable contamination limit for total surface area averaged over 1 square meter (m^2) was 5,000 disintegrations per minute per 100 square centimeters (dpm/100 cm^2) for alpha and beta contamination. The maximum allowable contamination for a single area not more than 100 cm^2 in that 1 m^2 was 15,000 dpm/100 cm^2 for alpha and beta contamination. The removable surface contamination limit was based on a surface wipe over 100 cm^2 and was 1,000 dpm/100 cm^2 for alpha and beta contamination. Ambient gamma exposure limits were based on the U.S. Nuclear Regulatory Commission limit of 5 microroentgens per hour above background.[2]

- **1995 ORISE Verification Survey**. In 1995, the Oak Ridge Institute for Science and Education (ORISE) performed a verification survey to validate the final status survey performed by Rockwell/Rocketdyne for Building 4013. Survey tasks included document reviews, surface scans, surface activity measurements, exposure rate measurements, and soil sampling. Deficiencies were noted in Rockwell/Rocketdyne's final status documentation and recommendations for revision were provided. Total surface activity

[1] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. L-11.
[2] Chapman, J. A., *Radiological Survey of Buildings T019 and T013; An Area Northwest of T059, T019, T013, and T012; And a Storage Yard West of Buildings T626 and T038, GEN-ZR-0010,* Rockwell International, Rocketdyne Division, August 26, 1988, pgs. 10, 17, 20, 24, 28-29, 64-65.

levels in Building 4013 were less than 55 dpm/100 cm^2 for alpha contamination and less than 1,400 dpm/100 cm^2 for beta contamination. Removable activity levels were less than 12 dpm/100 cm^2 for gross alpha and less than 16 dpm/100 cm^2 for gross beta. Exposure rates inside Building 4013 ranged from 8 to 11 μR/hr while background exterior exposure rates ranged from 12 to 16 μR/hr and averaged 14 μR/hr. Soil samples taken in the storage area northwest of Building 4013 are described in the table below. Other than the U.S. Department of Energy's (DOE) generic residual soil concentration guidelines for thorium and radium of 5 picocuries per gram (pCi/g) in the first 15 centimeters of soil and 15 pCi/g in thick layers of subsurface soil, guidelines for other radionuclides are developed on a site-specific basis. There were no approved site-wide guidelines at the Santa Susana Field Laboratory for the other radionuclides of concern. As a result, this survey compared radionuclide concentrations in soils to background concentration levels. ORISE's verification results showed surface activity levels and exposure rates were less than DOE and U.S. Nuclear Regulatory Commission (NRC) guidelines for release to unrestricted use in 1995 (see surface contamination guideline table below). Radionuclide concentrations in soil were comparable to background concentrations.[1,2]

Radionuclide Concentrations Found in Northwest Area Soil Samples

Radionuclide Concentrations (pCi/g)		
Radionuclide	**Samples Collected**	**Background**
Cs-137	<0.1 to 0.5	<0.1 to 0.2
Ra-226	0.8 to 1.0	<0.2 to 1.2
Th-228	1.2 to 1.5	0.6 to 1.4
Th-232	1.5 to 1.7	0.6 to 1.7
U-235	<0.1	<0.1
U-238	<1.5 to 1.9	<2.2 to 2.5

[1] Vitkus, T.J. and Bright, T.L., *Verification Survey of the Interim Storage Facility: Buildings T030, T641, and T013; An Area Northwest of Buildings T019, T013, T012, and T029 and a Storage Yard West of Buildings T626 and T038, Santa Susana Field Laboratory, Rockwell International, Ventura County, California, ORISE 96/C-4*, Oak Ridge Institute for Science and Education, February 1996, pgs. 6,-15, 30, C-1–C-2.

[2] Correspondence from Vitkus, T.J., Oak Ridge Institute for Science and Education, to Williams, D., U.S. Department of Energy, *Reference: Comments on the Final Status Survey Documentation for the Interim Storage Facility; Building T013, T019, T024, T030, and T641; the Storage Yard West of Buildings T626 and T038; and the NW Area; Santa Susana Field Laboratory, Ventura County California*, January 11, 1966.

Surface Contamination Guidelines from DOE Order 5400.5 (1990) and NRC Regulatory Guide 1.86 (1974)

Allowable Total Residual Surface Contamination (dpm/100 cm^2)			
Radionuclides	**Average**	**Maximum**	**Removable**
Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-125, and I-129	100	300	20
Th-Natural, Th-232, Sr-90, Ra-223, Ra-224, U-232, I-126, I-131, and I-133	1,000	3,000	200
U-Natural, U-235, U-238, and associated decay products	5,000α	15,000α	1,000α
Beta-gamma emitters (radionuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above	5,000β-γ	15,000β-γ	1,000β-γ
External Gamma Radiation			
The average level of gamma radiation inside a building or habitable structure on a site that has no radiological restriction on its use shall not exceed the background level by more than 20 μR/h.			

Source: U.S. Atomic Energy Commission (now NRC) Regulatory Guide 1.86, Termination of Operating Licenses for Nuclear Reactors, June 1974, p. 1.86-5.
U.S. Department of Energy Order 5400.5, Radiation Protection of the Public and the Environment, February 8, 1990, p. IV-6.

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Location: None found.

Aerial Photographs: Building 4013 is first identified on a 1965 aerial photograph. It was located just south of an escarpment. A 1967 aerial photograph identifies probable leakage emanating from an unidentified object located at the northwest corner of Building 4013 and draining southwest between Buildings 4013 and 4019 to 20th Street. A 1972 aerial photograph notes an open storage area north of Building 4013. By 1980, five probable horizontal tanks are identified north of Building 4013. In 1988, eight probable horizontal tanks and one known horizontal tank are located north of the building. In 1995, eight horizontal tanks and an overhead pipe are noted north of the building. By 2005, Building 4013 has been demolished.[1]

Radionuclides of Concern: The research team found no evidence that nuclear or radioactive materials were known to have been handled in Building 4013.[2] Radionuclides associated with the potential migration from SNAP Buildings 4012 and 4019 include: americium (Am-241), , cesium-137 (Cs-137), plutonium isotopes (Pu-238, Pu-239, Pu-240, Pu-241), strontium-90 (Sr-90), and natural and enriched uranium (U-234, U-235, U-238).[3,1] All radionuclides of concern

[1] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.
[2] Chapman, J. A., *Radiological Survey of Buildings T019 and T013; An Area Northwest of T059, T019, T013, and T012; And a Storage Yard West of Buildings T626 and T038. GEN-ZR-0010.* Rockwell International, Rocketdyne Division, August 26, 1988, pgs. 10, 17, 20, 24.
[3] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume1 – Methodology*, May 2005, p. 2-9.

listed are included for analysis in the August 2009 *Final Field Sampling Plan, Radiological Background Study, Santa Susana Field Laboratory*. Table 3.3 presents a summary of radiological contaminants of concern.

Drainage Pathways: Storm drainage for Building 4013 follows a culvert southwest of the building to 20th Street.[2] Aerial photographs from 1965 to 2005 identify a drainage pathway that flows south from 20th Street to impoundments in Area III.[3] The general slope of Area IV, including Building 4013, is in a southerly direction. Water runoff is directed to the retention reservoirs which are part of the SSFL effluent control system. Liquid effluent discharge from the final retention pond into the Bell Canyon drainage occurs only after controlled effluent holdup and sampling. The north end of Building 4013 is near the surface drainage divide for the area. North of drainage divide, water drains northerly to Simi Valley.[4,5] Building 4013 was located west of SNAP Critical Facility Building 4012 and may have received drainage from Building 4012. Building 4013 is attached to the site sewer system.

Radiological Contamination Potential: Class 1 due to potential radioactive material migration via surface water flow or airborne release from SNAP Critical Test Facility Buildings 4012 and 4019.

Recommended Locations for Sediment/Soil Sampling:

Plate 1 and Figure 2.1 provide a convenient reference for the following recommendations.

Extensive soil sampling is recommended in the Building 4013 area. Building 4013 is located between SNAP Critical Test Facility Buildings 4012 and 4019. Consequently, potential radioactive material migration via surface water flow or airborne release from these facilities may affect Building 4013. Significant information is lacking regarding the excavation activities at Building 4013. In addition, previous characterization studies for the Building 4013 area were focused on delineating the extent of contamination to standards that were applicable at the time. Previous characterization studies for the Building 4013 area were focused on delineating the extent of contamination to standards that were applicable at the time and not to the standard required by the December 2010 Administrative Order on Consent. Therefore, additional characterization is recommended for the Building 4013 area. This includes the following Building 4013 areas:

- The area between the Building 4013 and Building 4012 footprints. Radionuclides originating from Building 4012 may have migrated to the area between buildings via surface water flow or airborne releases.

[1] Unknown Author, *Log Book, Building 4019, 1/20/64 to 6/3/65*, January 20, 1964, HDMSP001853462.
[2] *Technical Site Information, Energy Technology Engineering Center (ETEC), GEN-AT-0027, Revision B*, Rockwell International Corporation, August 1993, p. b-25.
[3] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.
[4] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.
[5] Map located at: http://www.dtsc-ssfl.com/files/maps/SSFL%20-%20Western%20Half.pdf.

- The area between the Building 4013 footprint and Building 4019. Radionuclides originating from Building 4019 may have migrated to the area between buildings via surface water flow or airborne releases.

- Sanitary sewer line south of the Building 4013 footprint. If radioactive materials were released into the sewer system, residual contamination may exist in the materials inside and surrounding the sewer lines.

- Northwest corner of the Building 4013 footprint and area between Building 4013 footprint and Building 4019 where leakage from unknown source was noted in aerial photographs.

- Area north of the Building 4013 footprint where aerial photographs note storage tanks of unknown content.

- Drainage pathways associated with the Building 4013 area and outside Area IV as proposed by the field sampling plan. Residual contamination may exist in drainages outside of Area IV.

2.1.4 Building 4019 Area

Site Description: The Building 4019 area comprised Building 4019, Electrical Substation 4719, and the land surrounding these two buildings. Building 4019 was constructed in 1962 as the Systems for Nuclear Auxiliary Power (SNAP) Flight Systems Nuclear Qualification Test Building located near the northwest property line of Area IV. Building 4019 is serviced by Electrical Substation 4719.[1] The building sits on a paved yard of asphalt concrete that extends 90 feet to the north. This yard was used for equipment staging and gas tanks.[2] Building 4019 is located between SNAP Buildings 4013 and 4059. Figures 2.1.4a through 2.1.4h provide a current photograph and the best available building-specific drawing(s) that the research team could find. Building 4013, a non-nuclear SNAP component assembly building, is discussed elsewhere in this section. SNAP 8 Development Reactor Building 4059 are discussed in the Subarea HSA-5C TM. Plate 1 presents a summary of all identified features for this site.

Building Features: Building 4019 sits on a concrete slab and has a steel frame, roof, and sides. It has a total area of 6,402 square feet. Building 4019 contains a high bay and a low-bay office-control center. The high bay is 60 feet long, 45 feet wide, and 36 feet high and contains a 10-ton crane, below-grade test cell with hydraulic lift, and an 8-foot vacuum test chamber.[3] The low bay is 60 feet long, 28 feet wide, and 10 feet high and contains the control room, personnel change room, equipment room, and offices.[4,1] Building 4019 has restrooms and air

[1] DE-AC03-98SF21530, *Environmental Restoration and Remediation of the Former Energy Technology Engineering Center*, Contract Awarded to Boeing North American, Inc., Rocketdyne Propulsion & Power, December 31, 1998, Attachment 1, Appendix 2, p. 2.
[2] Chapman, J. A., *Radiological Survey of Buildings T019 and T013; An Area Northwest of T059, T019, T013, and T012; And a Storage Yard West of Buildings T626 and T038, GEN-ZR-0010*, Rockwell International, Rocketdyne Division, August 26, 1988, pgs. 10, 17, 24.
[3] Chapman, J. A., *Radiological Survey of Buildings T019 and T013; An Area Northwest of T059, T019, T013, and T012; And a Storage Yard West of Buildings T626 and T038, GEN-ZR-0010*, Rockwell International, Rocketdyne Division, August 26, 1988, p. 17.
[4] Liddy, P., *Building 4019 Final Status Survey Report*, The Boeing Company, June 10, 1999, p. 7.

conditioning.[2] A vault (Room 109) is located in the southeast corner of the high bay measuring 12 feet long, 10 feet wide, and 10 feet high. It was originally built with cinder block walls for nuclear fuel element storage. The reactor test chamber in the high bay floor is 12 feet in diameter and 40 feet deep.[3,4]

A description of auxiliary systems in Building 4019 included a liquid radioactive waste system that involved accumulating waste from the vault sump and the change room sink and floor drain in the radioactive waste holdup tank.[5] The as-built plumbing plan identifies floor drains, pumps, and tanks. In 1964, the plumbing plan indicates that a circulating pump and sump pump were added to the vault underneath the change room (Room 107). The circulating pump was part of a waste survey tank (radioactive waste holdup tank) that was connected to the sump pump and change room shower drain. In 1973, three floor drains in the change room and two floor drains in the control room were deactivated, and the shower and lavatory in the change room were removed.[6] In 1993, the waste survey tank was found deteriorated and partially submerged in water that filled the tank vault. Possible sources of the water included the emergency safety shower adjacent to the vault, rainwater runoff, or percolation of groundwater through the containment wall. The tank was estimated to have a capacity of 500 gallons.[7] The vault water and tank contents were analyzed for radiological and chemical contamination and none was found.[8] The tank removal plan called for removing the tank and associated piping, sealing a 4-inch open sewer main, backfilling the vault space, and capping the vault with a concrete slab.[9]

A 300-gallon aboveground deionized water tank was associated with Building 4019. A sanitary sewer line is identified forming a "T" directly south of Building 4019.[10]

Figure 2.1.4b provides a floor plan of Building 4019. Six as-built drawings for Building 4019 are also included in this section. Figure 2.1.4c is an as-built plot plan, Figure 2.1.4d is an as-built foundation plan, Figure 2.1.4e is an as-built floor plan, Figure 2.1.4f is an as-built section drawing, Figure 2.1.4g is an as-built heat, ventilation, and air conditioning section drawing, and Figure 2.1.4h is an as-built plumbing plan for Building 4019.

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[1] Jaquay, K., *Final Report Decontamination and Dismantlement Operations at SSFL Building 4019 for Release Without Radiological Restrictions*, The Boeing Company, September 11, 1999, p. 16.
[2] *Technical Site Information, Energy Technology Engineering Center (ETEC), GEN-AT-0027, Revision B*, Rockwell International Corporation, August 1993, p. b-30.
[3] Chapman, J. A., *Radiological Survey of Buildings T019 and T013; An Area Northwest of T059, T019, T013, and T012; And a Storage Yard West of Buildings T626 and T038, GEN-ZR-0010*, Rockwell International, Rocketdyne Division, August 26, 1988, p. 17.
[4] Liddy, P., *Building 4019 Final Status Survey Report*, The Boeing Company, June 10, 1999, p. 7.
[5] Operating Limits, SNAP 10 A Flight Systems in the Acceptance Test Facility (Building 019), Enclosure to 64AT-6960, p. 6.
[6] Norman Engineering Co., *Building 019, SNAP Flight Systems Prototype, Nuclear Test Facility, Plumbing Plans and Details, 303-019-M3, Rev. 7*, September 8, 1961.
[7] Internal correspondence from Ingersoll, R.D. to DeBear, W.S., Rockwell International, *Reference: Notification Unreported Underground Tank, Rocketdyne Facilities Engineering Environmental Tasks*, dated December 22, 1993.
[8] Internal correspondence from Lenox, A.J. to Ingersoll, R., Rockwell International, *Reference: Building 19 Underground Storage Tank*, dated July 12, 1994.
[9] Internal correspondence from Ingersoll, R.D., Rockwell to Gaylord, G.G., Rockwell International, *Reference: Removal Plan - Underground Water Storage Tank, Building 019*, dated October 13, 1994.
[10] *Technical Site Information, Energy Technology Engineering Center (ETEC), GEN-AT-0027, Revision B*, Rockwell International Corporation, August 1993, pgs. b-23, b-41, b-45.

Former Use(s): Building 4019 was built to conduct criticality acceptance tests of SNAP reactors before they were delivered to the Atomic Energy Commission for launch as space power systems. The criticality tests of the S10FS3 reactor were conducted in Building 4019 in 1963 before the reactor was operated in the SNAP Environmental Test Facility (Building 4024).[1] In 1964 and 1965, three SNAP 10A flight systems, FS-1, FS-4, and FS-5, were assembled and tested in Building 4019. The total time spent by any flight system in Building 4019 was less than four months, and the reactor operation was less than 16 hours total for any flight system. Radiation exposure to the test facility was reported to be minor.[2] According to The Boeing Company, all nuclear materials were removed from the building when the last SNAP reactor was removed in 1965 and the facility was used for other purposes during the 1970s and 1980s.[3] However, a 1968 letter indicates that fissile materials were being stored in Building 4019.[4] According to the U.S. Nuclear Regulatory Commission (NRC), fissile material is any "nuclide that is capable of undergoing fission after capturing low-energy thermal (slow) neutrons." This current definition means the "three primary fissile materials are uranium-233, uranium-235, and plutonium-239. This definition excludes natural and depleted uranium that has not been irradiated, or has only been irradiated in thermal reactors."[5] Upon termination of the SNAP program in 1970, all SNAP components were removed. Building 4019 was re-designated the Energy Technology Engineering Center (ETEC) Construction Staging and Computer Facility.[6]

Information from Interviewees: A number of former employees were interviewed about their experience at the SSFL. Two remembered Building 4019. Excerpts from these interviews are included below.

Interviewee 195 started working in Area IV on the hill in 1968 at the Building 355 and later went into other buildings like Building 19, Building 4013, Building 59, and the infamous sodium burn pit. The following excerpt was pulled from the interview.

> *"Also I worked in Building 19 where they built the "snubbers"—shock absorbers —great big rubber donuts that they put under pavement for earthquakes. This work was done for the highway commission. When they cleaned up Building 19 they had a lot of hydraulic lines."*[7]

Interviewee 427 worked for Atomics International beginning in June 1957 and was initially assigned as a test engineer to the pyroprocessing refabrication experiment and later went on to work on zirconium hydride reactor systems at the Santa Susana Field Laboratory. The following excerpts were pulled from the interview.

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[1] The Boeing Company, Rocketdyne Environmental Affairs, *Building 4019 – SNAP Flight System Critical Facility*, January 8, 2003, p. 1.
[2] Jaquay, K., *Final Report Decontamination and Dismantlement Operations at SSFL Building 4019 for Release Without Radiological Restrictions*, The Boeing Company, September 11, 1999, pgs. 16, 19.
[3] The Boeing Company, Rocketdyne Environmental Affairs, *Building 4019 – SNAP Flight System Critical Facility*, January 8, 2003, p. 1.
[4] Internal correspondence from Bunch, D.F. to Alexander, R.E., Atomics International, a Division of North American Aviation, Inc., *Reference: Emergency Preparedness Meeting with SAN Personnel*, dated January 25, 1968.
[5] "Fissile Material," U.S. Nuclear Regulatory Commission, http://www.nrc.gov/reading-rm/basic-ref/glossary/fissile-material.html (August 2, 2010).
[6] Liddy, P., *Building 4019 Final Status Survey Report*, The Boeing Company, June 10, 1999, p. 7.
[7] Interview No. 195 conducted by DOE in 2010.

"I was involved with nuclear acceptance testing prior to mating the SNAP 10A to a launch vehicle. The first Flight System (FS-1) was tested quite thoroughly to see if it was acceptable for launch vehicle integration, for launch, and for orbital startup. It was installed in an underground vacuum chamber in Building 19 and had a nuclear fuel loading in the core. The system had to be raised to operating temperatures by heating the return piping. In the process of running the test, NaK leaked into the vacuum chamber from a failed expansion compensator. The vacuum chamber was then filled with inert argon to enable removing the system to determine where the failure had occurred and what repairs could be made.

The firemen started spraying the smoking NaK with their hose to try to keep it cold! A very, very wrong thing to do with liquid NaK. Instead, they started a real uncontrollable fire. Normally, we would throw chemicals on the NaK liquid to slow down the reaction until the liquid could be scoped up and put into a safe container. The firemen didn't know the right NaK fire fighting procedures or the proper procedures for containment of spilled NaK. At that moment, FS-1 could not be repaired and became unusable scrap!

The DOE representative had a sidekick, RTV, who said it was an act of sabotage, but it was really a design flaw in the expansion compensator, which were small thin metal bellows that required many difficult welds. The multiple welds weakened the bellows which caused the failure, and that's why FS-1 was scrapped. The nuclear fuel was removed and returned to safe storage.

Flight System 4 (FS-4) became the launch system and we repeated the process with a revised container around the bellows so that if the NaK leaked, it would be contained.

The test was re-done, the temperature was increased but could only go up to operating temperature a few times because the resistance heaters had a finite life. The first time the system temperature was increased, the converter shorted out and produced no electricity. Analytical tests were performed and people from DeSoto were involved and they couldn't find the failure (i.e., the short). It shorted when the temperature went up and came back when the temperature went down. The launch date was less than one month away so what do we do?

I got on a ladder and sat on the top of the vacuum chamber and looked through the little windows to see if I could see a spark and find where the short was located. A second person also looked for the spark, and we both found it in the exact same spot, (on top of the converter in the space between the radiator and the structure). We removed the vacuum chamber and placed a ladder against the radiation shield and found the arcing spot. Because we had a launch date coming up, we fixed the short ourselves by cutting off a small insignificant part of the converter radiator. Then we completed the test and shipped FS-4 off to the launch site to be launched on 13:24 PST on 3 April 1965. -----FS-4 became an American Legacy!" [1]

[1] Interview No. 427 conducted by DOE in 2010.

Radiological Incident Reports: There has been one incident associated with Building 4019. The following table provides information presented in an incidents database provided by Boeing. Summaries of only the incident reports that resulted or may have resulted in releases to the environment are provided following the table, when available. Summaries of all available incident reports are provided in Attachment A.

Building 4019 Incident Report Summary

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A0304	4/10/1976	LARGE TANK	Ir-192	STUCK GAMMAGRAPH SOURCE UNCOUPLED BY UNBADGED OPERATOR.

- According to a 1988 Rockwell report, no major contamination incidents are known to have occurred in Building 4019. No fission product releases occurred and facility activation by neutrons was negligible.[1]

In addition to the incidents listed in Boeing's database, the following sodium potassium (NaK) incidents were noted in a 1964 log book.

- On June 23, 1964, a NaK leak detector alarm went off while testing SNAP 10AFSI. The following day, NaK was noticed inside the vacuum chamber, with the highest concentration of NaK around the instrument compartment. On June 25, 1964, the "vacuum chamber center section was raised above floor level…to observe NaK from the spill." The next day the SNAP 10 FSI unit was out of the vacuum center section, approximately 6 feet above the high bay floor. People were taking pictures, but only one was wearing the proper NaK protective clothing.[2]

- On June 29, 1964, a NaK fire was observed inside the "A.P.V." of Building 4019. According to a log book, "the NaK fire looked quite large and close to out of control. 3 or 4 metal-X extinguishers were emptied before control was attained." A large amount of NaK was pouring out of the instrument compartment and a fireman on duty assumed it was coming from the "Rx coolant system." The expansion compensater, which was discovered to be the source of the NaK leak, was cut out of the "Rx coolant system." The following day was spent cleaning up from the fire.[3]

Current Use: Building 4019 has been declared free from contamination, but has yet to be demolished as of 2010.[4]

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[1] Chapman, J. A., *Radiological Survey of Buildings T019 and T013; An Area Northwest of T059, T019, T013, and T012; And a Storage Yard West of Buildings T626 and T038, GEN-ZR-0010*, Rockwell International, Rocketdyne Division, August 26, 1988, pgs. 10, 24.

[2] Unknown Author, *Log Book, Building 4019, 1/20/64 to 6/3/65*, January 20, 1964, HDMSP001853466-HDMSP001853468.

[3] Unknown Author, *Log Book, Building 4019, 1/20/64 to 6/3/65*, January 20, 1964, HDMSP001853466-HDMSP001853468.

[4] The Boeing Company, Santa Susana Field Laboratory, *Site Environmental Report for Calendar Year 2008 DOE Operations at The Boeing Company Santa Susana Field Laboratory Area IV*, September 2009, p. 2-4.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): A chronology of radiological investigations at this building is as follows:

- **1970 SNAP Component Removal**. Upon termination of the SNAP program in 1970, the SNAP components were removed from the building and disposed. A radiation survey was performed to ensure no residual radioactivity existed.[1]

- **1988 Rocketdyne Radiological Survey**. In 1988, Rocketdyne performed a radiological survey of Building 4019 along with Building 4013 and two adjacent areas to determine if any radioactive material remained that required further surveying or decontamination. A walk-through survey for gamma exposure rates was performed and measurements were made at 46 initial locations inside Building 4019. Analysis of initial data showed one outlier obtained in the northwest corner of the high bay. An additional 21 exposure rate measurements and beta surface activity measurements were performed to verify that the outlier was an anomaly. The average gamma exposure rate of the initial 46 locations was 7.6 microroentgens per hour (μR/hr). The average for the total 67 measurements was 7.8 μR/hr. The average exposure rate calculated for indoor samples was reported as considerably lower than the outdoor "natural background" levels ranging between 14 and 16 μR/hr. An average ambient gamma exposure rate corrected for background was 0.04 ± 1.09 μR/hr, which is less than the 5 μR/hr acceptable limit. The Building 4019 vault was handled as a separate data set because of its dissimilar construction and resultant effect on exposure rates. Ten gamma exposure rate measurements were taken in the vault with an average of 12.4 μR/hr. According to the survey report, this elevated rate was attributed to primordial isotopes in the building material and no further investigation was required. The survey concluded that none of the areas were contaminated with residual radioactivity. Acceptable limits adopted by Rocketdyne for this survey were based on enriched uranium used for SNAP programs. The maximum acceptable contamination limit for total surface area averaged over 1 square meter (m^2) was 5,000 disintegrations per minute per 100 square centimeters (dpm/100 cm^2) for alpha and beta contamination. The maximum allowable contamination for a single area not more than 100 cm^2 in that 1 m^2 was 15,000 dpm/100 cm^2 for alpha and beta contamination. The removable surface contamination limit was based on a surface wipe over 100 cm^2 and was 1,000 dpm/100 cm^2 for alpha and beta contamination. Ambient gamma exposure limits were based on the NRC limit of 5 μR/hr above background.[2]

- **1995 ORISE Verification Survey**. In 1995, the Oak Ridge Institute for Science and Education (ORISE) performed verification survey activities to validate cleanup procedures and survey methods used by Rocketdyne. The verification survey found residual beta-gamma surface contamination in excess of U.S. Department of Energy (DOE) guidelines in a 1-square-meter area of the high bay. The average beta-gamma total surface activity was 5,900 dpm/100cm^2, exceeding the DOE limit of 5,000 dpm/100cm^2. This result combined with other deficiencies, including lack of access to

[1] Chapman, J. A., *Radiological Survey of Buildings T019 and T013; An Area Northwest of T059, T019, T013, and T012; And a Storage Yard West of Buildings T626 and T038, GEN-ZR-0010*, Rockwell International, Rocketdyne Division, August 26, 1988, pgs. 2, 24, 29.

[2] Chapman, J. A., *Radiological Survey of Buildings T019 and T013; An Area Northwest of T059, T019, T013, and T012; And a Storage Yard West of Buildings T626 and T038, GEN-ZR-0010,* Rockwell International, Rocketdyne Division, August 26, 1988, pgs. 2, 10, 17, 20, 24, 28-29, 64-65.

the Building 4019 vault and inadequate documentation of previous surveys, led ORISE to recommend additional decontamination and surveys.[1]

- **1998 Boeing Final Status Survey**. In September 1998, Boeing conducted comprehensive decontamination and decommissioning efforts and a final status survey of Building 4019. Direct, qualitative alpha and beta-gamma scans followed by selected cumulative counts and smear surveys were conducted in the high bay, reactor test chamber, vault room, equipment room, and office areas to confirm that no contamination existed above regulatory limits. The highest quantitative total alpha measurement found was 13 dpm/100 cm^2 and the highest quantitative total beta measurement was 961 dpm/100 cm^2. These measurements are below the 5,000 dpm/100 cm^2 limit for fixed contamination. The highest removable alpha contamination found was 6 dpm/100 cm^2 and the highest removal beta found was 12 dpm/100 cm^2. These measurements are below the 1,000 dpm/100 cm^2 removable contamination limit. The high bay floor area identified above radiological limits in the 1995 ORISE survey was scabbled and samples were taken. The highest cesium-137 (Cs-137) was 1.8 pCi/g. This area was remediated and the debris was disposed of as radioactive waste. No cobalt-60 (Co-60) was detected. This survey confirmed that the facility met DOE and State of California guidelines for unrestricted use in 1998.[2]

- **1998 ORISE Re-Verification Survey**. In September 1998, ORISE performed a re-verification of Building 4019 that included surveys of both the test vault and the previously identified contaminated area in the high bay. All surface activity levels satisfied DOE and U.S. Nuclear Regulatory Commission (NRC) guidelines in 1998 (see the table below).[3]

Surface Contamination Guidelines from DOE Order 5400.5 (1990) and NRC Regulatory Guide 1.86 (1974)

Allowable Total Residual Surface Contamination (dpm/100 cm^2)			
Radionuclides	**Average**	**Maximum**	**Removable**
Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-125, and I-129	100	300	20
Th-Natural, Th-232, Sr-90, Ra-223, Ra-224, U-232, I-126, I-131, and I-133	1,000	3,000	200
U-Natural, U-235, U-238, and associated decay products	5,000α	15,000α	1,000α
Beta-gamma emitters (radionuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above	5,000β-γ	15,000β-γ	1,000β-γ

[1] Vitkus, T.J. and Bright, T.L., *Verification Survey of Buildings T019 and T024 Santa Susana Field Laboratory, Rockwell International, Ventura County, California*, Oak Ridge Institute for Science and Education, February 1996, pgs. 4, 8-9, 12, 14.
[2] Liddy, P., *Building 4019 Final Status Survey Report*, The Boeing Company, June 10, 1999, p. 4.
[3] Vitkus, T., *Addendum to the Verification Survey Report for Building T019 and T024, Santa Susana Field Laboratory, Ventura County, California (ORISE 1996a)*, Oak Ridge Institute for Science and Education, February 16, 1999, pgs. 2-3.

External Gamma Radiation			
The average level of gamma radiation inside a building or habitable structure on a site that has no radiological restriction on its use shall not exceed the background level by more than 20 μR/h.			

Source: U.S. Atomic Energy Commission (now NRC) Regulatory Guide 1.86, Termination of Operating Licenses for Nuclear Reactors, June 1974, p. 1.86-5.
U.S. Department of Energy Order 5400.5, Radiation Protection of the Public and the Environment, February 8, 1990, p. IV-6.

- **1998 California DHS Verification Survey**. In October 1998, the California Department of Health Services (DHS) performed a verification survey.[1]

- **2001 EPA Verification Survey**. In October 2001, an independent oversight verification and confirmation survey funded by the Environmental Protection Agency was conducted to compare results against previous surveys by Rocketdyne/Boeing and ORISE. The 2001 survey showed results below NRC radiological limits in 2001 (see table above) and confirmed the conclusions reached by both Rocketdyne/Boeing and ORISE.[2]

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Location: None found.

Aerial Photographs: Building 4019 was first identified on a 1965 aerial photograph. A 1967 aerial photograph identifies probable leakage emanating from the northwest corner of Building 4013 and draining southwest between Buildings 4013 and 4019 to 20th Street. A 1972 aerial photograph notes an open storage (OS) area north of Building 4019. In 1978, the open storage is identified as OS-10 and contains a probable stain and two vertical tanks. The stain and vertical tanks are noted with varying degrees of certainty in 1980, 1988, and 1995. By 2005, Building 4019 is the only structure still standing in the immediate vicinity. A probable stain, first identified in 2002, is located near the northwest corner of Building 4019.[3]

Radionuclides of Concern: Totally encapsulated highly enriched uranium was handled in Building 4019. Radionuclides resulting from reactor operations in Building 4019 include: americium-241 (Am-241), Cs-137, plutonium isotopes (Pu-238, Pu-239, Pu-240, Pu-241), strontium-90 (Sr-90), and natural and enriched uranium (U-234, U-235, U-238).[4] All radionuclides of concern listed are included for analysis in the August 2009 *Final Field Sampling Plan, Radiological Background Study, Santa Susana Field Laboratory.* Table 3.3 presents a summary of radiological contaminants of concern.

[1] The Boeing Company, Rocketdyne Environmental Affairs, *Building 4019 – SNAP Flight System Critical Facility*, January 8, 2003, pgs. 1-2.
[2] Rash, M., *Final Oversight Verification and Confirmation Radiological Survey Report for Buildings T-011, T-019, T-055, and T-100*, Tetra Tech EM, Inc., December 20, 2002, pgs. 1, 26.
[3] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.
[4] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume1 – Methodology*, May 2005, p. 2-9.

Drainage Pathways: Storm drainage for Building 4019 follows a culvert south of the building to 20th Street.[1] Aerial photographs from 1965 to 2005 identify a drainage pathway that flows south from 20th Street to impoundments in Area III.[2] The general slope of Area IV, including Building 4019, is in a southerly direction. Water runoff is directed to the retention reservoirs which are part of the SSFL industrial effluent control system. Liquid effluent discharge from the final retention pond into the Bell Canyon drainage occurs only after controlled effluent holdup and sampling. The north end of Building 4019 is near the surface drainage divide for the area. North of drainage divide, water drains northerly to Simi Valley.[3,4]

Radiological Contamination Potential: Class 1 because of former use of Building 4019.
Recommended Locations for Sediment/Soil Sampling:

Plate 1 and Figure 2.1 provide a convenient reference for the following recommendations.

Extensive soil sampling is recommended in the Building 4019 area. As discussed above, previous investigation found radiological contamination in Building 4019 and characterization studies for the Building 4019 area were focused on delineating the extent of contamination to standards that were applicable at the time. Previous characterization studies for the Building 4019 area were focused on delineating the extent of contamination to standards that were applicable at the time and not to the standard required by the December 2010 Administrative Order on Consent. Therefore, additional characterization is recommended for the Building 4019 area. This includes the following Building 4019 areas and appurtenances:

- Former test vault location in the central portion of Building 4019. Past use of the vault may have left residual contamination in the area.

- Former waste holdup tank and vault located under Room 107 at south end of Building 4019. The known radioactive waste holdup tank may have left residual contamination in the area.

- Drain and pump locations identified in the as-built plumbing plan of Building 4019. If radioactive materials were released into the building drains, residual contamination may be in the area.

- Sanitary sewer line south of Building 4019. If radioactive materials were released into the sewer system, residual contamination may exist in the materials inside and surrounding the sewer lines.

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[1] *Technical Site Information, Energy Technology Engineering Center (ETEC), GEN-AT-0027, Revision B*, Rockwell International Corporation, August 1993, p. b-25.
[2] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.
[3] Chapman, J. A., *Radiological Survey of Buildings T019 and T013; An Area Northwest of T059, T019, T013, and T012; And a Storage Yard West of Buildings T626 and T038, GEN-ZR-0010,* Rockwell International, Rocketdyne Division, August 26, 1988, p. 17.
[4] Map located at: http://dtsc-ssfl.com/files/maps/SSFL%20-%20Western%20Half.pdf.

- Storm drainage south of the Building 4019. Storm water originating from Building 4019 discharges into this storm drain. Consequently, this storm drain may provide a pathway for the migration of radionuclides from Building 4019 and residual contamination may be in the area.

- Area north and west of Building 4019 where staining from unknown source was noted in aerial photograph.

- Area between Building 4013 footprint and Building 4019 where leakage from an unknown source was noted in aerial photographs.

- The area between Building 4019 and the Building 4059 footprint. Radionuclides originating from either building may have migrated to the area between buildings via surface water flow or airborne releases.

- Drainage pathways associated with the Building 4019 area and outside Area IV as proposed by the field sampling plan. Residual contamination may exist in drainages outside of Area IV.

2.1.5 Building 4025 Area

Site Description: The Building 4025 area comprises Building 4025, Electrical Substations 4725 and 4924, Mechanical Equipment Slab 4925, Sodium Reactor Experiment Mock-Up Equipment Building 4926, and the land surrounding these buildings.[1] Building 4025 was constructed in 1959 as the Remote Handling Mock-Up Building to support Systems for Nuclear Auxiliary Power (SNAP) reactor tests. It was designated a non-nuclear facility.[2,3] Figures 2.1.5a through 2.1.5b provide a current photograph and the best available building-specific drawing(s) that the research team could find. Building 4025 was located on B Street north of Sodium Laboratory Building 4006 and west of SNAP Environmental Test Facility Building 4024. Building 4006 is discussed elsewhere in this section. Building 4024 is discussed in the Subarea HSA-5A TM. No as-built drawings were located for Building 4025. Plate 1 presents a summary of all identified features for this site.

Building Features: Building 4025 measured 5,595 square feet and consisted of a low bay, middle bay, and high bay. The building was constructed with a steel frame, roof, and siding. Ceiling heights were 9 feet, 20 feet, and 35.5 feet, respectively. Two 2-ton bridge cranes were located at the building, as was a restroom.[4,5,6] Figure 2.1.5b provides a floor plan for Building

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[1] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.

[2] Chapman, J. A., *Radiological Survey of Buildings T049, T042, T027, T032, and T025, GEN-ZR-0013*, Rockwell International, Rocketdyne Division, August 8, 1988, pgs. 9, 17, 22, 24, 26, 31, 35, 109-114, 119-120.

[3] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. J-13.

[4] Chapman, J. A., *Radiological Survey of Buildings T049, T042, T027, T032, and T025, GEN-ZR-0013*, Rockwell International, Rocketdyne Division, August 8, 1988, p. 22.

[5] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. J-13.

[6] *Technical Site Information, Energy Technology Engineering Center (ETEC), GEN-AT-0027, Revision B*, Rockwell International Corporation, August 1993, p. b-31.

4025. This floor plan depicts a pit at the southern end of the middle bay.[1] No other information has been located on this pit. A 1999 letter regarding demolition notes that Building 4025 will be removed and includes the following two tasks: "Excavate pits that are backfilled at B4025" and "Backfill and compact to 90% pits at B4025."[2] Another 1999 demolition letter notes that Building 4025 has a standard foundation with two 10-foot by 10-foot pits.[3] Further details on these pits are not known at this time. A demolition checklist contains hand written notes indicating Building 4025 may have had an underground storage tank (UST). Geophysical surveys did not identify a tank so it was either never present or was removed. The notes suggest drawings depict this UST.[4] No such drawings have been located to date.

A sanitary sewer line is identified north of Building 4025 with flow in the sewer line directed to the west.[5]

Former Use(s): Building 4025 was used as the Remote Handling Mock-Up Building through 1970 for remote handling and viewing of mock-up work in support of SNAP 2/10A tests, SNAP 8 tests, and other nuclear reactor tests. Following cancellation of the SNAP program in 1970, Building 4025 was designated the Energy Technology Engineering Center Instrumentation and Inventory Building and was used for component assembly, storage, and instrumentation work at least through mid-1988. An outside area surrounding Building 4025 was used as a storage yard for salvageable materials and scrap components in 1988.[6]

Information from Interviewees: None to date.

Radiological Incident Reports: There has been one incident associated with Building 4025. The following table provides information presented in an incidents database provided by Boeing. Summaries of only the incident reports that resulted or may have resulted in releases to the environment are provided following the table, when available. Summaries of all available incident reports are provided in Attachment A.

Building 4025 Incident Report Summary

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A0306	11/16/1979	SHIELDED AREA	Co-60	OFF SCALE DOSIMETER DURING GAMMAGRAPH OPERATION.

[1] Chapman, J. A., *Radiological Survey of Buildings T049, T042, T027, T032, and T025, GEN-ZR-0013*, Rockwell International, Rocketdyne Division, August 8, 1988, p. 24.
[2] Correspondence from McLain, S., G.D. Heil, Inc., to Mitchell, M., The Boeing Company, *Reference: ITB No. 503818, Demolition of 8 Buildings, Rocketdyne SSFL*, June 8, 1999.
[3] Correspondence from Ramirez, P.B., Boeing, Rocketdyne Propulsion & Power, to Laughlin, R., Ventura County Resource Management Agency Planning Division, *Reference: ETEC Demolition Projects, ETEC Site, Area IV, Santa Susana Field Laboratory*, June 23, 1999.
[4] Lenox, A., *SHEA Building Demolition Assessment Checklist (Refer to Demo Team Scope of Work)*, The Boeing Company, April 3, 2000.
[5] *Technical Site Information, Energy Technology Engineering Center (ETEC), GEN-AT-0027, Revision B*, Rockwell International Corporation, August 1993, p. b-23.
[6] Chapman, J. A., *Radiological Survey of Buildings T049, T042, T027, T032, and T025, GEN-ZR-0013*, Rockwell International, Rocketdyne Division, August 8, 1988, p. 31.

Current Use: Demolished in September 1999.[1] Based on available information, the dimensions of the excavation made during building demolition are unknown.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): In 1988, Rockwell/Rocketdyne performed a radiological survey of Building 4025 and the surrounding parking lot/storage area outside the building. During this survey, background radiation levels were found to vary considerably and had to be statistically corrected. The most important factor influencing ambient background radiation conditions around Building 4025 was its close proximity to the Radioactive Material Handling Facility (RMHF), which stored high levels of radioactive material. The exterior storage yard was approximately 200 feet from RMHF Building 4075. After correcting for background radiation, the survey concluded that no residual radioactivity was found above Nuclear Regulatory Commission acceptance limits of 5 microroentgens per hour in 1988.[2]

Radiological Use Authorizations: None found.
Former Radiological Burial or Disposal Location: None found.

Aerial Photographs: Building 4025 is first identified in a 1959 aerial photograph. In 1967, a possible pipeline is noted at the south side of the building. A drainage pathway and open storage (OS) area, denoted OS-2, is identified north of the building. OS-2 contained a stain in 1967. The drainage pathway and OS-2 were still visible in 1972, but not in 1978. In 1980, OS-2 was visible with a possible stain. In 2005, a ground scar is noted where Building 4025 used to exist.[3]

Radionuclides of Concern: Building 4025 was not known to have handled or stored radioactive materials. Residual radioactivity was not suspected in Building 4025 during a 1988 radiological survey.[4] However, a radiological incident report described below indicates a Co-60 source. This suggests other sealed source use in the building. Radionuclides associated with potential migration from RMHF Contaminated Equipment Storage Building 4075 include: isotopes of uranium, thorium, and plutonium; and mixed fission products.[5] Radionuclides associated with nearby SNAP Building 4024 include: americium-241 (Am-241), cesium-137 (Cs-137), Co-60, europium isotopes (Eu-152, Eu-154), isotopes of plutonium (Pu-238, Pu-239, Pu-240, Pu-241), strontium-90 (Sr-90), tritiated titantium (H-3), and natural and enriched uranium (U-234, U-235, U-238).[6] All radionuclides of concern listed are included for analysis in the August 2009 *Final Field Sampling Plan, Radiological Background Study, Santa Susana Field Laboratory*. Table 3.3 presents a summary of the radiological contaminants of concern.

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[1] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, pgs. J-13–J-14.
[2] Chapman, J. A., Radiological Survey of Buildings T049, T042, T027, T032, and T025, GEN-ZR-0013, Rockwell International, Rocketdyne Division, August 8, 1988.
[3] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.
[4] Chapman, J. A., Radiological Survey of Buildings T049, T042, T027, T032, and T025, GEN-ZR-0013, Rockwell International, Rocketdyne Division, August 8, 1988, p. 31.
[5] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. 1-17.
[6] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 1 – Methodology*, May 2005, p. 2-9.

Drainage Pathways: Storm drainage for Building 4025 follows a culvert south of the building to 17th Street.[1] Aerial photographs from 1957 to 2005 indicate that drainage followed 17th Street to the south and continued to impoundments in Areas III and IV. The Area IV impoundment is identified as IM-5 on aerial photograph analysis and as the 17th Street Drainage in this technical memorandum.[2] The 17th Street Drainage is discussed later in this section. The general slope of Area IV is in a southerly direction. Water runoff is directed to the retention reservoirs which are part of the SSFL industrial effluent control system. Liquid effluent discharge from the final retention pond into the Bell Canyon drainage occurs only after controlled effluent holdup and sampling.[3] Building 4025 was located south of RMHF Building 4075 and may have received drainage from Building 4075.

Radiological Contamination Potential: Class 1 because of proximity to SNAP Building 4024, RMHF Building 4075, and OS-2 and the potential of radioactive material migration via surface water flow or airborne release from these buildings.

Recommended Locations for Sediment/Soil Sampling:

Plate 1 and Figure 2.1 provide a convenient reference for the following recommendations.

Due to the potential radioactive material migration via surface water flow or airborne release from SNAP Building 4024 and RMHF Building 4075, there is a possibility that residual contamination in the Building 4025 area will exceed the standard required by the December 2010 Administrative Order on Consent. Therefore, additional characterization is recommended for the Building 4025 area. This includes the following Building 4025 areas:

- Pit area located at the southern end of the middle bay in the Building 4025 footprint. Lack of excavation and backfill information requires this area be examined for residual contamination.

- Pits discussed in demolition correspondence if locations can be determined. Lack of excavation and backfill information requires this area be examined for residual contamination.

- Possible UST, if location can be determined. A UST of unknown content may be a source of residual contamination.

- Area south of the Building 4025 footprint where a possible pipeline is noted in aerial photographs. If radioactive materials were released into the pipeline, residual contamination may exist in the materials surrounding the pipeline.

[1] *Technical Site Information, Energy Technology Engineering Center (ETEC), GEN-AT-0027, Revision B*, Rockwell International Corporation, August 1993, p. b-25.
[2] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.
[3] Chapman, J. A., Radiological Survey of Buildings T049, T042, T027, T032, and T025, GEN-ZR-0013, Rockwell International, Rocketdyne Division, August 8, 1988, p. 17.

- Sanitary sewer line north of the Building 4025 footprint. If radioactive materials were released into the sewer system, residual contamination may exist in the materials inside and surrounding the sewer lines.

- Storm drainage south of the Building 4025 footprint. Storm water originating from Building 4075 or OS-2 could discharge into this storm drain. Consequently, this storm drain may provide a pathway for the migration of radionuclides from these areas and residual contamination may be in the area.

- Drainage pathway and OS-2 north of the Building 4025 footprint where an unknown stain was identified in aerial photographs. If radioactive materials were released from OS-2, this drainage may provide a pathway for the migration of radionuclides from these areas and residual contamination may be in the area.

- Drainage pathways associated with the Building 4025 area and outside Area IV as proposed by the field sampling plan. Residual contamination may exist in drainages outside of Area IV.

2.1.6 Building 4228 Area

Site Description: The Building 4228 area comprises the Building 4228 complex and surrounding land near the northwest property line of Area IV. The Building 4228 complex includes Building 4228, Electrical Substation 4708, Electrical Equipment Pads 4807 and 4808, Air Blast Heat Exchanger Pad 4809, and Sodium Component Test Installation (SCTI) Power Pak Cooling Tower 4710. Building 4228 was constructed in the early 1980s as the SCTI Power Pak Facility. The northwest end of Building 4228 was built on top of the Systems for Nuclear Auxiliary Power (SNAP) Critical Test Facility Building 4012.[1,2] Figure 2.1.6a provides a current photograph. The research team was unable to find building-specific drawing(s). Building 4228 was located east of SNAP Non-Nuclear Component Assembly Building 4013 and west of former SNAP 8 Experimental Reactor Building 4010. Buildings 4010, 4012, and 4013 (including Buildings 4413 and 4823) are discussed elsewhere in this section. No as-built drawings were located for Building 4228. Plate 1 presents a summary of all identified features for this site.

Building Features: A sanitary sewer map shows a sewer line that appears to be located south of the Building 4228 footprint. Building 4228 was associated with 10 aboveground tanks ranging in size from 55 gallons to 20,000 gallons. Contents included oil, morpholine, sulphuric acid, deionized water, polyphosphate, and hydrazine. Secondary containment for the 55-gallon hydrazine tank was an open concrete pit.[3] It is not known exactly where this pit was located.

Former Use(s): Building 4228 has been identified as the Power Pak facility and the SCTI Co-Generation Plant. This technical memorandum will refer to Building 4228 as the SCTI Power

[1] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. L-21.
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[3] *Technical Site Information, Energy Technology Engineering Center (ETEC), GEN-AT-0027, Revision B*, Rockwell International Corporation, August 1993, pgs. b-23, b-42, b-46.

Pak facility. The SCTI Power Pak facility was designed to harness the steam produced through SCTI's sodium experiments and generate commercial electric power. The system operated from 1988 through 1993. The power generated was sold onto the grid through Edison Power.[1,2]

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: Demolished in 2003.[3] Based on available information, the dimensions of the excavation made during building demolition are unknown.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): Radiological surveys specific to Building 4228 were not conducted. Building 4012 was released by the U.S. Department of Energy by the time Building 4228 was demolished. According to a Safety, Health, and Environmental Affairs Impact Review Checklist, the demolition of Building 4228 did not involve radioactive materials and was not conducted in a radiological area.[4]

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Locations: None found.

Aerial Photographs: In 1978, prior to the construction of Building 4228, an open storage (OS) area, identified as OS-7, and a possible waste disposal area (WDA), identified as WDA-6, are visible north of the Building 4228 site. A probable stain was located at the west end of OS-7. Possible solid waste debris is noted in WDA-6. Building 4228 first appears on a 1988 aerial photograph. A structure containing cooling fans (Building 4710) is visible to the east of Building 4228. An overhead pipe is also noted near the southwest corner of Building 4228. In 1995, overhead pipes, a vertical tank, and a probable stain are identified around Building 4228 and the cooling fan structure. A stain near the south end of the cooling fan structure is also noted. By 2005, all the structures associated with Building 4228 were gone.[5]

Radionuclides of Concern: The research team did not find evidence that radioactive material were used in Building 4228. Radionuclides resulting from former reactor operations in Building 4012, which supported the northwest end of Building 4228, include: americium (Am-241), cesium-137 (Cs-137), plutonium isotopes (Pu-238, Pu-239, Pu-240, Pu-241), strontium-90 (Sr-90), and natural and enriched uranium (U-234, U-235, U-238).[6,1] All radionuclides of concern

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[1] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. L-21.
[2] Kneff, D.W. et al., *Sodium Component Test Installation (SCTI) Demolition Final Report, EID-08336*, The Boeing Company, October 1, 2003, pgs. 8-9.
[3] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, pgs. L-21–L-22.
[4] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. L-21.
[5] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.
[6] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume1 – Methodology*, May 2005, p. 2-9.

listed are included for analysis in the August 2009 *Final Field Sampling Plan, Radiological Background Study, Santa Susana Field Laboratory*. Table 3.3 presents a summary of radiological contaminants of concern.

Drainage Pathways: Aerial photographs from 1957 to 2005 indicate that drainage followed 17th Street to the south and continued to impoundments in Areas III and IV. The Area IV impoundment is identified as IM-5 on aerial photograph analysis and as the 17th Street Drainage in this technical memorandum.[2] The 17th Street Drainage is discussed later in this section. The general slope of Area IV is in a southerly direction. Water runoff is directed to the retention reservoirs which are part of the SSFL industrial effluent control system. Liquid effluent discharge from the final retention pond into the Bell Canyon drainage occurs only after controlled effluent holdup and sampling. The north end of Building 4228 is near the surface drainage divide for the area. North of drainage divide, water drains northerly to Simi Valley.[3,4] Building 4228 was located on top of and south of former SNAP Critical Test Facility Building, which handled radioactive materials and generated radionuclides, and may have received drainage from Building 4012.

Radiological Contamination Potential: Class 1 because Building 4228 was located on top of and south of former SNAP Critical Test Facility Building 4012, which is also identified as Class 1.

Recommended Locations for Sediment/Soil Sampling:

Plate 1 and Figure 2.1 provide a convenient reference for the following recommendations.

Extensive soil sampling is recommended in the Building 4228 area primarily because it was constructed on top of former SNAP Critical Test Facility Building 4012. Significant information is lacking regarding the excavation activities at Building 4228. Radiological surveys specific to Building 4228 were not conducted and previous characterization studies for the Building 4012 area were focused on delineating the extent of contamination to standards that were applicable at the time. Previous characterization studies for the Building 4012/4228 area were focused on delineating the extent of contamination to standards that were applicable at the time and not to the standard required by the December 2010 Administrative Order on Consent. Therefore, additional characterization is recommended for the Building 4228 area. This includes the following Building 4228 areas and appurtenances:

- Former Building 4012 critical cell (Room 110) and fuel storage room (Room 109) in the northern Building 4228 footprint. Past contamination of these rooms may have left residual contamination in the area.

[1] Unknown Author, *Facility Information, Building 012*, Unknown Date, HDMSP001828011.
[2] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.
[3] Chapman, J. A., *Radiological Survey of Buildings T019 and T013; An Area Northwest of T059, T019, T013, and T012; And a Storage Yard West of Buildings T626 and T038, GEN-ZR-0010*, Rockwell International, Rocketdyne Division, August 26, 1988, p. 17.
[4] Map located at: http://www.dtsc-ssfl.com/files/maps/SSFL%20-%20Western%20Half.pdf.

- Former Building 4012 radioactive waste tank holdup tank outside Room 104 on the south side of the Building 4228 footprint. The known radioactive waste holdup tank may have left residual contamination in the area.

- Sanitary sewer line located south of the Building 4228 footprint. If radioactive materials were released into the sewer system, residual contamination may exist in the materials inside and surrounding the sewer lines.

- Former OS-7 and possible WDA-6 identified on aerial photographs north of the Building 4228 footprint. If radioactive materials were stored or disposed in OS-7 or WDA-6, contamination could have migrated to the Building 4228 area, and residual contamination may exist.

- Probable stain identified on a 1995 aerial photograph east of the Building 4228 footprint and at south end of Building 4710 footprint. The unknown stains may be possible sources of contamination.

- Drainage pathways associated with the Building 4228 area and outside Area IV as proposed by the field sampling plan. Residual contamination may exist in drainages outside of Area IV.

2.1.7 Building 4310 Area

Site Description: The Building 4310 area comprises Building 4310 and the land surrounding it. Building 4310 was constructed in the early 1960s. It was a small, portable structure. Building 4310 appears near Systems for Nuclear Auxiliary Power (SNAP) Experimental Reactor Building 4010 on a January 1967 industrial planning map. It appears near Small Component Test Loop (SCTL) Building 4826, and Control Element Test Structure 4354 on industrial planning maps from 1971 through 1973.[1,2] Because Building 4310 changed locations, it is discussed as part of Group 1 and Group 6 building areas. Figure 2.1.7a provides a current photograph. The research team was unable to find building-specific drawing(s). Buildings 4010, 4354, and 4826 are discussed elsewhere in this section. No as-built drawings were located for Building 4310. Plate 1 presents a summary of all identified features for this site.

Building Features: A sanitary sewer map shows a sewer line that appears to be located south of the original Building 4310.[3]

Former Use(s): Building 4310 was identified as a portable change room on industrial planning maps.[4] Presumably a portable change room is a non-permanent structure used for changing clothes.

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[1] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. P-9.
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[3] *Technical Site Information, Energy Technology Engineering Center (ETEC), GEN-AT-0027, Revision B*, Rockwell International Corporation, August 1993, p. b-23.
[4] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: Building 4310 was relocated near the SCTL Buildings 4826 and 4354 sometime between 1967 and 1971.[1,2] The research team could not find any detailed information describing how the building was moved.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): Radiological surveys specific to Building 4310 were not conducted. The original Building 4310 location was covered as part of the Rockwell/Rocketdyne 1994-1995 Area IV Radiological Characterization Survey. An ambient gamma and walkabout survey was conducted in the area of Building 4310. The average gamma exposure rate for the developed areas of the Santa Susana Field Laboratory Area IV was 13.6 microroentgens per hour (μR/hr) with a maximum rate of 19.4 μR/hr. The average exposure rate for all of Area IV was 14.6 μR/hr with a maximum rate of 21.4 μR/hr. The local background exposure rate outside of Area IV was 15.6 μR/hr with a maximum value of 20.5 μR/hr. According to the survey report, the gamma radiation distribution of Area IV was statistically indistinguishable from the local background gamma radiation distribution. The U.S. Nuclear Regulatory Commission and the State of California specify a limit of 5 μR/hr above the average background of the data set for release of land for radiologically unrestricted use. Ambient gamma regulatory limits were below these acceptable limits.[3]

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Location: None found.

Aerial Photographs: Building 4310 is first identified on a 1967 aerial photograph near Building 4010. The 1967 aerial photograph indicates that drainage flows southwest from an open storage (OS) area identified as OS-2 in Subarea HSA-7 toward Building 4010 and 4310. By 1972, Building 4310 was relocated and included in a processing area (PA) designated PA-1 in the Environmental Protection Agency's aerial photograph analysis.[4]

Radionuclides of Concern: The research team did not find evidence of radioactive material use in Building 4310. Radionuclides associated with potential migration from SNAP Buildings 4010 and 4012 include: antimony-125 (Sb-125), americium-241 (Am-241), cesium isotopes (Cs-134, Cs-137), cobalt-60 (Co-60), europium isotopes (Eu-152, Eu-154), isotopes of plutonium (Pu-238, Pu-239, Pu-240, Pu-241), strontium-90 (Sr-90), and natural and enriched uranium isotopes

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[1] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. P-9.
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[3] Rockwell International/Rocketdyne Division, *Area IV Radiological Characterization Survey, A4CM-ZR-0011, Rev. A*, August 15, 1996.
[4] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.

(U-234, U-235, U-238).[1,2,3] All radionuclides of concern listed are included for analysis in the August 2009 *Final Field Sampling Plan, Radiological Background Study, Santa Susana Field Laboratory*. Table 3.3 presents a summary of radiological contaminants of concern.

Drainage Pathways: Aerial photographs from 1957 to 2005 indicate that drainage followed 17th Street to the south and continued to impoundments in Areas III and IV. The Area IV impoundment is identified as IM-5 on aerial photograph analysis and as the 17th Street Drainage in this technical memorandum.[4] The 17th Street Drainage is discussed later in this section. The general slope of Area IV is in a southerly direction. Water runoff is directed to the retention reservoirs which are part of the SSFL industrial effluent control system. Liquid effluent discharge from the final retention pond into the Bell Canyon drainage reportedly occurs only after controlled effluent holdup and sampling.[5,6]

Radiological Contamination Potential: Class 1 for original Building 4310 site because of proximity to SNAP Buildings 4010 and 4012 and the potential of radioactive material migration via surface water flow or airborne release from these buildings.

Recommended Locations for Sediment/Soil Sampling:

Plate 1 and Figure 2.6 provide a convenient reference for the following recommendations.

Extensive soil sampling is recommended in the Building 4310 area primarily because of its proximity to SNAP Buildings 4010 and 4012 and the potential for radioactive material migration via surface water flow or airborne release from these areas. Radiological surveys specific to Building 4310 were not conducted and previous characterization studies for the Building 4310 area were focused on delineating the extent of contamination to standards that were applicable at the time. Previous characterization studies for the Building 4310 area were focused on delineating the extent of contamination to standards that were applicable at the time and not to the standard required by the December 2010 Administrative Order on Consent. Therefore, additional characterization is recommended for the Building 4310 area. This includes the following Building 4310 areas and appurtenances:

- Sanitary sewer located south of the Building 4310 footprint. If radioactive materials were released into sewer lines, residual contamination may exist in materials inside and surrounding the sewer lines.

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[1] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 1 –Methodology*, May 2005, p. 2-9.
[2] Zwetzig, G.B., *Survey of Fission- and Corrosion-Product Activity in Sodium- or NaK-Cooled Reactors, AI-AEC-MEMO-12790*, Atomics International, a Division of North American Rockwell Corporation, February 28, 1969, p. 5.
[3] Unknown Author, *Facility Information, Building 012*, Unknown Date, HDMSP001828011.
[4] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.
[5] Chapman, J. A., *Radiological Survey of Buildings T019 and T013; An Area Northwest of T059, T019, T013, and T012; And a Storage Yard West of Buildings T626 and T038, GEN-ZR-0010,* Rockwell International, Rocketdyne Division, August 26, 1988, p. 17.
[6] Map located at: http://www.dtsc-ssfl.com/files/maps/SSFL%20-%20Western%20Half.pdf.

- Drainage pathways associated with the Building 4310 area and outside Area IV as proposed by the field sampling plan. Residual contamination may exist in drainages outside of Area IV.

2.2 Group 2

The Group 2 index map is presented in Figure 2.2. Following Figure 2.2, the site photograph and layout drawings for each building area within HSA-5B Group 2 are presented. HSA-5B Group 2 includes 11 building areas that were part of the Sodium Component Test Installation (SCTI) Building Complex. Note that Building 4358, originally built to support SCTI, was later moved to support the Small Component Test Loop (SCTL). As a result, Building 4358 will be discussed as appropriate in Group 2 and Group 4 of this section.

2.2.1 Building 4355 Area

Site Description: The Building 4355 area comprises Building 4355, Electrical Substation 4756, and the land surrounding these buildings near B Street. Building 4355 was the Control Center for the SCTI Building Complex constructed between 1959 and 1964. The SCTI Building Complex included Buildings 4355, 4356, 4357, 4359, 4360, 4361, 4362, 4392, 4457, 4656, and 4756. These buildings are discussed later in this section. Building 4355 was located adjacent to SCTI Buildings 4356, 4357, and 4359, and north of SCTL Buildings 4026, 4226, and 4826.[1,2,3] Figures 2.2.1a through 2.2.1b provide a current photograph and the best available building-specific drawing(s) that the research team could find. No as-built drawings were located for Building 4355. Plate 1 presents a summary of all identified features for this site.

Building Features: Building 4355 was a 4,369-square-foot steel-framed enclosed structure.[4,5] Building 4355 contained restrooms and air conditioning. The ceiling height was 10 feet.[6] Figure 2.2.1b presents a floor plan for Building 4355 with notations depicting the control room, lab, computer, lockers, transformer, hot water, and rest rooms. A sanitary sewer map shows that at one point a sewer line branch connected to the north side of Building 4355. The branch line runs north and connects to a sewer main south of Building 4013.[7] A 1966 drawing depicts a below-grade pipe running from a floor drain on the east side of Building 4359 to a catch basin located

[1] Kneff, D.W. et al., *Sodium Component Test Installation (SCTI) Demolition Final Report, EID-08336*, October 1, 2003, pgs. 7, 13-14.
[2] DE-AC03-98SF21530, *Environmental Restoration and Remediation of the Former Energy Technology Engineering Center*, Contract Awarded to Boeing North American, Inc., Rocketdyne Propulsion & Power, December 31, 1998, Attachment 1, Appendix 2, pgs. 1-2.
[3] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. P-19.
[4] Kneff, D.W. et al., *Sodium Component Test Installation (SCTI) Demolition Final Report, EID-08336*, October 1, 2003, p. 14.
[5] DE-AC03-98SF21530, *Environmental Restoration and Remediation of the Former Energy Technology Engineering Center*, Contract Awarded to Boeing North American, Inc., Rocketdyne Propulsion & Power, December 31, 1998, Attachment 1, Appendix 2, pgs. 1-2.
[6] *Technical Site Information, Energy Technology Engineering Center (ETEC), GEN-AT-0027, Revision B*, Rockwell International Corporation, August 1993, p. b-36.
[7] *Technical Site Information, Energy Technology Engineering Center (ETEC), GEN-AT-0027, Revision B*, Rockwell International Corporation, August 1993, p. b-23.

between Buildings 4026 and 4355.[1] A riser located on the south side of Building 4355 supplied water for the sprinkler system in Buildings 4355 and 4357.[2]

Former Use(s): Building 4355 was the SCTI Control Center and contained the control room, data acquisition system, offices for facility management and staff, restrooms, a small chemistry laboratory, a facility record storage.[3] Building 4355 was used to monitor and control operations in Building 4356.[4]

Information from Interviewees: A number of former employees were interviewed about their experience at the SSFL. Two remembered Building 4355. Excerpts from these interviews are included below.

Interviewee 195 started working in Area IV on the hill in 1968 at the Building 355 SCTI and later went into other buildings like Building 19, Building 4013, Building 59, and the infamous sodium burn pit. The following excerpts were pulled from the interview.

> *"I tried to keep to procedures and I made an entry in the logbook when I was performing something. I was the shift leader at SCTI and when you took on that responsibility for a shift, say from 8 to 3:30, you wrote in the logbook who was doing what: "Joe Blow is doing Procedure X, Revision whatever." My boss would review my logbook— everything was supposed to be logged. Some facilities were tighter and some were looser about logbooks.*
>
> *At SCTI we were not required to wear film badges but there were certain areas in Area IV where you were required to wear a film badge. Some of the sodium tanks had radioactive material to measure the level of the materials in the tanks. In Buildings 13 and 19 we didn't need to wear them."*[5]

Interviewee 63 worked at the Santa Susana Field Laboratory for 42 years starting in June 1957 at the Sodium Reactor Experiment, then leaving SSFL for a few years and returning back to the hill in 1965 or 1966. The following excerpts were pulled from the interview.

> *I finally got back up on the hill in about 1965 or 1966 and I stayed up there until I retired. When I first got back up on the mountain, I did engineering studies – paper studies looking at various reactor designs. Later I was assigned to be the manager of the SCTI in about 1968 or 1969. There we tested steam generating equipment. I did that for a number of years. In mid-1970, I was made manager of operations. I had 120 employees and all of the work was non-nuclear. There were many operating facilities at SSFL during that time. We had a big pump test*

[1] *SSFL Area IV, Bldg. 359, Water/Sewer Distribution, Demolition & Installation, M359-68339-MI*, Rockwell International, December 12, 1966, HDMSe00455082.
[2] Gump, J.A., *Building Construction and Protection Survey, Building/Facility 357/SSFL*, April 23, 1987.
[3] Kneff, D.W. et al., *Sodium Component Test Installation (SCTI) Demolition Final Report, EID-08336*, October 1, 2003, pgs. 13-14.
[4] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. P-19.
[5] Interview No. 195 conducted by DOE in 2010.

loop and a number of instrumentation areas. We had an instrument lab and a chem lab.

I didn't need to wear a film badge at SCTI or thereafter. The only time I had to wear a film badge was when I worked at the Sodium Reactor Experiment

The SCTI cooling tower put off a plume of steam. I heard that people were worried about that plume. All it had in it was steam, water! People assumed it was like the towers that they frequently used to depict the accident at Three Mile Island, even though those were equally innocuous.

The primary purpose of the SCTI was to come up with a foolproof design. We wanted to make something that would be safe, right off the shelf. It couldn't have leaks or other problems. It needed to be leak-proof and dependable. The Big Pump Test Facility was used for a number of purposes. All the work we did there was developmental. We were always trying to improve on the design, make better probes, better pumps, improve reliability."[1]

Radiological Incident Reports: There has been one incident associated with Building 4355. The following table provides information presented in an incidents database provided by Boeing. Summaries of only the incident reports that resulted or may have resulted in releases to the environment are provided following the table, when available. Summaries of all available incident reports are provided in Attachment A.

Building 4355 Incident Report Summary

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A0184	4/15/1988	OUTSIDE BARRIER	Ir-192	BOTTLED WATER DELIVERY MAN PASSED THROUGH R/A BARRIER OF RADIOGRAPHER.

Current Use: Demolished in 2003.[2] SCTI demolition involved removal of building structures, followed by grade-level concrete slabs, ramps, footings, and pavement, and finally below-grade pipes, ducts, trenches, tanks and pits. It doesn't appear that there were any large pits associated with Building 4355. The exact dimensions of the excavation are unknown. Backfilling and grading operations used on-site soil, possibly from the Area IV borrow area.[3,4]

[1] Interview No. 63 conducted by DOE in 2010.
[2] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 - Area IV Site Summaries*, May 2005, p. P-19.
[3] Kneff, et al., *Sodium Component Test Installation (SCTI) Demolition Final Report, EID-08336*, The Boeing Company, October 2003, p. 39.
[4] Correspondence from Lopez, J., Lopez General Engineering Contractors, Inc., to Robinson, K.S., The Boeing Company, *Reference: SCTI Demolition Buildings: 4355, 4356, 4357, 4358, 4457 & Associated, May 22, 2002.*

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): During demolition in 2003, Building 4355 debris was surveyed daily for total and removable contamination. No radiological contamination reportedly was detected.[1]

Radiological Use Authorizations: Use Authorization 117D, dated July 1, 1984, permitted the operation of Bowed Tubes Measurement. The authorization specified the use of a 1.0 microcurie cobalt-60 (Co-60) sealed source that was checked annually to ensure that no leakage occurred.[2] A 1995 radioactive materials inventory also noted use of cesium-137 (Cs-137) sealed sources in Building 4355.[3,4]

Former Radiological Burial or Disposal Location: None found.

Aerial Photographs: Building 4355 is first identified in a 1959 aerial photograph with an area of probable leakage located near the southwest corner of the building. Building 4355 is included in a processing area (PA) designated PA-1 in the Environmental Protection Agency's aerial photograph analysis. Because multiple buildings are included in PA-1, aerial photograph analysis for this area cannot be attributed to specific buildings, unless explicitly stated. A 1962/63 aerial photograph identifies overhead pipes and ground scarring in PA-1. A 1965 aerial photograph shows an expansion of Building 4355 to the west. Aerial photographs from 1965 through 1995 denote possible storage tanks and overhead pipes in PA-1. Open storage areas are noted in PA-1 in 1978, 1980, and 1995. In 1967 and 1978, a stain was identified in PA-1. A possible stain was noted in 1980 and 1983 and a probable stain was identified in PA-1 in 1995. By 1998, all of the previously identified features in PA-1 were no longer present. By 2005, Building 4357 is no longer present in PA-1.[5]

Aerial photograph analysis from 1959 to 2005 identifies a hazardous material storage area (HMSA) located east of Building 4355 inside PA-1. In 1959, a new building (possibly Building 4357), a possible below ground/recessed area, and a possible stain were observed. The possible recessed area remained visible in 1962/63 and a possible underground storage tank was noted. These features could not be confirmed on the 1965 or 1967 photographs. By 1978, a probable open storage area was observed housing approximately six to eight objects, each about one-fourth the size of an automobile. In 1980, probable staining was observed, and in 1983 and 1987 an area of dark-toned material was visible. In 1990 and 1992, areas of possible staining were noted. By 1993, this area no longer appeared active. In 1998, approximately 12 containers, each about the size of an automobile, were observed at this location. By 2002, the containers and the building had been removed from the former HMSA.[6]

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[1] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. P-19.
[2] Review of Radiation Safety Records Management System, 2010.
[3] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. P-19.
[4] Review of Radiation Safety Records Management System, 2010.
[5] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.
[6] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.

Radionuclides of Concern: Sealed source use of Co-60, Cs-137, and Ir-192 are described above in Radiological Use Authorizations and Radiological Incident Reports. Other sealed source use is possible. Radionuclides associated with potential migration from Systems for Nuclear Auxiliary Power (SNAP) Buildings 4010 and 4012 include: antimony-125 (Sb-125), americium-241 (Am-241), Cs-134, Cs-137, Co-60, europium isotopes (Eu-152, Eu-154), isotopes of plutonium (Pu-238, Pu-239, Pu-240, Pu-241), strontium-90 (Sr-90), tritiated titanium (H-3), and natural and enriched uranium isotopes (U-234, U-235, U-238).[1,2,3] All radionuclides of concern listed, with the exception of Ir-192, are included for analysis in the August 2009 *Final Field Sampling Plan, Radiological Background Study, Santa Susana Field Laboratory*. Ir-192 has half-life of less than one year and thus does not meet the criteria for analysis. Table 3.3 presents a summary of radiological contaminants of concern.

Drainage Pathways: A 1966 drawing depicts a below-grade storm drain running northeast across the Building 4355 footprint to a catch basin located between Buildings 4026 and 4355.[4] A hazardous material spill report states that a local underground drainage system was approximately 30 feet away from a spill site at Building 4355.[5] Aerial photographs from 1957 to 2005 indicate that drainage from PA-1 followed 17th Street to the south and continued to impoundments in Areas III and IV. The Area IV impoundment is identified as IM-5 on aerial photograph analysis and as the 17th Street Drainage in this technical memorandum.[6] The 17th Street Drainage is discussed later in this section. The general slope of Area IV is in a southerly direction. Water runoff is directed to the retention reservoirs which are part of the SSFL industrial effluent control system. Liquid effluent discharge from the final retention pond into the Bell Canyon drainage occurs only after controlled effluent holdup and sampling.[7,8] Because the general slope of Area IV is in a southerly direction, runoff from SNAP Buildings 4010 and 4012 could potentially impact Building 4355. The SNAP buildings handled radioactive materials and generated radionuclides, which means there is a possibility of radiological contamination in the area of Building 4355.

Radiological Contamination Potential: Class 1 because sealed radioactive material sources were used in Building 4355 and there is a potential of radioactive material migration via surface water flow or airborne release from SNAP Buildings 4010 and 4012.

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[1] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume I Methodology*, May 2005, p. 2-9.

[2] Zwetzig, G.B., *Survey of Fission- and Corrosion-Product Activity in Sodium- or NaK-Cooled Reactors, AI-AEC-MEMO-12790*, Atomics International, a Division of North American Rockwell Corporation, February 28, 1969, p. 5.

[3] Unknown Author, *Facility Information, Building 012*, Unknown Date, HDMSP001828011.

[4] *SSFL Area IV, Bldg. 359, Water/Sewer Distribution, Demolition & Installation, M359-68339-MI*, Rockwell International, December 12, 1966, HDMSe00455082.

[5] Internal correspondence from Christy, Lt. T.L. to Greenwell, Capt., W.I., Rockwell International, *Reference: Hazardous Material Spill, Sulfuric Acid, Bldg. 355 Area of SCTI, Santa Susana Facility*, September 27, 1988.

[6] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.

[7] Chapman, J. A., *Radiological Survey of Buildings T019 and T013; An Area Northwest of T059, T019, T013, and T012; And a Storage Yard West of Buildings T626 and T038, GEN-ZR-0010*, Rockwell International, Rocketdyne Division, August 26, 1988, p. 17.

[8] Map located at: http://www.dtsc-ssfl.com/files/maps/SSFL%20-%20Western%20Half.pdf.

Recommended Locations for Sediment/Soil Sampling:

Plate 1 and Figure 2.2 provide a convenient reference for the following recommendations.

Due to radioactive sealed source use and potential radioactive material migration via surface water flow or airborne release from SNAP Buildings 4010 and 4012, there is a possibility that radionuclide concentrations in soil will exceed the standard required by the December 2010 Administrative Order on Consent. Therefore, additional characterization is recommended for the Building 4355 area. This includes the following Building 4355 areas:

- Sanitary sewer located at the north side of the Building 4355 footprint. If radioactive materials were released into the sewer system, residual contamination may exist in the materials inside and surrounding the sewer lines.

- Former below-grade storm drain located under southeastern portion of the Building 4355 footprint. Storm water originating from Buildings 4010 or 4012 could potentially discharge into this storm drain. Consequently, this storm drain may provide a pathway for migration of radionuclides from these areas and residual contamination may exist in the area.

- Former catch basin area located between the Building 4026 footprint and the Building 4355 footprint. Storm water originating from Buildings 4010 or 4012 could potentially discharge into this catch basin. Consequently, the catch basin may be an area with residual contamination.

- Area of probable leakage identified in aerial photograph at southwest corner of the Building 4355 footprint. If radioactive materials were released, residual contamination may exist.

- Former underground drainage system near the Building 4355 footprint, if location can be determined. If radiological materials were released into the drainage system, residual contamination may exist in the area.

- Drainage pathways associated with the Building 4355 area and outside Area IV as proposed by the field sampling plan. Residual contamination may exist in drainages outside of Area IV.

2.2.2 Building 4356 Area

Site Description: The Building 4356 area comprises Building 4356, Building 4656 Cooling Stacks, and the land surrounding these buildings. Building 4356 was constructed in 1959 as the Sodium Component Test Installation (SCTI) High Bay. The SCTI Building Complex included Buildings 4355, 4356, 4357, 4359, 4360, 4361, 4362, 4392, 4457, 4656, and 4756. Most of the facility process systems were contained within or adjacent to Building 4356. The Building 4656 Cooling Stacks were southwest of Building 4356.[1,1,2] Figures 2.2.2a through 2.2.2c provide a

[1] Kneff, D.W. et al., *Sodium Component Test Installation (SCTI) Demolition Final Report, EID-08336*, October 1, 2003, pgs. 7-8, 13-14.

current photograph and the best available building-specific drawing(s) that the research team could find. Building 4356 was located south of B Street, between 17th and 20th Streets, adjacent to SCTI Building 4355.[3] The remaining SCTI Buildings listed above are discussed elsewhere in this section. No as-built drawings were located for Building 4356. Plate 1 presents a summary of all identified features for this site.

Building Features: Building 4356 was a 9,560-square-foot steel-framed enclosed structure that housed the steam generator test articles, sodium system, and two fossil fuel-fired sodium heaters.[4] Building 4356 did not contain any restrooms or heating and ventilation features. The ceiling height was 65 feet.[5] The SCTI Complex included a sodium heater, a primary sodium heat transfer system, a secondary sodium heat transfer system, a steam and feed water system, a circulating cooling water system, and supporting equipment and systems. Four sodium drain tanks and a reaction tank were located in below-grade concrete pits that extended up to 54 feet below grade. An additional 22 aboveground tanks containing sodium, sulfuric acid, calcium hydroxide, sodium hydroxide, morpholine, brine, gaseous argon, hydrazine, deionized water, and diesel oil, were associated with Building 4356.[6,7] Figure 2.2.2b presents a floor plan of Building 4356 and denotes a large pit in the center of the facility. Figure 2.2.2c presents an area plan for the west yard of Building 4356 that denotes a secondary containment pit, trench, and some of the tanks associated with the SCTI.

Former Use(s): The SCTI Complex was a development test facility for liquid metal (sodium) system components. It provided a test site for the non-nuclear developmental testing of typical liquid metal reactor components, primarily steam generators. The SCTI Complex was originally designed to test sodium-heated steam generators and sodium-to-sodium intermediate heat exchangers under simulated sodium-cooled nuclear power plant operating conditions at a power level of 35 megawatts thermal. It operated from 1964 through 1995 and underwent system upgrades to the steam and feed water systems in 1973. Further modifications in the late 1970s and early 1980s included the addition of a second sodium heater and the replacement of most of the steam/feed water system and the water make-up system.[8] Operations included sodium tank cleaning, generation of steam from a sodium heat source, water treatment, and x-ray operations.[9]

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[1] DE-AC03-98SF21530, *Environmental Restoration and Remediation of the Former Energy Technology Engineering Center*, Contract Awarded to Boeing North American, Inc., Rocketdyne Propulsion & Power, December 31, 1998, Attachment 1, Appendix 2, p. 2.

[2] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. P-21.

[3] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.

[4] Kneff, D.W. et al., *Sodium Component Test Installation (SCTI) Demolition Final Report, EID-08336*, October 1, 2003, p. 13.

[5] *Technical Site Information, Energy Technology Engineering Center (ETEC), GEN-AT-0027, Revision B*, Rockwell International Corporation, August 1993, p. b-36.

[6] Kneff, D.W. et al., *Sodium Component Test Installation (SCTI) Demolition Final Report, EID-08336*, October 1, 2003, pgs. 5, 7-8, 13-15.

[7] *Technical Site Information, Energy Technology Engineering Center (ETEC), GEN-AT-0027, Revision B*, Rockwell International Corporation, August 1993, pgs. b-43, b-47.

[8] Kneff, D.W. et al., *Sodium Component Test Installation (SCTI) Demolition Final Report, EID-08336*, October 1, 2003, pgs. 5, 7-8, 13.

[9] *Group 5 –Central Portion of Areas III and IV, RCRA Facility Investigation Report, Santa Susana Field Laboratory, Ventura County, California, Volume IX – RFI Site Reports, Appendix R*, Hazardous Materials Storage Area, CH2M Hill, November 2008, p. Table R.2-1.

Information from Interviewees: A number of former employees were interviewed about their experience at the Santa Susana Field Laboratory. Four remembered specific information about Building 4356. Excerpts from these interviews are included below.

Interviewee 135 started with Atomics International in 1974 and was a project manager at the SCTI working on the steam feed system. The following excerpt was pulled from the interview.

> *"The SCTI steam and feed water system condensers produced what was really pure distilled water and we wanted to pipe it into the Simi Valley water system rather than dispose of it on site. There were people who came from all over the United States to protest this plan. It was eventually piped over to Silvernale Reservoir. The SCTI was originally a heat exchanger test facility one of the boilers had been salvaged from a battleship."*[1]

Interviewee 255 was an atomic reactor inspector and x-ray technician at the Santa Susana Field Laboratory from 1967 to 1985. The following excerpts were pulled from the interview.

> *"I remember one time we went down to Building 4356, where the steam generator was located in SCTI, and I was going down in the pit to do some inspection. I got down to the bottom grating and the whole bottom floor, about 10 feet down, was full of water. The sump pump had quit working.*
>
> *I think the worst job I had was x-raying inside a gas-fired heater at SCTI. You had to go in and set up your equipment and your film, crawl out through a burner opening, run the iridium pill out, x-ray it, crawl back into the heater and make another set up to do it all over again."*[2]

Interviewee 279 worked at the Santa Susana Field Laboratory an instrumentation engineer in the mid-1960s to support procurement of a data acquisition system the SCTI. The following excerpts were pulled from the interview.

> *"Occasionally we would get a leak in the piping at the SCTI. If sodium leaked out, it would cause a fire. We were all trained in what to do when something like that happened. We had some powder that we would sprinkle on it, I think maybe it was calcium carbonate, that would put it out. Sometimes we would call the fire department if we couldn't get it out ourselves. When we would get a leak, we would have to shut the experiment down, drain the sodium back out of the pipes into the tanks, wait for everything to cool down, and then fix the leak. It didn't happen often, but it did happen."*[3]

Interviewee 290 worked at the Santa Susana Field Laboratory for 35 years from January 1964 to January 1999 starting as a forklift operator and later becoming a shift leader and operations engineers. The following excerpts were pulled from the interview.

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[1] Interview No. 135 conducted by DOE in 2010.
[2] DOE/EPA Joint Interview 255, July 2010.
[3] Interview No. 279 conducted by DOE in 2010.

> *"I spent 11 years in Building 356, which was the SCTI..... All my work was sodium non-nuclear, with no responsibilities relating to radiological materials or waste.... Sodium leaks happened on occasion. I remember several at the SCTI, which caused a lot of damage."*[1]

Radiological Incident Reports: There have been several incidents associated with Building 4356. The following table provides information presented in an incidents database provided by Boeing. Summaries of only the incident reports that resulted or may have resulted in releases to the environment are provided following the table, when available. Summaries of all available incident reports are provided in Attachment A.

Building 4356 Incident Report Summary

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A0639	10/7/1974	SCTI TANK #5	Cs-137	SOURCE REMOVED FROM SCTI SURGE TANK AND STORED WITH OUT APPROVAL.
A0093	12/8/1981	TEST STAND	Ir-192	RADIOGRAPHIC SOURCE PIGTAIL UNCOUPLED AND FELL TO DECK.
A0138	5/11/1985	SCTI 3RD DECK	Ir-192	SOURCE STUCK IN SHORT RADIUS TUBE DURING RADIOGRAPHIC OPERATION AT SCTI.
A0153	2/20/1986	SCTI	Ir-192	RADIOGRAPHY BARRIER REMOVED AND EMPLOYEES ENTERED AREA.

- On December 8, 1981, an iridium-192 (Ir-192) radiographic source pigtail uncoupled and fell to the deck of the SCTI test stand (A0093).[2] A pigtail is a source assembly that consists of the sealed source and a connector that attaches the source to the control cable.[3] The research team has not located the original incident report.

- On May 11, 1985, an employee gammagraphing between the 2nd and 3rd deck of the SCTI could not retrieve the 45 curie (Ci) Ir-192 source. The source had become stuck in the short radius tube during radiographic operations. The employee was advised to stay clear of the area and security and management were notified. Survey meters and dosimeters were brought to Building 4356 and security road blocks were put in place. The dose rate at the radiographer's barrier rope on the east side indicated 12 milliroentgens per hour (12 mR/hr). The radiographer pointed out the source location below the floor on the 3rd deck along the steam generator. The dose rate was approximately 3 roentgens per hour (R/hr) at 4 feet from the back side of the source. A bend in the tube was pried back to allow the source to be cranked back into the lead camera. One employee received 2 millirems

[1] Interview No. 290 conducted by DOE in 2010.
[2] Review of Radiological Incident Index, 2010.
[3] "License for Radiography and Radiation Safety Requirements for Radiographic Operators," 10 C.F.R. §§ 34.3 and 34.43, 2010.

(mrem) during the source recovery for a total of 13 mrems for the day. The health physicist on site received 18 mrem during the recovery (A0138).[1]

Current Use: Demolition of the SCTI Complex began in 1997 and was completed in 2002.[1] Building structures were removed followed by the below-grade pipes, ducts, trenches, tanks and pits. The concrete pits extended up to 54 feet below grade and required extensive soil excavation. The exact dimensions of the excavation are unknown. Backfilling and grading used on-site soil, possibly from the Area IV borrow area.[2,3]

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): During demolition in 2003, Building 4356 debris was surveyed daily for total and removable contamination. No radiological contamination reportedly was detected.[4]

Radiological Use Authorizations: Use Authorization Series 72, originally dated January 8, 1974, permitted the use of two 250 microcurie (μCi) cesium-137 (Cs-137) sealed sources and one 100 μCi Cs-137 sealed source that were used as sodium level gauges. These sources were checked annually to ensure that no leakage occurred.[5]

Former Radiological Burial or Disposal Location: None found.

Aerial Photographs: Building 4356 is first identified in a 1959 aerial photograph and is included in a processing area (PA) designated PA-1 in the Environmental Protection Agency's aerial photograph analysis. Because multiple buildings are included in PA-1, aerial photograph analysis for this area cannot be attributed to specific buildings, unless explicitly stated. A 1962/63 aerial photograph identifies overhead pipes and ground scarring in PA-1. Aerial photographs from 1965 through 1995 denote possible storage tanks and overhead pipes in PA-1. Open storage areas are noted in PA-1 in 1978, 1980, and 1995. In 1967 and 1978, a stain was identified in PA-1. A possible stain was noted in 1980 and 1983 and a probable stain was identified in PA-1 in 1995. By 1998, all of the previously identified features in PA-1 were no longer present. By 2005, Building 4356 is no longer present in PA-1.[6]

Radionuclides of Concern: Sealed source use of Cs-137 and Ir-192 are noted above in Radiological Use Authorizations and Radiological Incident Reports. This suggests potential use of other sealed sources as well. Radionuclides associated with potential migration from Systems for Nuclear Auxiliary Power (SNAP) Buildings 4010 and 4012 include: antimony-125 (Sb-125), americium-241 (Am-241), Cs-134, Cs-137, cobalt-60 (Co-60), europium isotopes (Eu-152, Eu-

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[1] Internal Correspondence from Badger, F.H. to Radiation & Nuclear Safety Group, Rockwell International, *Re: Radiological Safety Incident Report, T-356 SCTI, May 11, 1985*, May 15, 1985.

[2] Kneff, et al., *Sodium Component Test Installation (SCTI) Demolition Final Report, EID-08336*, The Boeing Company, October 2003, pgs. 39-45.

[3] Correspondence from Lopez, J., Lopez General Engineering Contractors, Inc., to Robinson, K.S., The Boeing Company, *Reference: SCTI Demolition Buildings: 4355, 4356, 4357, 4358, 4457 & Associated, May 22, 2002.*

[4] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. P-21.

[5] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. P-21.

[6] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.

154), isotopes of plutonium (Pu-238, Pu-239, Pu-240, Pu-241), strontium-90 (Sr-90), tritiated titanium (H-3), and natural and enriched uranium (U-234, U-235, U-238).[1,2,3] All radionuclides of concern listed, with the exception of Ir-192, are included for analysis in the August 2009 *Final Field Sampling Plan, Radiological Background Study, Santa Susana Field Laboratory*. Ir-192 has half-life of less than one year and thus does not meet the criteria for analysis. Table 3.3 presents a summary of radiological contaminants of concern.

Drainage Pathways: Storm drainage for Building 4356 follows a culvert west and then southwest of the building to 20th Street.[4] Aerial photographs from 1957 to 2005 indicate that drainage from PA-1 followed 17th Street to the south and continued to impoundments in Areas III and IV. The Area IV impoundment is identified as IM-5 on aerial photograph analysis and as the 17th Street Drainage in this technical memorandum.[5] The 17th Street Drainage is discussed later in this section. The general slope of Area IV is in a southerly direction. Water runoff is directed to the retention reservoirs which are part of the SSFL industrial effluent control system. Liquid effluent discharge from the final retention pond into the Bell Canyon drainage occurs only after controlled effluent holdup and sampling.[6,7] Because the general slope of Area IV is in a southerly direction, runoff from SNAP Buildings 4010 and 4012 could potentially impact Building 4356. The SNAP buildings handled radioactive materials and generated radionuclides, which means there is a possibility of radiological contamination in the area of Building 4356.

Radiological Contamination Potential: Class 1 because sealed radioactive material sources were used in Building 4356, there is a potential of radioactive material migration via surface water flow or airborne release from SNAP Buildings 4012 and 4012, and lack of site investigation.

Recommended Locations for Sediment/Soil Sampling:

Plate 1 and Figure 2.2 provide a convenient reference for the following recommendations.

Due to the radioactive sealed source use, potential radioactive material migration via surface water flow or airborne release from SNAP Buildings 4012 and 4012, and lack of site investigation, there is a possibility that radionuclide concentrations in soil will exceed the standards required by the December 2010 Administrative Order on Consent. Therefore,

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[1] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 1 Methodology*, May 2005, p. 2-9.
[2] Zwetzig, G.B., *Survey of Fission- and Corrosion-Product Activity in Sodium- or NaK-Cooled Reactors, AI-AEC-MEMO-12790*, Atomics International, a Division of North American Rockwell Corporation, February 28, 1969, p. 5.
[3] Unknown Author, *Facility Information, Building 012*, Unknown Date, HDMSP001828011.
[4] *Technical Site Information, Energy Technology Engineering Center (ETEC), GEN-AT-0027, Revision B*, Rockwell International Corporation, August 1993, p. b-25.
[5] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.
[6] Chapman, J. A., *Radiological Survey of Buildings T019 and T013; An Area Northwest of T059, T019, T013, and T012; And a Storage Yard West of Buildings T626 and T038, GEN-ZR-0010*, Rockwell International, Rocketdyne Division, August 26, 1988, p. 17.
[7] Map located at: http://www.dtsc-ssfl.com/files/maps/SSFL%20-%20Western%20Half.pdf.

additional characterization is recommended for the Building 4356 area. This includes the following Building 4356 areas:

- Former secondary containment pits (large pit and several smaller pits) and trench locations in the Building 4356 footprint and in the west yard area. If radiological materials migrated or were released into the pits or trench drainage system, residual contamination may exist in the area.

- Former sealed source storage areas within the Building 4356 footprint, if further location information can be determined. If any radioactive material was released from use of sealed sources, residual contamination may exist.

- Storm drain located at southwestern portion of the Building 4356 footprint and along southwestern portion of the west yard. Storm water drainage may provide a pathway for migration of radionuclides originating from Buildings 4010 or 4012. Consequently, this storm drain may provide a pathway for migration of radionuclides and residual contamination may exist in the area.

- Drainage pathways associated with the Building 4356 area and outside Area IV as proposed by the field sampling plan. Residual contamination may exist in drainages outside of Area IV.

2.2.3 Building 4357 Area

Site Description: The Building 4357 area comprises Building 4357 and the land surrounding it near B Street and 17th Street.[1] Building 4357 was constructed in 1958 as the Heat Transfer Loop Control Building. It later became part of the Sodium Component Test Installation (SCTI) Building Complex, serving as a storage building. The SCTI Building Complex included Buildings 4355, 4356, 4357, 4359, 4360, 4361, 4362, 4392, 4457, 4656, and 4756.[2,3] Building 4357 was located adjacent to SCTI Building 4355 and north of Small Component Test Loop (SCTL) Building 4026, both discussed elsewhere in this section. Figures 2.2.3a through 2.2.3b provide a current photograph and the best available building-specific drawing(s) that the research team could find. . No as-built drawings were located for Building 4357. Plate 1 presents a summary of all identified features for this site.

Building Features: Building 4357 was constructed with a concrete slab floor and steel frame siding and roof. The building measured 42 feet long, 20 feet wide, and 10 feet high with 840 square feet of floor area. Building 4357 was not connected to the water or sewer system.[4] Figure 2.2.3b presents a floor plan for Building 4357. Room 100 housed electrical switch gear no longer in use and sodium pump parts. Room 101 was used for storage of sodium pump parts. A riser located on the south side of Building 4355 supplied water for the sprinkler system in

[1] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[2] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. P-25.
[3] Kneff, D.W. et al., *Sodium Component Test Installation (SCTI) Demolition Final Report, EID-08336*, October 1, 2003, pgs. 5, 13.
[4] *Appendix A, Building Reconnaissance Report, Building 357, GEN-??-0000*, July 30, 1996, pgs. 31, 34.

Building 4357 through a 2-inch pipe.[1] A 2,000-gallon aboveground liquid argon tank (T-357) was associated with Building 4357.[2]

Former Use(s): Building 4357 was first used as a Heat Transfer Loop Control Building and later a Pump Bearing Test Facility Control Building for the Liquid Metal Engineering Center (LMEC) and Energy Technology Engineering Center (ETEC). By 1987, Building 4357 served as the SCTI Storage Building after serving as the Pump Bearing Test Facility Control Room. The SCTI Complex was a development test facility for liquid metal (sodium) system components. The facility provided a test site for the non-nuclear developmental testing of typical liquid metal reactor components, primarily steam generators.[3,4]

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: Demolished in 2002.[5] SCTI demolition involved removal of building structures, followed by grade-level concrete slabs, ramps, footings, and pavement, and finally below-grade pipes, ducts, trenches, tanks and pits. The exact dimensions of the excavation are unknown. Backfilling and grading operations used on-site soil, possibly from the Area IV borrow area.[6,7]

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): During demolition, Building 4357 debris was surveyed daily for total and removable contamination. No radiological contamination was reportedly detected. At demolition and prior to disposition, liquid sodium from the SCTI Complex was tested for radioactivity and reportedly found to be free of contamination.[8]

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Location: None found.

Aerial Photographs: Building 4357 is first identified in a 1959 aerial photograph. It is located in the southwest corner of a hazardous material storage area (HMSA) within a processing area (PA) designated PA-1 in the Environmental Protection Agency's aerial photograph analysis. Because multiple buildings are included in the HMSA, aerial photograph analysis for this area cannot be attributed to specific buildings, unless explicitly stated. In 1959, a possible below

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[1] Gump, J.A., *Building Construction and Protection Survey, Building/Facility 357/SSFL*, April 23, 1987.
[2] *Technical Site Information, Energy Technology Engineering Center (ETEC), GEN-AT*-0027, Revision B, Rockwell International Corporation, August 1993, pgs. b-43, b-48.
[3] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. P-25.
[4] Kneff, D.W. et al., *Sodium Component Test Installation (SCTI) Demolition Final Report, EID-08336*, October 1, 2003, pgs. 5, 13.
[5] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. P-25.
[6] Kneff, et al., *Sodium Component Test Installation (SCTI) Demolition Final Report, EID-08336*, The Boeing Company, October 2003, p. 39.
[7] Correspondence from Lopez, J., Lopez General Engineering Contractors, Inc., to Robinson, K.S., The Boeing Company, *Reference: SCTI Demolition Buildings: 4355, 4356, 4357, 4358, 4457 & Associated, May 22, 2002*.
[8] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. P-25.

ground/recessed area and a possible stain were observed. The possible recessed area remained visible in 1962/63 and a possible underground storage tank was noted. These features could not be confirmed on the 1965 or 1967 photographs. By 1978, a probable open storage area was observed in the HMSA containing approximately six to eight objects. In 1980, probable staining was observed, and in 1983 and 1987 an area of dark-toned material was visible. In 1990 and 1992, areas of possible staining were noted in the HMSA. By 1993, this area no longer appeared active. In 1998, approximately 12 containers were observed at this location. By 2002, the containers and the building had been removed from the HMSA.[1]

Radionuclides of Concern: The research team did not find evidence of radioactive material use in Building 4357.[2] Radionuclides associated with potential migration from Systems for Nuclear Auxiliary Power (SNAP) Buildings 4010 and 4012 include: antimony-125 (Sb-125), americium-241 (Am-241), cesium isotopes (Cs-134, Cs-137), cobalt-60 (Co-60), europium isotopes (Eu-152, Eu-154), isotopes of plutonium (Pu-238, Pu-239, Pu-240, Pu-241), strontium-90 (Sr-90), tritiated titanium (H-3), and natural and enriched uranium (U-234, U-235, U-238).[3,4,5] All radionuclides of concern listed are included for analysis in the August 2009 *Final Field Sampling Plan, Radiological Background Study, Santa Susana Field Laboratory*. Table 3.3 presents a summary of radiological contaminants of concern.

Drainage Pathways: Aerial photographs from 1957 to 2005 indicate that drainage from PA-1 followed 17th Street to the south and continued to impoundments in Areas III and IV. The Area IV impoundment is identified as IM-5 on aerial photograph analysis and as the 17th Street Drainage in this technical memorandum.[6] The 17th Street Drainage is discussed later in this section. The general slope of Area IV is in a southerly direction. Water runoff is directed to the retention reservoirs which are part of the SSFL industrial effluent control system. Liquid effluent discharge from the final retention pond into the Bell Canyon drainage occurs only after controlled effluent holdup and sampling.[7,8] Because the general slope of Area IV is in a southerly direction, runoff from SNAP Buildings 4010 and 4012 could potentially impact Building 4357. The SNAP buildings handled radioactive materials and generated radionuclides, which means there is a possibility of radiological contamination in the area of Building 4357.

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[1] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.

[2] *Appendix A, Building Reconnaissance Report, Building 357, GEN-??-0000*, July 30, 1996, pgs. 31, 34.

[3] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 1 – Methodology*, May 2005, p. 2-9.

[4] Zwetzig, G.B., *Survey of Fission- and Corrosion-Product Activity in Sodium- or NaK-Cooled Reactors, AI-AEC-MEMO-12790*, Atomics International, a Division of North American Rockwell Corporation, February 28, 1969, p. 5.

[5] Unknown Author, *Facility Information, Building 012*, Unknown Date, HDMSP001828011.

[6] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.

[7] Chapman, J. A., *Radiological Survey of Buildings T019 and T013; An Area Northwest of T059, T019, T013, and T012; And a Storage Yard West of Buildings T626 and T038, GEN-ZR-0010*, Rockwell International, Rocketdyne Division, August 26, 1988, p. 17.

[8] Map located at: http://www.dtsc-ssfl.com/files/maps/SSFL%20-%20Western%20Half.pdf.

Radiological Contamination Potential: Class 2 because of the potential radioactive material migration via surface water flow or airborne release from SNAP Buildings 4010 and 4012, and lack of site investigation.

Recommended Locations for Sediment/Soil Sampling:

Plate 1 and Figure 2.2 provide a convenient reference for the following recommendations.

Due to the lack of site investigation and potential radioactive material migration via surface water flow or airborne release from SNAP Buildings 4010 and 4012, there is a possibility that radionuclide concentrations in soil will exceed the standards required by the December 2010 Administrative Order on Consent. Therefore, additional characterization is recommended for the Building 4357 area. This includes the following Building 4357 areas:

- Low-lying areas north and east of the Building 4357 footprint included in the HMSA where recessed areas were identified in aerial photographs. Low-lying areas could collect possible radioactive drainage from Buildings 4010 and 4012 and may contain residual contamination.
- Possible stained areas identified in aerial photographs north and east of the Building 4357 footprint. Unknown stains could possibly contain residual contamination.
- Drainage pathways associated with the Building 4357 area and outside Area IV as proposed by the field sampling plan. Residual contamination may exist in drainages outside of Area IV.

2.2.4 Building 4358 Area

Site Description: The Building 4358 area comprises Building 4358 and the land surrounding it. Building 4358 was constructed in 1967 as the Sodium Component Test Installation (SCTI) Chemical Storage Building. It was located northwest of SCTI Building 4656 at the corner of B and 20th Streets. In 1978, the building became a Small Component Test Loop (SCTL) Chemical Storage Building and was moved to a new location south of SCTL Building 4026 and west of 17th Street.[1,2,3] Because Building 4358 changed locations, it is discussed as part of Group 2 and Group 4 building areas. Figures 2.2.4a through 2.2.4b provide a current photograph and the best available building-specific drawing(s) that the research team could find. SCTI Buildings 4355, 4356, 4357, 4359, 4360, 4361, 4362, 4392, 4457, and 4656 are all discussed elsewhere in this section. No as-built drawings were located for Building 4358. Plate 1 presents a summary of all identified features for this site.

Building Features: Building 4358 was constructed with a concrete slab floor and steel frame, siding, and roof. The building measured 22 feet long, 50 feet wide, and 12 feet high with 1,120

[1] *Appendix A, Building Reconnaissance Report, Building 358, GEN-??-0000*, November 15, 1996, p. 31.
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[3] Wondolleck, John, *Area IV Santa Susana Field Laboratory, Environmental Impact Statement, Draft Gap Analysis Report*, CDM, June 1, 2008, Appendix A, p. 13.

square feet of floor area.[1] Building 4358 did not contain any restrooms, but was heated.[2] Figure 2.2.4b presents a floor plan of Building 4358.

Former Use(s): Building 4358 was originally constructed as a chemical storage facility in support of SCTL. The building was relocated and became a chemical storage building in support of SCTL and Kalina operations.[3]

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: Building 4358 was moved to a new location south of SCTL Building 4026 and west of 17th Street in 1978.[4,5,6] The research team could not find any detailed information describing how the building was moved or if a building foundation remained in place.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): The original Building 4358 location was covered as part of the Rockwell/Rocketdyne 1994-1995 Area IV Radiological Characterization Survey. An ambient gamma and walkabout survey was conducted in the area of Building 4358. The average gamma exposure rate for the developed areas of the Santa Susana Field Laboratory Area IV was 13.6 microroentgens per hour (μR/hr) with a maximum rate of 19.4 μR/hr. The average exposure rate for all of Area IV was 14.6 μR/hr with a maximum rate of 21.4 μR/hr. The local background exposure rate outside of Area IV was 15.6 μR/hr with a maximum value of 20.5 μR/hr. According to the survey report, the gamma radiation distribution of Area IV was statistically indistinguishable from the local background gamma radiation distribution. The U.S. Nuclear Regulatory Commission and the State of California specify a limit of 5 μR/hr above the average background for release of land for radiologically unrestricted use. Ambient gamma regulatory limits were below these acceptable limits.[7]

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Location: None found.

Aerial Photographs: Building 4358 is first identified in a 1967 aerial photograph and is included in a processing area (PA) designated PA-1 in the Environmental Protection Agency's aerial photograph analysis. In 1978, Building 4358 is relocated, but is still within PA-1. Because multiple buildings are included in PA-1, aerial photograph analysis for this area cannot

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[1] *Appendix A, Building Reconnaissance Report, Building 358, GEN-??-0000*, November 15, 1996, p. 31.
[2] *Technical Site Information, Energy Technology Engineering Center (ETEC), GEN-AT-0027, Revision B*, Rockwell International Corporation, August 1993, p. b-36.
[3] Wondolleck, John, *Area IV Santa Susana Field Laboratory, Environmental Impact Statement, Draft Gap Analysis Report*, CDM, June 1, 2008, Appendix A, p. 13.
[4] *Appendix A, Building Reconnaissance Report, Building 358, GEN-??-0000*, November 15, 1996, p. 31.
[5] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[6] Wondolleck, John, *Area IV Santa Susana Field Laboratory, Environmental Impact Statement, Draft Gap Analysis Report*, CDM, June 1, 2008, Appendix A, p. 13.
[7] Rockwell International/Rocketdyne Division, *Area IV Radiological Characterization Survey, A4CM-ZR-0011, Rev. A*, August 15, 1996.

be attributed to specific buildings, unless explicitly stated. Aerial photographs from 1965 through 1995 denote possible storage tanks and overhead pipes in PA-1. Open storage areas are noted in PA-1 in 1978, 1980, and 1995. In 1967 and 1978, a stain was identified in PA-1. In 1980 and 1983, a possible stain was noted in PA-1. A probable stain was identified in PA-1 in 1995. In 1988, possible saturated material was identified along the southeast side of Building 4358. By 1998, all of the previously identified features in PA-1 were no longer present. By 2005, Building 4358 was no longer present in PA-1.[1]

Radionuclides of Concern: The research team did not find evidence of radioactive material use in Building 4358. Radionuclides associated with potential migration from Systems for Nuclear Auxiliary Power (SNAP) Building 4019 include: americium-241 (Am-241), cesium-137 (Cs-137), plutonium isotopes (Pu-238, Pu-239, Pu-240, Pu-241), strontium-90 (Sr-90), and natural and enriched uranium (U-234, U-235, U-238).[2,3] All radionuclides of concern listed are included for analysis in the August 2009 *Final Field Sampling Plan, Radiological Background Study, Santa Susana Field Laboratory*. Table 3.3 presents a summary of the radiological contaminants of concern.

Drainage Pathways: Storm drainage for the original 1967 Building 4358 location follows a culvert along 20th Street.[4] Aerial photographs from 1965 to 2005 show drainage flowing south from 20th Street and continuing into Area III impoundments.[5] The general slope of Area IV is in a southerly direction. Water runoff is directed to the retention reservoirs which are part of the SSFL industrial effluent control system. Liquid effluent discharge from the final retention pond into the Bell Canyon drainage occurs only after controlled effluent holdup and sampling.[6,7] Because the general slope of Area IV is in a southerly direction, runoff from SNAP Building 4019 could potentially impact Building 4358 at its original location. The SNAP building handled radioactive materials and generated radionuclides, which means there is a possibility of radiological contamination in the area of Building 4358.

Radiological Contamination Potential: Class 2 because of potential radioactive material migration via surface water flow or airborne release from SNAP Building 4019, and limited site investigation.

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[1] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.

[2] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume1 – Methodology*, May 2005, p. 2-9.

[3] Unknown Author, *Log Book, Building 4019, 1/20/64 to 6/3/65*, January 20, 1964, HDMSP001853462.

[4] *Technical Site Information, Energy Technology Engineering Center (ETEC), GEN-AT-0027, Revision B*, Rockwell International Corporation, August 1993, p. b-25.

[5] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.

[6] Chapman, J. A., *Radiological Survey of Buildings T019 and T013; An Area Northwest of T059, T019, T013, and T012; And a Storage Yard West of Buildings T626 and T038, GEN-ZR-0010*, Rockwell International, Rocketdyne Division, August 26, 1988, p. 17.

[7] Map located at: http://www.dtsc-ssfl.com/files/maps/SSFL%20-%20Western%20Half.pdf.

Recommended Locations for Sediment/Soil Sampling:

Plate 1 and Figure 2.4 provide a convenient reference for the following recommendations.

Due to the limited site investigation and potential for radioactive material migration via surface water flow or airborne release from SNAP Building 4019, there is a possibility that radionuclide concentrations in soil will exceed the standard required by the December 2010 Administrative Order on Consent. Therefore, additional characterization is recommended for the original Building 4358 area. This includes the following Building 4358 areas:

- Storm drain west of the Building 4358 footprint near the 20th Street drainage. The storm drain collects storm water from former SNAP Building 4019. Residual contamination from the storm drain may exist.

- Drainage pathways associated with the Building 4358 area and outside Area IV as proposed by the field sampling plan. Residual contamination may exist in drainages outside of Area IV.

2.2.5 Building 4359 Area

Site Description: The Building 4359 area comprises Building 4359 and the land surrounding it. Building 4359 was constructed in approximately 1975. The structure built was as the Sodium Component Test Installation (SCTI) Atomizing Air Building. The SCTI Complex included Buildings 4355, 4356, 4357, 4359, 4360, 4361, 4362, 4392, 4457, 4656, and 4756. Building 4359 was located south of SCTI Building 4355 and west of Small Component Test Loop (SCTL) Building 4026.[1,2,3,4] Figures 2.2.5a through 2.2.5b provide a current photograph and the best available building-specific drawing(s) that the research team could find. Plate 1 presents a summary of all identified features for this site.

Building Features: Building 4359 was a 500-square-foot metal-framed building with corrugated sheet metal roofing and siding. Its size has been reported anywhere from 500 to 775 square feet.[5,6,7] Building 4359 did not contain any restrooms or heating and ventilation features.

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[1] Kneff, D.W. et al., *Sodium Component Test Installation (SCTI) Demolition Final Report, EID-08336*, October 1, 2003, pgs. 5, 13.
[2] Correspondence from Mattera, N.L., The Boeing Company, to Brown, A., Ventura County Air Pollution Control Division, *Reference: Sodium Component Test Installation (SCTI) Facility Demolition Project, Building 4392 and 4359 at the Santa Susana Field Laboratory (SSFL)*, April 6, 2000.
[3] Energy Technology Engineering Center, *Technical Site Information, Energy Technology Engineering Center (ETEC),GEN-AT-0027, Revision B*, August 1993, p. b-36.
[4] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[5] Kneff, D.W. et al., *Sodium Component Test Installation (SCTI) Demolition Final Report, EID-08336*, October 1, 2003, pgs. 5, 13.
[6] Correspondence from Mattera, N.L., The Boeing Company, to Brown, A., Ventura County Air Pollution Control Division, *Reference: Sodium Component Test Installation (SCTI) Facility Demolition Project, Building 4392 and 4359 at the Santa Susana Field Laboratory (SSFL)*, April 6, 2000.
[7] Energy Technology Engineering Center, *Technical Site Information, Energy Technology Engineering Center (ETEC),GEN-AT-0027, Revision B*, August 1993, p. b-36.

The ceiling height was 15 feet.[1] Figure 2.2.5b shows a water/sewer distribution drawing for Building 4359. This 1966 drawing depicts a below-grade pipe running from a floor drain on the northeast side of Building 4359 to a catch basin located between Buildings 4026 and 4355.[2]

Former Use(s): Building 4359 was identified as the SCTI Atomizing Air Building and housed an air compressor for the SCTI facility. The SCTI complex was a development test facility for liquid metal (sodium) system components. The facility provided a test site for the non-nuclear developmental testing of typical liquid metal reactor components, primarily steam generators.[3] Building 4359 was later converted to a parts storage building with some electrical control switches.[4]

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: Demolished in 2002.[5] Building structures were removed followed by the below-grade pipes, ducts, trenches, tanks and pits. It doesn't appear that there were any large pits associated with Building 4359. The exact dimensions of the excavation are unknown. Backfilling and grading used on-site soil, possibly from the Area IV borrow area.[6,7]

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): During demolition, Building 4359 debris was surveyed daily for total and removable contamination. No radiological contamination reportedly was detected. At demolition and prior to disposition, liquid sodium from the SCTI complex was tested for radioactivity and reportedly found to be free of contamination.[8]

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Location: None found.

Aerial Photographs: In 1959, prior to the construction of Building 4359, an area of probable leakage is identified in what would become the northwest portion of Building 4359. Building 4359 is first identified in a 1978 aerial photograph and is included in a processing area (PA)

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[1] *Technical Site Information, Energy Technology Engineering Center (ETEC), GEN-AT-0027, Revision B*, Rockwell International Corporation, August 1993, p. b-36.

[2] *SSFL Area IV, Bldg. 359, Water/Sewer Distribution, Demolition & Installation, M359-68339-MI*, Rockwell International, December 12, 1966, HDMSe00455082.

[3] Kneff, D.W. et al., *Sodium Component Test Installation (SCTI) Demolition Final Report, EID-08336*, October 1, 2003, pgs. 5, 13.

[4] Correspondence from Mattera, N.L., The Boeing Company, to Brown, A., Ventura County Air Pollution Control Division, *Reference: Sodium Component Test Installation (SCTI) Facility Demolition Project, Building 4392 and 4359 at the Santa Susana Field Laboratory (SSFL)*, April 6, 2000.

[5] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. P-33.

[6] Kneff, et al., *Sodium Component Test Installation (SCTI) Demolition Final Report, EID-08336*, The Boeing Company, October 2003, p. 39.

[7] Correspondence from Lopez, J., Lopez General Engineering Contractors, Inc., to Robinson, K.S., The Boeing Company, *Reference: SCTI Demolition Buildings: 4355, 4356, 4357, 4358, 4457 & Associated, May 22, 2002.*

[8] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. P-33.

designated PA-1 in the Environmental Protection Agency's aerial photograph analysis. Because multiple buildings are included in PA-1, aerial photograph analysis for this area cannot be attributed to specific buildings, unless explicitly stated. Aerial photographs from 1978 through 1995 denote possible storage tanks and overhead pipes in PA-1. Open storage areas are noted in PA-1 in 1978, 1980, and 1995. In 1978, a stain was identified in PA-1. In 1980 and 1983, a possible stain was noted in PA-1. A probable stain was identified in PA-1 in 1995. By 1998, all of the previously identified features in PA-1 were no longer present. By 2005, Building 4359 was no longer present in PA-1.[1]

Radionuclides of Concern: The research team did not find evidence of radioactive material use in Building 4359. Radionuclides associated with potential migration from Systems for Nuclear Auxiliary Power (SNAP) Buildings 4010 and 4012 include: antimony-125 (Sb-125), americium-241 (Am-241), cesium isotopes (Cs-134, Cs-137), cobalt-60 (Co-60), europium isotopes (Eu-152, Eu-154), isotopes of plutonium (Pu-238, Pu-239, Pu-240, Pu-241), strontium-90 (Sr-90), tritiated titanium (H-3), and natural and enriched uranium (U-234, U-235, U-238).[2,3,4] All radionuclides of concern listed are included for analysis in the August 2009 *Final Field Sampling Plan, Radiological Background Study, Santa Susana Field Laboratory*. Table 3.3 presents a summary of radiological contaminants of concern.

Drainage Pathways: Aerial photographs from 1957 to 2005 indicate that drainage from PA-1 followed 17th Street to the south and continued to impoundments in Areas III and IV. The Area IV impoundment is identified as IM-5 on aerial photograph analysis and as the 17th Street Drainage in this technical memorandum.[3] The 17th Street Drainage is discussed later in this section. The general slope of Area IV is in a southerly direction. Water runoff is directed to the retention reservoirs which are part of the SSFL industrial effluent control system. Liquid effluent discharge from the final retention pond into the Bell Canyon drainage occurs only after controlled effluent holdup and sampling.[5,6] Because the general slope of Area IV is in a southerly direction, runoff from SNAP Buildings 4010 and 4012 could potentially impact Building 4359. The SNAP buildings handled radioactive materials and generated radionuclides, which means there is a possibility of radiological contamination in the area of Building 4359.

Radiological Contamination Potential: Class 2 because of potential radioactive material migration via surface water flow or airborne release from SNAP Buildings 4010 and 4012, and lack of site investigation.

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[1] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.

[2] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 1 –Methodology*, May 2005, p. 2-9.

[3] Zwetzig, G.B., *Survey of Fission- and Corrosion-Product Activity in Sodium- or NaK-Cooled Reactors, AI-AEC-MEMO-12790*, Atomics International, a Division of North American Rockwell Corporation, February 28, 1969, p. 5.

[4] Unknown Author, *Facility Information, Building 012*, Unknown Date, HDMSP001828011.

[5] Chapman, J. A., *Radiological Survey of Buildings T019 and T013; An Area Northwest of T059, T019, T013, and T012; And a Storage Yard West of Buildings T626 and T038, GEN-ZR-0010,* Rockwell International, Rocketdyne Division, August 26, 1988, p. 17.

[6] Map located at: http://www.dtsc-ssfl.com/files/maps/SSFL%20-%20Western%20Half.pdf.

Recommended Locations for Sediment/Soil Sampling:

Plate 1 and Figure 2.2 provide a convenient reference for the following recommendations.

Due to the lack of site investigation and potential radioactive material migration via surface water flow or airborne release from SNAP Buildings 4010 and 4012, there is a possibility that radionuclide concentrations in soil will exceed the standard required by the December 2010 Administrative Order on Consent. Therefore, additional characterization is recommended for the Building 4359 area. This includes the following Building 4359 areas:

- Former floor drain and pipe location running northeast from northeast portion of the Building 4359 footprint. If radioactive materials were released into the building drain system, residual contamination may exist in materials surrounding the drain and pipe lines.

- Former catch basin area located northeast of the Building 4359 footprint. Storm water originating from Buildings 4010 or 4012 could potentially discharge into this catch basin. Consequently, the catch basin may be an area with residual contamination.

- Area of probable leakage identified in aerial photograph at what was to become northwest portion of Building 4359. If radioactive materials were released, residual contamination may exist.

- Drainage pathways associated with the Building 4359 area and outside Area IV as proposed by the field sampling plan. Residual contamination may exist in drainages outside of Area IV.

2.2.6 Building 4360 Area

Site Description: The Building 4360 area comprises Building 4360 and the land surrounding it on the corner of B Street and 20th Street. Building 4360 was constructed in 1982 as the Sodium Component Test Installation (SCTI) Chemical Storage Building.[1,2] The SCTI Complex included Buildings 4355, 4356, 4357, 4359, 4360, 4361, 4362, 4392, 4457, 4656, and 4756.[3] Building 4360 was located north of SCTI Buildings 4361 and 4656, and west of SCTI Building 4362. These buildings are discussed elsewhere in this section.[4] Figures 2.2.6a through 2.2.6b provide a current photograph and the best available building-specific drawing(s) that the research team could find. No as-built drawings were located for Building 4360. Plate 1 presents a summary of all identified features for this site.

[1] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[2] *Technical Site Information, Energy Technology Engineering Center (ETEC), GEN-AT-0027, Revision B*, Rockwell International Corporation, August 1993, p. b-37.
[3] Kneff, et al., *Sodium Component Test Installation (SCTI) Demolition Final Report, EID-08336*, October 1, 2003, pgs. 5, 13.
[4] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.

Building Features: Building 4360 was a steel-framed building with a steel roof and siding. It measured 384 square feet. Building 4360 did not contain any restrooms or heating and ventilation features. The ceiling height was 14 feet.[1] A sanitary sewer map shows a sewer line that forms a "T" at the intersection of B and 20th Street. Building 4360 is located at the southeast corner of this intersection.[2] Features of the SCTI area to the south of Building 4360 are depicted in Figure 2.2.6b.

Former Use(s): Building 4360 was the SCTI Chemical Storage Building. The SCTI complex was a development test facility for liquid metal (sodium) system components. The facility provided a test site for the non-nuclear developmental testing of typical liquid metal reactor components, primarily steam generators.[3]

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: Demolished in 1999.[4] Building structures were removed followed by the below-grade pipes, ducts, trenches, tanks and pits. It doesn't appear that there were any large pits associated with Building 4359. The exact dimensions of the excavation are unknown. Backfilling and grading used on-site soil, possibly from the Area IV borrow area.[5,6]

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): Radiological surveys specific to Building 4360 have not been conducted. At demolition and prior to disposition, liquid sodium from the SCTI complex was tested for radioactivity and reportedly found to be free of contamination.[7]

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Location: None found.

Aerial Photographs: Building 4360 is first identified in a 1980 aerial photograph and is included in a processing area (PA) designated PA-1 in the Environmental Protection Agency's aerial photograph analysis. Because multiple buildings are included in PA-1, aerial photograph analysis for this area cannot be attributed to specific buildings, unless explicitly stated. Aerial photographs from 1980 through 1995 denote possible storage tanks and overhead pipes in PA-1.

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[1] *Technical Site Information, Energy Technology Engineering Center (ETEC), GEN-AT-0027, Revision B*, Rockwell International Corporation, August 1993, p. b-37.
[2] *Technical Site Information, Energy Technology Engineering Center (ETEC), GEN-AT-0027, Revision B*, Rockwell International Corporation, August 1993, p. b-23.
[3] Kneff, D.W. et al., *Sodium Component Test Installation (SCTI) Demolition Final Report, EID-08336*, October 1, 2003, pgs. 5, 13.
[4] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. P-35.
[5] Kneff, et al., *Sodium Component Test Installation (SCTI) Demolition Final Report, EID-08336*, The Boeing Company, October 2003, p. 39.
[6] Correspondence from Lopez, J., Lopez General Engineering Contractors, Inc., to Robinson, K.S., The Boeing Company, *Reference: SCTI Demolition Buildings: 4355, 4356, 4357, 4358, 4457 & Associated, May 22, 2002.*
[7] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. P-35.

Open storage areas are noted in PA-1 in 1980, and 1995. In 1980 and 1983, a possible stain was noted in PA-1. A probable stain was identified in PA-1 in 1995. By 1998, all of the previously identified features in PA-1 were no longer present. By 2005, Building 4360 was no longer present in PA-1.[1]

Radionuclides of Concern: The research team did not find evidence of radioactive material use in Building 4360. Radionuclides associated with potential migration from SNAP Building 4019 include: americium-241 (Am-241), cesium-137 (Cs-137), plutonium isotopes (Pu-238, Pu-239, Pu-240, Pu-241), strontium-90 (Sr-90), and natural and enriched uranium (U-234, U-235, U-238).[2,3] All radionuclides of concern listed are included for analysis in the August 2009 *Final Field Sampling Plan, Radiological Background Study, Santa Susana Field Laboratory*. Table 3.3 presents a summary of the radiological contaminants of concern.

Drainage Pathways: A storm drainage culvert appears to cut across the Building 4360 site from B Street to 20th Street.[4] Aerial photographs from 1965 to 2005 show drainage flowing south from 20th Street and continuing into Area III impoundments.[5] The general slope of Area IV is in a southerly direction. Water runoff is directed to the retention reservoirs which are part of the SSFL industrial effluent control system. Liquid effluent discharge from the final retention pond into the Bell Canyon drainage occurs only after controlled effluent holdup and sampling.[6,7] Because the general slope of Area IV is in a southerly direction and Building 4360 is located at the corner of 20th Street, runoff from SNAP Building 4019 could potentially impact Building 4360. The SNAP building handled radioactive materials and generated radionuclides, which means there is a possibility of radiological contamination in the area of Building 4360.

Radiological Contamination Potential: Class 2 because of potential radioactive material migration via surface water flow or airborne release from SNAP Building 4019, and lack of site investigation.

Recommended Locations for Sediment/Soil Sampling:

Plate 1 and Figure 2.2 provide a convenient reference for the following recommendations.

Due to the lack of site investigation and potential radioactive material migration via surface water flow or airborne release from SNAP Building 4019, there is a possibility that radionuclide

[1] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.
[2] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume1 – Methodology*, May 2005, p. 2-9.
[3] Unknown Author, *Log Book, Building 4019, 1/20/64 to 6/3/65*, January 20, 1964, HDMSP001853462.
[4] *Technical Site Information, Energy Technology Engineering Center (ETEC), GEN-AT-0027, Revision B*, Rockwell International Corporation, August 1993, p. b-25.
[5] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.
[6] Chapman, J. A., *Radiological Survey of Buildings T019 and T013; An Area Northwest of T059, T019, T013, and T012; And a Storage Yard West of Buildings T626 and T038, GEN-ZR-0010*, Rockwell International, Rocketdyne Division, August 26, 1988, p. 17.
[7] Map located at: http://www.dtsc-ssfl.com/files/maps/SSFL%20-%20Western%20Half.pdf.

concentrations in soil will exceed the standard required by the December 2010 Administrative Order on Consent. Therefore, additional characterization is recommended for the Building 4360 area. This includes the following Building 4360 areas:

- Sanitary sewer located north and west of the Building 4360 footprint. If radioactive materials were released into the sewer system, residual contamination may exist in the materials inside and surrounding the sewer lines.

- Storm drainage that appears to cut across the Building 4360 footprint. Storm water originating from Building 4019 could discharge into this storm drain. Consequently, this storm drain may provide a pathway for the migration of radionuclides and residual contamination may exist in the area.

- Drainage pathways associated with the Building 4360 area and outside Area IV as proposed by the field sampling plan. Residual contamination may exist in drainages outside of Area IV.

2.2.7 Site 4361 Area

Site Description: The Building 4361 area comprises Building 4361 and the land surrounding it west of 20th Street. Building 4361 was constructed in 1981 as the Sodium Component Test Installation (SCTI) Hazardous Material Storage Building.[1,2] The SCTI Complex included Buildings 4355, 4356, 4357, 4359, 4360, 4361, 4362, 4392, 4457, 4656, and 4756.[3] Building 4361 was located adjacent to SCTI Cooling Tower 4656 and west of SCTI Building 4356. Figures 2.2.7a through 2.2.7b provide a current photograph and the best available building-specific drawing(s) that the research team could find. Building 4361 was located northwest of SCTI Building 4392, which, along with the other SCTI buildings, is discussed elsewhere in this section. No as-built drawings were located for Building 4361. Plate 1 presents a summary of all identified features for this site.

Building Features: Building 4361 was a steel-framed building with a steel roof and siding. It measured 936 square feet. It did not contain any restrooms or heating and ventilation features. The ceiling height was 12 feet.[4] Features of the SCTI area surrounding Building 4361 are depicted in Figure 2.2.7b. This figure shows that Building 4361 was located west of a secondary containment pit and trench, south of numerous SCTI tanks, and east of the Building 4656 Cooling Tower.

Former Use(s): Building 4361 is identified as the SCTI Hazardous Material Storage Building.[5] The SCTI complex was a development test facility for liquid metal (sodium) system components.

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[1] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[2] *Technical Site Information, Energy Technology Engineering Center (ETEC), GEN-AT-0027, Revision B*, Rockwell International Corporation, August 1993, p. b-37.
[3] Kneff, et al., *Sodium Component Test Installation (SCTI) Demolition Final Report, EID-08336*, October 1, 2003, pgs. 5, 13.
[4] *Technical Site Information, Energy Technology Engineering Center (ETEC), GEN-AT-0027, Revision B*, Rockwell International Corporation, August 1993, p. b-37.
[5] Kneff, D.W. et al., *Sodium Component Test Installation (SCTI) Demolition Final Report, EID-08336*, October 1, 2003, pgs. 5, 13.

The facility provided a test site for the non-nuclear developmental testing of typical liquid metal reactor components, primarily steam generators.[1]

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: Demolished in 2003.[2] SCTI building structures were removed followed by the below-grade pipes, ducts, trenches, tanks and pits. It doesn't appear that there were any large pits associated with Building 4361; however, there was a large secondary containment pit located east of Building 4361. The exact dimensions of the excavation are unknown. Backfilling and grading used on-site soil, possibly from the Area IV borrow area.[3,4]

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): During demolition, Building 4361 debris was surveyed daily for total and removable contamination. No radiological contamination reportedly was detected. At demolition and prior to disposition, liquid sodium from the SCTI complex was tested for radioactivity and reportedly found to be free of contamination.[5]

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Location: None found.

Aerial Photographs: Building 4361 is identified on a 1988 aerial photograph and is included in a processing area (PA) designated PA-1 in the Environmental Protection Agency's aerial photograph analysis. Because multiple buildings are included in PA-1, aerial photograph analysis for this area cannot be attributed to specific buildings, unless explicitly stated. Aerial photographs from 1988 and 1995 denote storage tanks and overhead pipes in PA-1. In 1995, an open storage area and probable stain are noted in PA-1. By 1998, all of the previously identified features in PA-1 were no longer present. By 2005, Building 4361 was no longer present in PA-1.[6]

Radionuclides of Concern: The research team did not find evidence of radioactive material use in Building 4361. Radionuclides associated with potential migration from Systems for Nuclear Auxiliary Power (SNAP) Building 4019 include: americium-241 (Am-241), cesium-137 (Cs-137), plutonium isotopes (Pu-238, Pu-239, Pu-240, Pu-241), strontium-90 (Sr-90), and natural

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[1] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.

[2] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. P-37.

[3] Kneff, et al., *Sodium Component Test Installation (SCTI) Demolition Final Report, EID-08336*, The Boeing Company, October 2003, p. 39.

[4] Correspondence from Lopez, J., Lopez General Engineering Contractors, Inc., to Robinson, K.S., The Boeing Company, *Reference: SCTI Demolition Buildings: 4355, 4356, 4357, 4358, 4457 & Associated, May 22, 2002.*

[5] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. P-37.

[6] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.

and enriched uranium (U-234, U-235, U-238).[1,2] All radionuclides of concern listed are included for analysis in the August 2009 *Final Field Sampling Plan, Radiological Background Study, Santa Susana Field Laboratory*. Table 3.3 presents a summary of contaminant of concern.

Drainage Pathways: A storm drainage culvert is located just south of Building 4361 and drains to 20th Street.[3] Aerial photographs from 1965 to 2005 show drainage flowing south from 20th Street and continuing into Area III impoundments. Aerial photographs from 1957 to 2005 indicate that drainage from PA-1 followed 17th Street to the south and continued to impoundments in Areas III and IV. The Area IV impoundment is identified as IM-5 on aerial photograph analysis and as the 17th Street Drainage in this technical memorandum.[4] The 17th Street Drainage is discussed later in this section. The general slope of Area IV is in a southerly direction. Water runoff is directed to the retention reservoirs which are part of the SSFL industrial effluent control system. Liquid effluent discharge from the final retention pond into the Bell Canyon drainage occurs only after controlled effluent holdup and sampling.[5,6] Because the general slope of Area IV is in a southerly direction, runoff from SNAP Building 4019 could potentially impact Building 4361. The SNAP building handled radioactive materials and generated radionuclides, which means there is a possibility of radiological contamination in the area of Building 4361.

Radiological Contamination Potential: Class 2 because of potential radioactive material migration via surface water flow or airborne release from SNAP Building 4019, and lack of site investigation.

Recommended Locations for Sediment/Soil Sampling:

Plate 1 and Figure 2.2 provide a convenient reference for the following recommendations.

Due to the lack of site investigation and potential radioactive material migration via surface water flow or airborne release from SNAP Building 4019, there is a possibility that radionuclide concentrations in soil will exceed the December 2010 Administrative Order on Consent. Therefore, additional characterization is recommended for the original Building 4361 area. This includes the following Building 4361 areas:

- Former secondary containment pit and trench located east of the Building 4361 footprint. If radiological materials migrated or were released into the pit or trench drainage system, residual contamination may exist in the area.

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[1] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume1 - Methodology*, May 2005, p. 2-9.
[2] Unknown Author, *Log Book, Building 4019, 1/20/64 to 6/3/65*, January 20, 1964, HDMSP001853462.
[3] *Technical Site Information, Energy Technology Engineering Center (ETEC), GEN-AT-0027, Revision B*, Rockwell International Corporation, August 1993, p. b-25.
[4] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory - Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.
[5] Chapman, J. A., *Radiological Survey of Buildings T019 and T013; An Area Northwest of T059, T019, T013, and T012; And a Storage Yard West of Buildings T626 and T038, GEN-ZR-0010*, Rockwell International, Rocketdyne Division, August 26, 1988, p. 17.
[6] Map located at: http://www.dtsc-ssfl.com/files/maps/SSFL%20-%20Western%20Half.pdf.

- Storm drainage channel located south of the Building 4361 footprint. The storm drain collects storm water from former SNAP Building 4019. Residual contamination from the storm drain may exist.

- Drainage pathways associated with the Building 4361 area and outside Area IV as proposed by the field sampling plan. Residual contamination may exist in drainages outside of Area IV.

2.2.8 Building 4362 Area

Site Description: The Building 4362 area comprises Building 4362 and the land surrounding it south of B Street. Building 4362 was used as the Sodium Component Test Installation (SCTI) Water Sampling Enclosure. The SCTI Building Complex was constructed between 1959 and 1964 and included Buildings 4355, 4356, 4357, 4359, 4360, 4361, 4362, 4392, 4457, 4656, and 4756.[1,2] Building 4362 was located north of SCTI Buildings 4356, 4361, and 4656, and east of SCTI Building 4360. These buildings are discussed elsewhere in this section. Figure 2.2.8a provides a current photograph. The research team was unable to find building-specific drawing(s). No as-built drawings were located for Building 4362. Plate 1 presents a summary of all identified features for this site.

Building Features: Building 4362 was a small structure, approximately 200 square feet.[3] A sanitary sewer map shows a sewer line located north of Building 4362.[4]

Former Use(s): Building 4362 was used to test the water used in the SCTI facility for purity. The SCTI complex was a development test facility for liquid metal (sodium) system components. The facility provided a test site for the non-nuclear developmental testing of typical liquid metal reactor components, primarily steam generators.[5,6]

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: Demolished in 2003.[7] SCTI building structures were removed followed by the below-grade pipes, ducts, trenches, tanks and pits. It doesn't appear that there were any large

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[1] Kneff, D.W. et al., *Sodium Component Test Installation (SCTI) Demolition Final Report, EID-08336*, October 1, 2003, pgs. 5, 13.
[2] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. P-39.
[3] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. P-39.
[4] *Technical Site Information, Energy Technology Engineering Center (ETEC), GEN-AT-0027, Revision B*, Rockwell International Corporation, August 1993, p. b-23.
[5] Kneff, D.W. et al., *Sodium Component Test Installation (SCTI) Demolition Final Report, EID-08336*, October 1, 2003, pgs. 5, 13.
[6] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. P-39.
[7] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. P-39.

pits associated with Building 4362. The exact dimensions of the excavation are unknown. Backfilling and grading used on-site soil, possibly from the Area IV borrow area.[1,2]

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): During demolition, Building 4362 debris was surveyed daily for total and removable contamination. No radiological contamination reportedly was detected. At demolition and prior to disposition, liquid sodium from the SCTI complex was tested for radioactivity and reportedly found to be free of contamination.[3]

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Location: None found.

Aerial Photographs: Building 4362 is so small it is difficult to identify specifically on aerial photographs. Building 4362 is included in a processing area (PA) designated PA-1 in the Environmental Protection Agency's aerial photograph analysis. Because multiple buildings are included in PA-1, aerial photograph analysis for this area cannot be attributed to specific buildings, unless explicitly stated. A 1962/63 aerial photograph identifies overhead pipes and ground scarring in PA-1. Aerial photographs from 1965 through 1995 denote possible storage tanks and overhead pipes in PA-1. Open storage areas are noted in PA-1 in 1978, 1980, and 1995. In 1967 and 1978, a stain was identified in PA-1. In 1980 and 1983, a possible stain was noted in PA-1. A probable stain was identified in PA-1 in 1995. By 1998, all of the previously identified features in PA-1 were no longer present. By 2005, Building 4026 was no longer present in PA-1. In 1978 and 1980 a large stained area is located southwest of Building 4026 and outside the PA-1 area.[4]

Radionuclides of Concern: The research team did not find evidence of radioactive material use in Building 4362. Radionuclides associated with potential migration from Systems for Nuclear Auxiliary Power (SNAP) Buildings 4010 and 4012 include: antimony-125 (Sb-125), americium-241 (Am-241), cesium isotopes (Cs-134, Cs-137), cobalt-60 (Co-60), europium isotopes (Eu-152, Eu-154), isotopes of plutonium (Pu-238, Pu-239, Pu-240, Pu-241), strontium-90 (Sr-90), tritiated titanium (H-3), and natural and enriched uranium (U-234, U-235, U-238).[5,6,7] All radionuclides of concern listed are included for analysis in the August 2009 *Final Field Sampling Plan, Radiological Background Study, Santa Susana Field Laboratory*. Table 3.3 presents a summary of radiological contaminants of concern.

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[1] Kneff, et al., *Sodium Component Test Installation (SCTI) Demolition Final Report, EID-08336*, The Boeing Company, October 2003, p. 39.

[2] Correspondence from Lopez, J., Lopez General Engineering Contractors, Inc., to Robinson, K.S., The Boeing Company, *Reference: SCTI Demolition Buildings: 4355, 4356, 4357, 4358, 4457 & Associated, May 22, 2002.*

[3] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. P-39.

[4] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.

[5] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 1 –Methodology*, May 2005, p. 2-9.

[6] Zwetzig, G.B., *Survey of Fission- and Corrosion-Product Activity in Sodium- or NaK-Cooled Reactors, AI-AEC-MEMO-12790*, Atomics International, a Division of North American Rockwell Corporation, February 28, 1969, p. 5.

[7] Unknown Author, *Facility Information, Building 012*, Unknown Date, HDMSP001828011.

Drainage Pathways: A storm drainage culvert is located north of Building 4263 and runs southwest to 20th Street.[1] Aerial photographs from 1965 to 2005 show drainage flowing south from 20th Street and continuing into Area III impoundments. Aerial photographs from 1957 to 2005 indicate that drainage from PA-1 followed 17th Street to the south and continued to impoundments in Areas III and IV. The Area IV impoundment is identified as IM-5 on aerial photograph analysis and as the 17th Street Drainage in this technical memorandum.[2] The 17th Street Drainage is discussed later in this section. The general slope of Area IV is in a southerly direction. Water runoff is directed to the retention reservoirs which are part of the SSFL industrial effluent control system. Liquid effluent discharge from the final retention pond into the Bell Canyon drainage occurs only after controlled effluent holdup and sampling.[3,4] Because the general slope of Area IV is in a southerly direction, runoff from SNAP Buildings 4010 and 4012, could potentially impact Building 4362. The SNAP buildings handled radioactive materials and generated radionuclides, which means there is a possibility of radiological contamination in the area of Building 4362.

Radiological Contamination Potential: Class 2 because of potential radioactive material migration via surface water flow or airborne release from SNAP Buildings 4010 and 4012, and lack of site investigation.

Recommended Locations for Sediment/Soil Sampling:

Plate 1 and Figure 2.2 provide a convenient reference for the following recommendations.

Due to the lack of site investigation and potential radioactive material migration via surface water flow or airborne release from SNAP Buildings 4010 and 4012, there is a possibility that radionuclide concentrations in soil will exceed the standard required by the December 2010 Administrative Order on Consent. Therefore, additional characterization is recommended for the Building 4362 area. This includes the following Building 4362 areas:

- Sanitary sewer located north of the Building 4362 footprint. If radioactive materials were released into the sewer system, residual contamination may exist in the materials inside and surrounding the sewer lines.

- Storm drainage channel located north of the Building 4362 footprint. The storm drain collects storm water from former SNAP Building 4019. Residual contamination from the storm drain may exist.

[1] *Technical Site Information, Energy Technology Engineering Center (ETEC), GEN-AT-0027, Revision B*, Rockwell International Corporation, August 1993, p. b-25.
[2] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.
[3] Chapman, J. A., *Radiological Survey of Buildings T019 and T013; An Area Northwest of T059, T019, T013, and T012; And a Storage Yard West of Buildings T626 and T038, GEN-ZR-0010*, Rockwell International, Rocketdyne Division, August 26, 1988, p. 17.
[4] Map located at: http://www.dtsc-ssfl.com/files/maps/SSFL%20-%20Western%20Half.pdf.

- Drainage pathways associated with the Building 4362 area and outside Area IV as proposed by the field sampling plan. Residual contamination may exist in drainages outside of Area IV.

2.2.9 Building 4392 Area

Site Description: The Building 4392 area comprises Building 4392 and the land surrounding it. Building 4392 was constructed between 1987 and 1991 as the Sodium Component Test Installation (SCTI) Electrical Equipment Building.[1,2] The SCTI Complex included Buildings 4355, 4356, 4357, 4359, 4360, 4361, 4362, 4392, 4457, 4656, and 4756.[3] Building 4392 was located south of SCTI Buildings 4356, 4361, and 4656, west of SCTI Building 4359, and west of Small Component Test Loop (SCTL) Buildings 4026 and 4226. These buildings are discussed elsewhere in this section. Figure 2.2.9a provides a current photograph. The research team was unable to find building-specific drawing(s). No as-built drawings were located for Building 4392. Plate 1 presents a summary of all identified features for this site.

Building Features: Building 4392 was a metal-framed building with corrugated sheet metal roofing and siding. It measured approximately 400 square feet.[4]

Former Use(s): Building 4392 was an electrical equipment building for the SCTI complex. It served as the electrical control for the H-2 Heater. The SCTI complex was a development test facility for liquid metal (sodium) system components. The facility provided a test site for the non-nuclear developmental testing of typical liquid metal reactor components, primarily steam generators.[5,6]

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: Demolished by 2003.[7] SCTI building structures were removed followed by the below-grade pipes, ducts, trenches, tanks and pits. It doesn't appear that there were any large

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[1] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.

[2] Correspondence from Mattera, N.L., The Boeing Company, to Brown, A., Ventura County Air Pollution Control Division, *Reference: Sodium Component Test Installation (SCTI) Facility Demolition Project, Building 4392 and 4359 at the Santa Susana Field Laboratory (SSFL)*, April 6, 2000.

[3] Kneff, D.W. et al., *Sodium Component Test Installation (SCTI) Demolition Final Report, EID-08336*, October 1, 2003, pgs. 5, 13.

[4] Correspondence from Mattera, N.L., The Boeing Company, to Brown, A., Ventura County Air Pollution Control Division, *Reference: Sodium Component Test Installation (SCTI) Facility Demolition Project, Building 4392 and 4359 at the Santa Susana Field Laboratory (SSFL)*, April 6, 2000.

[5] Kneff, D.W. et al., *Sodium Component Test Installation (SCTI) Demolition Final Report, EID-08336*, October 1, 2003, pgs. 5, 13.

[6] Correspondence from Mattera, N.L., The Boeing Company, to Brown, A., Ventura County Air Pollution Control Division, *Reference: Sodium Component Test Installation (SCTI) Facility Demolition Project, Building 4392 and 4359 at the Santa Susana Field Laboratory (SSFL)*, April 6, 2000.

[7] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.

pits associated with Building 4392. The exact dimensions of the excavation are unknown. Backfilling and grading used on-site soil possibly from the Area IV borrow area.[1,2]

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): Radiological surveys specific to Building 4392 were not conducted. The Building 4392 area was covered as part of the Rockwell/Rocketdyne 1994-1995 Area IV Radiological Characterization Survey. A walkabout gamma survey was conducted in the area of Building 4392. Only areas showing elevated gamma activity in the walkabout survey were followed up with an ambient gamma survey. Walkabout data was not reported in the characterization survey report. However, the walkabout survey results were reported to be consistent with ambient gamma survey measurements. The average gamma exposure rate for the developed areas of the Santa Susana Field Laboratory Area IV was 13.6 microroentgens per hour (μR/hr) with a maximum rate of 19.4 μR/hr. The average exposure rate for all of Area IV was 14.6 μR/hr with a maximum rate of 21.4 μR/hr. The local background exposure rate outside of Area IV was 15.6 μR/hr with a maximum value of 20.5 μR/hr. According to the survey report, the gamma radiation distribution of Area IV was statistically indistinguishable from the local background gamma radiation distribution. The U.S. Nuclear Regulatory Commission and the State of California specify a limit of 5 μR/hr above the average background of the data set for release of land for radiologically unrestricted use. Ambient gamma regulatory limits were below these acceptable limits.[3]

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Location: None found.

Aerial Photographs: Building 4392 is first identified on a 1988 aerial photograph. In 1995, it is included in a processing area (PA) designated PA-1 in the Environmental Protection Agency's aerial photograph analysis. Because multiple buildings are included in PA-1, aerial photograph analysis for this area cannot be attributed to specific buildings, unless explicitly stated. A 1995 aerial photograph denotes storage tanks, overhead pipes, open storage areas, and a probable stain in PA-1. By 1998, all of the previously identified features in PA-1 were no longer present. By 2005, Building 4392 was no longer present in PA-1.[4]

Radionuclides of Concern: The research team did not find evidence of radioactive material use in Building 4392. Radionuclides associated with potential migration from Systems for Nuclear Auxiliary Power (SNAP) Buildings 4010 and 4012 include: antimony-125 (Sb-125), americium-241 (Am-241), Cs-134, Cs-137, cobalt-60 (Co-60), europium isotopes (Eu-152, Eu-154), isotopes of plutonium (Pu-238, Pu-239, Pu-240, Pu-241), strontium-90 (Sr-90), tritiated titanium

[1] Kneff, et al., *Sodium Component Test Installation (SCTI) Demolition Final Report, EID-08336*, The Boeing Company, October 2003, p. 39.
[2] Correspondence from Lopez, J., Lopez General Engineering Contractors, Inc., to Robinson, K.S., The Boeing Company, *Reference: SCTI Demolition Buildings: 4355, 4356, 4357, 4358, 4457 & Associated, May 22, 2002.*
[3] Rockwell International/Rocketdyne Division, *Area IV Radiological Characterization Survey, A4CM-ZR-0011, Rev. A*, August 15, 1996.
[4] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.

(H-3), and natural and enriched uranium (U-234, U-235, U-238).[1,2,3] All radionuclides of concern listed are included for analysis in the August 2009 *Final Field Sampling Plan, Radiological Background Study, Santa Susana Field Laboratory*. Table 3.3 presents a summary of radiological contaminants of concern.

Drainage Pathways: A storm drain culvert was located north of Building 4392 and ran southwest to 20th Street.[4] Aerial photographs from 1965 to 2005 show drainage flowing south from 20th Street and continuing into Area III impoundments. Aerial photographs from 1957 to 2005 indicate that drainage from PA-1 followed 17th Street to the south and continued to impoundments in Areas III and IV. The Area IV impoundment is identified as IM-5 on aerial photograph analysis and as the 17th Street Drainage in this technical memorandum. The 17th Street Drainage is discussed later in this section.[5] The general slope of Area IV is in a southerly direction. Water runoff is directed to the retention reservoirs which are part of the SSFL industrial effluent control system. Liquid effluent discharge from the final retention pond into the Bell Canyon drainage occurs only after controlled effluent holdup and sampling.[6,7] Because the general slope of Area IV is in a southerly direction, runoff from SNAP Buildings 4010 and 4012 could have impacted the Building 4392 area. The SNAP buildings handled radioactive materials and generated radionuclides, which means there is a possibility of radiological contamination in the area of Building 4392.

Radiological Contamination Potential: Class 2 because of potential radioactive material migration via surface water flow or airborne release from SNAP Buildings 4010 and 4012, and lack of site investigation.

Recommended Locations for Sediment/Soil Sampling:

Plate 1 and Figure 2.2 provide a convenient reference for the following recommendations.

Due to the lack of site investigation and potential radioactive material migration via surface water flow or airborne release from SNAP Buildings 4010 and 4012, there is a possibility that radionuclide concentrations in soil will exceed the standard required by the December 2010 Administrative Order on Consent. Therefore, additional characterization is recommended for the original Building 4392 area. This includes the following Building 4362 areas:

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[1] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume I –Methodology*, May 2005, p. 2-9.
[2] Zwetzig, G.B., *Survey of Fission- and Corrosion-Product Activity in Sodium- or NaK-Cooled Reactors, AI-AEC-MEMO-12790*, Atomics International, a Division of North American Rockwell Corporation, February 28, 1969, p. 5.
[3] Unknown Author, *Facility Information, Building 012*, Unknown Date, HDMSP001828011.
[4] *Technical Site Information, Energy Technology Engineering Center (ETEC), GEN-AT-0027, Revision B*, Rockwell International Corporation, August 1993, p. b-25.
[5] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory - Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.
[6] Chapman, J. A., *Radiological Survey of Buildings T019 and T013; An Area Northwest of T059, T019, T013, and T012; And a Storage Yard West of Buildings T626 and T038, GEN-ZR-0010*, Rockwell International, Rocketdyne Division, August 26, 1988, p. 17.
[7] Map located at: http://www.dtsc-ssfl.com/files/maps/SSFL%20-%20Western%20Half.pdf.

- Storm drainage channel located north of the Building 4392 footprint. The storm drain may have collected storm water from former SNAP Buildings 4010 and 4012. Residual contamination from the storm drain may exist.

- Drainage pathways associated with the Building 4392 area and outside Area IV as proposed by the field sampling plan. Residual contamination may exist in drainages outside of Area IV.

2.2.10 Building 4457 Area

Site Description: The Building 4457 area comprises Building 4457 and the land surrounding it on B Street. Building 4457 was constructed between 1971 and 1972 as the Sodium Component Test Installation (SCTI) Pump Bearing Test Structure. The SCTI Complex included Buildings 4355, 4356, 4357, 4359, 4360, 4361, 4362, 4392, 4457, 4656, and 4756. Building 4457 was located south of B Street near SCTI Buildings 4355 and 4357 and Support Trailer Building 4478.[1,2,3] These buildings are discussed elsewhere in this section. Figures 2.2.10a through 2.2.10b provide a current photograph and the best available building-specific drawing(s) that the research team could find. The research team was unable to find building-specific drawing(s). No as-built drawings were located for Building 4457. Plate 1 presents a summary of all identified features for this site.

Building Features: Building 4457 was a two-story building.[4] The building had three subsurface emergency containment sumps for sodium components. Sump 1 was a sodium drain tank containment sump approximately 27 feet long by 14 feet wide by 10 feet deep. Sump 2 was a sodium pump tank containment sump approximately 12 feet long by 12 feet wide by 14 feet deep. Sump 1 and 2 were connected by a 2 foot-wide by 2 foot-deep trench. Sump 3 was a sodium cold trap containment sump approximately 4 feet long by 4 feet wide by 4 feet deep. During the 1980s, Sump 1 was backfilled with soil and capped with concrete. Concrete berms were placed around the perimeter. The berms later served as secondary containment for the storage of hazardous materials. In a 2000 Resource Conservation and Recovery Act Facility Investigation Work Plan Addendum, the concrete was noted as having evidence of cracks within the containment area. During the 1970s and 1980s, Sump 2 received rainwater, waste oils, and possibly solvents from spills or leakage of hazardous material containers. In the 1980s, the sump was emptied, backfilled with soil, and capped with concrete. Sump 3 was a physical low spot for sodium processes. Hazardous chemicals reportedly were not used or disposed in this sump. It was filled with concrete and capped following building demolition activities.[5]

Former Use(s): Building 4457 was used for proof and performance testing of sodium lubricated bearings used in large sodium pumps. In July 1972, a shaft seal failed, causing oil to

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[1] Kneff, D.W. et al., *Sodium Component Test Installation (SCTI) Demolition Final Report, EID-08336*, October 1, 2003, pgs. 5, 13.
[2] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. P-43.
[3] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[4] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. P-43.
[5] Ogden Environmental and Energy Services Co., Inc., *RCRA Facility Investigation Work Plan Addendum Amendment, Santa Susana Field Laboratory, Ventura County, California*, June 2000, pgs. 7-1–7-2.

contaminate the sodium system. Attempts to clean and repair the system failed. Building 4457 was subsequently gutted and used for storage of waste oils from non-radiological facilities. Hazardous materials stored in the area of 4457 included acids, bases, solvents, and petroleum-based oils and lubricants. By 1996, Building 4457 was listed as "foundation only."[1,2,3]

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: The foundation was removed in 1999.[4] SCTI building structures were removed followed by the below-grade pipes, ducts, trenches, tanks and pits. It doesn't appear that there were any large pits associated with Building 4457. The exact dimensions of the excavation are unknown. Backfilling and grading used on-site soil possibly from the Area IV borrow area.[5,6]

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): Radiological surveys specific to Building 4457 were not conducted. The Building 4457 area was covered as part of the Rockwell/Rocketdyne 1994-1995 Area IV Radiological Characterization Survey. An ambient gamma and walkabout survey was conducted in the area of Building 4457. The average gamma exposure rate for the developed areas of the Santa Susana Field Laboratory Area IV was 13.6 microroentgens per hour (μR/hr) with a maximum rate of 19.4 μR/hr. The average exposure rate for all of Area IV was 14.6 μR/hr with a maximum rate of 21.4 μR/hr. The local background exposure rate outside of Area IV was 15.6 μR/hr with a maximum value of 20.5 μR/hr. According to the survey report, the gamma radiation distribution of Area IV was statistically indistinguishable from the local background gamma radiation distribution. The U.S. Nuclear Regulatory Commission and the State of California specify a limit of 5 μR/hr above the average background of the data set for release of land for radiologically unrestricted use. Ambient gamma regulatory limits were below these acceptable limits.[7]

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Location: None found.

Aerial Photographs: Building 4457 is first identified in a 1972 aerial photograph. It is located in a hazardous material storage area (HMSA) within a processing area (PA) designated PA-1 in the Environmental Protection Agency's aerial photograph analysis. Because multiple buildings

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[1] Kneff, D.W. et al., *Sodium Component Test Installation (SCTI) Demolition Final Report, EID-08336*, October 1, 2003, pgs. 5, 13.
[2] Ogden Environmental and Energy Services Co., Inc., *RCRA Facility Investigation Work Plan Addendum Amendment, Santa Susana Field Laboratory, Ventura County, California*, June 2000, pgs. 7-1–7-2.
[3] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. P-43.
[4] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. P-43.
[5] Kneff, et al., *Sodium Component Test Installation (SCTI) Demolition Final Report, EID-08336*, The Boeing Company, October 2003, p. 39.
[6] Correspondence from Lopez, J., Lopez General Engineering Contractors, Inc., to Robinson, K.S., The Boeing Company, *Reference: SCTI Demolition Buildings: 4355, 4356, 4357, 4358, 4457 & Associated, May 22, 2002.*
[7] Rockwell International/Rocketdyne Division, *Area IV Radiological Characterization Survey, A4CM-ZR-0011, Rev. A*, August 15, 1996.

are included in the HMSA. aerial photograph analysis for this area cannot be attributed to specific buildings. unless explicitly stated. By 1978. a probable open storage area was observed in the HMSA containing approximately six to eight objects. In 1980. probable staining was observed. and in 1983 and 1987 an area of dark-toned material was visible. In 1990 and 1992. areas of possible staining were noted in the HMSA. By 1993. this area no longer appeared active. In 1998. approximately 12 containers were observed at this location. By 2002. the containers and the building had been removed from the HMSA.[1]

Radionuclides of Concern: The research team did not find evidence of radioactive material use in Building 4457. Radionuclides associated with potential migration from Systems for Nuclear Auxiliary Power (SNAP) Buildings 4010 and 4012 include: antimony-125 (Sb-125). americium-241 (Am-241). cesium isotopes (Cs-134. Cs-137). cobalt-60 (Co-60). europium isotopes (Eu-152. Eu-154). isotopes of plutonium (Pu-238. Pu-239. Pu-240. Pu-241). strontium-90 (Sr-90). H-3. U-234. U-235. and U-238.[2,3,4] All radionuclides of concern listed are included for analysis in the August 2009 *Final Field Sampling Plan. Radiological Background Study. Santa Susana Field Laboratory*. Table 3.3 presents a summary of radiological contaminants of concern.

Drainage Pathways: Aerial photographs from 1957 to 2005 indicate that drainage from PA-1 followed 17th Street to the south and continued to impoundments in Areas III and IV. The Area IV impoundment is identified as IM-5 on aerial photograph analysis and as the 17th Street Drainage in this technical memorandum.[5] The 17th Street Drainage is discussed later in this section. The general slope of Area IV is in a southerly direction. Water runoff is directed to the retention reservoirs which are part of the SSFL industrial effluent control system. Liquid effluent discharge from the final retention pond into the Bell Canyon drainage occurs only after controlled effluent holdup and sampling.[6,7] Because the general slope of Area IV is in a southerly direction. runoff from SNAP Buildings 4010 and 4012 could potentially impact Building 4457. The SNAP buildings handled radioactive materials and generated radionuclides. which means there is a possibility of radiological contamination in the area of Building 4457.

Radiological Contamination Potential: Class 2 because of potential radioactive material migration via surface water flow or airborne release from SNAP Buildings 4010 and 4012. possible and probable stains noted in aerial photographs. and lack of site investigation.

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[1] Kartman. A.S.. *Aerial Photographic Analysis of Santa Susana Field Laboratory - Area IV. Ventura County. California. Volume 1 & 2*. U.S. Environmental Protection Agency. Office of Research and Development. Environmental Sciences Division. March 2010.

[2] Sapere Consulting. Inc. and The Boeing Company. *Historical Site Assessment of Area IV Santa Susana Field Laboratory. Ventura County. California. Volume 1 -Methodology*. May 2005. p. 2-9.

[3] Zwetzig. G.B.. *Survey of Fission- and Corrosion-Product Activity in Sodium- or NaK-Cooled Reactors. AI-AEC-MEMO-12790*. Atomics International. a Division of North American Rockwell Corporation. February 28. 1969. p. 5.

[4] Unknown Author. *Facility Information. Building 012*. Unknown Date. HDMSP001828011.

[5] Kartman. A.S.. *Aerial Photographic Analysis of Santa Susana Field Laboratory - Area IV. Ventura County. California. Volume 1 & 2*. U.S. Environmental Protection Agency. Office of Research and Development. Environmental Sciences Division. March 2010.

[6] Chapman. J. A.. *Radiological Survey of Buildings T019 and T013; An Area Northwest of T059. T019. T013. and T012; And a Storage Yard West of Buildings T626 and T038. GEN-ZR-0010*. Rockwell International. Rocketdyne Division. August 26. 1988. p. 17.

[7] Map located at: http://www.dtsc-ssfl.com/files/maps/SSFL%20-%20Western%20Half.pdf.

Recommended Locations for Sediment/Soil Sampling:

Plate 1 and Figure 2.2 provide a convenient reference for the following recommendations.

Due to the lack of site investigation, stains noted in aerial photographs, and potential radioactive material migration via surface water flow or airborne release from SNAP Buildings 4010 and 4012, there is a possibility that radionuclide concentrations in soil will exceed the standard required by the December 2010 Administrative Order on Consent. Therefore, additional characterization is recommended for the original Building 4457 area. This includes the following Building 4457 areas:

- Former containment sumps in the Building 4457 area. If radiological materials migrated or were released into the pit, residual contamination may exist in the area.

- Low-lying areas south and east of Building 4457 footprint included in the HMSA where recessed areas were identified in aerial photographs. Low-lying areas could collect possible radioactive drainage from Buildings 4010 and 4012 and may contain residual contamination.

- Possible and probable stained areas identified in aerial photographs south and east of the Building 4457 footprint. Unknown stains could possibly contain residual contamination.

- Drainage pathways associated with the Building 4457 area and outside Area IV as proposed by the field sampling plan. Residual contamination may exist in drainages outside of Area IV.

2.2.11 Building 4478 Area

Site Description: The Building 4478 area comprises Building 4478 and the land surrounding it on B Street. Building 4478 was first identified on a 1967 industrial planning map as an office support trailer located east of the Hot Laboratory Building 4020, discussed in Subarea HSA-5D. Between 1967 and 1971, Building 4478 was moved from its original location to a position on B Street, northeast of Sodium Component Test Installation (SCTI) Buildings 4357 and 4457.[1,2] These buildings are discussed elsewhere in this section. Figure 2.2.11a provides a current photograph. The research team was unable to find building-specific drawing(s). No as-built drawings were located for Building 4478. Plate 1 presents a summary of all identified features for this site.

Building Features: Building 4478 was a dual axis 8-foot by 30-foot office trailer.[3]

Former Use(s): Building 4478 was originally used as a support trailer. By 1971, the building was used to service the SCTI. The SCTI complex was a development test facility for liquid

[1] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. P-47.
[2] SSFL Area IV, Atomics International Nuclear Development Field Laboratories, Industrial Planning Maps, January 1967, April 1971.
[3] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. P-47.

metal (sodium) system components. The facility provided a test site for the non-nuclear developmental testing of typical liquid metal reactor components, primarily steam generators. By 1981, Building 4478 was used for radioactive count analysis.[1,2]

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: Demolished.[3] Based on available information, the dimensions of the excavation made during building demolition are unknown.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): At demolition and prior to disposition, liquid sodium from the SCTI complex was tested for radioactivity and reportedly found to be free of contamination. Since radiological materials were not handled in Building 4478 and no contamination occurred, no further tests were conducted.[4]

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Location: None found.

Aerial Photographs: Building 4478 is first clearly visible in a 1980 aerial photograph. It is located in a hazardous material storage area (HMSA) within a processing area (PA) designated PA-1 in the Environmental Protection Agency's aerial photograph analysis. Because multiple buildings are included in the HMSA, aerial photograph analysis for this area cannot be attributed to specific buildings, unless explicitly stated. In 1978, a probable open storage area was observed in the HMSA containing approximately six to eight objects. In 1980, probable staining was observed, and in 1983 and 1987 an area of dark-toned material was visible. In 1990 and 1992, areas of possible staining were noted in the HMSA. By 1993, this area no longer appeared active. In 1998, approximately 12 containers were observed at this location. By 2002, the containers and the building had been removed from the HMSA.[5]

Radionuclides of Concern: The research team did not find evidence of radioactive material use in Building 4478. Radionuclides associated with potential migration from Systems for Nuclear Auxiliary Power (SNAP) Buildings 4010 and 4012 include: antimony-125 (Sb-125), americium-241 (Am-241), cesium isotopes (Cs-134, Cs-137), cobalt-60 (Co-60), europium isotopes (Eu-152, Eu-154), isotopes of plutonium (Pu-238, Pu-239, Pu-240, Pu-241), strontium-90 (Sr-90), H-

[1] Kneff, D.W. et al., *Sodium Component Test Installation (SCTI) Demolition Final Report, EID-08336*, October 1, 2003, p. 5.
[2] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. P-47.
[3] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. P-47.
[4] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. P-47.
[5] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.

3, U-234, U-235, and U-238.[1,2,3] All radionuclides of concern listed are included for analysis in the August 2009 *Final Field Sampling Plan, Radiological Background Study, Santa Susana Field Laboratory*. Table 3.3 presents a summary of radiological contaminants of concern.

Drainage Pathways: Aerial photographs from 1957 to 2005 indicate that drainage from PA-1 followed 17th Street to the south and continued to impoundments in Areas III and IV. The Area IV impoundment is identified as IM-5 on aerial photograph analysis and as the 17th Street Drainage in this technical memorandum.[4] The 17th Street Drainage is discussed later in this section. The general slope of Area IV is in a southerly direction. Water runoff is directed to the retention reservoirs which are part of the SSFL industrial effluent control system. Liquid effluent discharge from the final retention pond into the Bell Canyon drainage occurs only after controlled effluent holdup and sampling.[5,6] Because the general slope of Area IV is in a southerly direction, runoff from SNAP Buildings 4010 and 4012 could potentially impact Building 4478. The SNAP buildings handled radioactive materials and generated radionuclides, which means there is a possibility of radiological contamination in the area of Building 4478.

Radiological Contamination Potential: Class 2 because of potential radioactive material migration via surface water flow or airborne release from SNAP Buildings 4010 and 4012, possible and probable staining noted in aerial photographs, and lack of site investigation.

Recommended Locations for Sediment/Soil Sampling:

Plate 1 and Figure 2.2 provide a convenient reference for the following recommendations.

Due to the lack of site investigation, possible and probable staining noted in aerial photographs, and potential radioactive material migration via surface water flow or airborne release from SNAP Buildings 4010 and 4012, there is a possibility that radionuclide concentrations in soil will exceed the standard required by the December 2010 Administrative Order on Consent. Therefore, additional characterization is recommended for the Building 4478 area. This includes the following Building 4478 areas:

- Northern and western edges of the Building 4478 footprint nearest B Street. Possible storm drainage from Buildings 4010 and 4012 may have contaminated the area.

- Possible and probable stained areas identified in aerial photographs south of the Building 4478 footprint. Unknown stains could possibly contain residual contamination.

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[1] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 1 –Methodology*, May 2005, p. 2-9.
[2] Zwetzig, G.B., *Survey of Fission- and Corrosion-Product Activity in Sodium- or NaK-Cooled Reactors, A1-AEC-MEMO-12790*, Atomics International, a Division of North American Rockwell Corporation, February 28, 1969, p. 5.
[3] Unknown Author, *Facility Information, Building 012*, Unknown Date, HDMSP001828011.
[4] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory - Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.
[5] Chapman, J. A., *Radiological Survey of Buildings T019 and T013; An Area Northwest of T059, T019, T013, and T012; And a Storage Yard West of Buildings T626 and T038, GEN-ZR-0010*, Rockwell International, Rocketdyne Division, August 26, 1988, p. 17.
[6] Map located at: http://www.dtsc-ssfl.com/files/maps/SSFL%20-%20Western%20Half.pdf.

- Drainage pathways associated with the Building 4478 area and outside Area IV as proposed by the field sampling plan. Residual contamination may exist in drainages outside of Area IV.

2.3 Group 3

The Group 3 index map is presented in Figure 2.3. Following Figure 2.3, the site photograph and layout drawings for each building area within HSA-5B Group 3 are presented. HSA-5B Group 3 includes six building areas containing the Building 4006 Sodium Laboratory, the Building 4606 and 4607 Sodium Laboratory Instrument Buildings, the Building 4615 Combustion Test Facility, the Building 4402 MHD Experiment Building, and Parking Lot 4506.

2.3.1 Building 4006 Area

Site Description: The Building 4006 area comprises Building 4006, Cooling Tower 4616, Electrical Substation 4706, an unknown Building 4477, and the land surrounding these buildings on the west side of 17th Street. Building 4006 was constructed between 1957 and 1959 as a sodium laboratory. Cooling Tower 4616 associated with Building 4006 was removed in the early 1980s to make room for a Power Pak associated substation.[1,2,3] Figures 2.3.1a through 2.3.1c provide a current photograph and the best available building-specific drawing(s) that the research team could find. Figure 2.3.1b is an as-built elevation and section drawing of Building 4006. Plate 1 presents a summary of all identified features for this site.

Building Features: Building 4006 has a steel frame and walls. It measures approximately 13,284 square feet and includes 2,268 square feet of office space and 7,674 square feet of lab space.[4] An active septic tank near Building 4006 was identified in 1999. Rocketdyne planned to abandon the septic tank and connect Building 4006 to an existing sewer system. Presumably, this is the Building 4006 septic tank that was removed in 2000. The location of the former septic tank is currently unknown, but presumably on the southwest side of the building near the sanitary sewer connection. The Building 4005/4006 leach field (identified as AI-Z8) had two underground septic tanks (Building 4005 septic tank and Building 4006 septic tank) with 2,340-gallon capacities and a 480 linear feet leach field. It was located in Parking Lot 4502, approximately 550 feet southwest of Building 4005 and 150 feet northeast of Building 4062. Although Building 4005 handled depleted and enriched uranium for nine months in 1966-1967, it is not likely to have impacted the Building 4005/4006 leach field as the leach field was disconnected and abandoned in 1960-1961 when the sewer treatment plant was constructed. The Building 4005/4006 leach field and drain lines were removed in 2001.[5,1,2,3,4]

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[1] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.

[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962-November 1992.

[3] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. O-5.

[4] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962-November 1992.

[5] ICF Kaiser Engineers, *Current Conditions Report and Draft RCRA Facility Investigation Work Plan, Area IV Santa Susana Field Laboratory, Ventura County, California, Part 1-Current Conditions Report, Volume 1*, October 1993, pgs. 4-83, 4-87.

A 1974 engineering drawing depicts a supply and drain tank (T-102) and an additional storage and drain tank (T-301) associated with Building 4006. See Figure 2.3.1c. The exact location of these tanks is not clear.

Former Use(s): Building 4006 was operated as a non-nuclear sodium laboratory. Use Authorizations provided for minor uses of radioactive materials. Cooling Tower 4616 was removed in the early 1980s to make room for a Power Pak associated substation. Building 4006 closed operations in 1999.[5]

Information from Interviewees: A number of former employees were interviewed about their experience at the SSFL. Three remembered Building 4006. Excerpts from their interviews are included below.

Interviewee 101 was an Atomics International employee from 1986 to 1997. The interviewee was a manager of system and test activities in the Engineering Department. The following excerpt was pulled from the interview.

> *"There was once a sodium leak on the floor from the Building 006 sodium loop, to which the SSFL fire department responded. Other than that, I am unaware of areas that may require cleanup."* [6]

Interviewee 110 was a member of the technical staff at SSFL who designed and tested high temperature liquid sodium systems, but did not recall working on anything radioactive. The following excerpts were pulled from the interview.

> *"Anyhow, having gotten hooked on this sodium stuff, I went to Building 6 (the Sodium Laboratory) where there were three or four sodium loops and I managed testing that went on there for some time. I also designed one of the loops. Building 6 is still there – I remember driving by it when I took the tour last year. Eventually in the late 70's I became Lead Engineer for the sodium purification system – I was the man who knew all about it. But not everyone agreed with me in terms of technical disputes! I trained outsiders such as people from DOE on one of the loops in Building 6 to give them a taste of what it was like to operate a sodium system. They actually got to operate a loop. With respect to Building 6,*

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[1] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, pgs. O-2, O-5–O-6.
[2] Correspondence from Lenox, A., The Boeing Company, to Evans, J., Ventura County Environmental Health Division, *Reference: Building 4006 Septic Tank Abandonment, Boeing North American, Santa Susana Field Laboratory, Ventura County, California*, June 14, 1999.
[3] *Group 5 – Central Portion of Areas III and IV RCRA Facility Investigation Report, Santa Susana Field Laboratory, Ventura County, California, Volume V – RFI Site Reports, Appendix I, Coal Gasification Process Development Unit*, CH2M Hill, Draft in Progress November 2008, p. Table I.2-4.
[4] Correspondence from Lee, M., The Boeing Company, to Richards, A., U.S. Department of Energy, *Reference: DE-AC03-99SF21530, Environmental Restoration and Remediation of the former Energy Technology Engineering Center (ETEC) Site Reporting Requirements Checklist FY00 Performance Milestones 00-4, Soil and Groundwater, removal of three septic tanks, 7/30/00*, September 12, 2000.
[5] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. O-5.
[6] Interview No. 101 conducted by DOE in 2010.

as an example, the company did not have a strong sense that people performing these tasks should be heavily trained and follow well thought out procedures. The people who preceded me in Building 6 did everything from memory. There were no recorded procedures until I came along. I wrote procedures detailed enough so that my secretary could operate the equipment.

Sodium was easy to get rid of and its by-products are non-toxic. Improper disposal did not occur in areas where I worked and frankly, I was one of those people that if anyone had proposed of doing anything stupid like that I would have gone ballistic!" [1]

Interviewee 277 started working at SSFL in May 1975 as a technician in Building 4006 for Atomic International's Sodium & Component Technology Group. The interviewee was transferred 2 to 3 years later to work at the RMHF. The following excerpts were pulled from the interview.

"At Building 006 I worked for IKL – he brought me in to the chemistry lab. I always kept a notebook as to what I did on experiments. I would turn the notebook in to the Engineer or Department Head. We would take samples. JLM worked on sensitizing stainless steel by putting it in different acid baths like acetic or nitric. The samples would go in the sodium loop and it would be run for a number of hours and then we would look at them to see if the sodium was still adhered to the stainless steel. We would see how we could clean the samples to test how well the sodium bonded." [2]

Radiological Incident Reports: There has been one incident associated with Building 4006. The following table provides information presented in an incidents database provided by Boeing. Summaries of only the incident reports that resulted or may have resulted in releases to the environment are provided following the table, when available. Summaries of all available incident reports are provided in Attachment A.

Building 4006 Incident Report Summary

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A0484	8/11/1960	BLDG MET LAB	AP	POLISHING SAMPLES OF SRE MODERATOR CAN CONTAMINATED CLEAN AREA.

- In addition to the incident described in Boeing's database, a 2008 Resource Conservation and Recovery Act Facility Investigation report describes other incidents associated with Building 4006, including a sodium fire on November 25, 1987 resulting in a release of sodium metal, a mercury spill in a sink on January 21, 1992, and a tetralin fire on August 16, 1959.[3]

[1] Interview No. 110 conducted by DOE in 2010.
[2] Interview No. 277 conducted by DOE in 2010.
[3] *Group 5 – Central Portion of Areas III and IV RCRA Facility Investigation Report, Santa Susana Field Laboratory, Ventura County, California, Volume V – RFI Site Reports, Appendix I, Coal Gasification Process Development Unit*, CH2M Hill, Draft in Progress November 2008, p. Table 1.2-1.

Current Use: Building 4006 is standing as of 2010, but is no longer in use.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): A chronology of radiological investigations at this building is as follows:

- **2001 Boeing Soil Sampling**. Soil sampling was performed during excavation of the leach field, septic tanks, and drain lines in 2001. No contamination was reportedly detected.[1,2]
- **2008 Boeing Radiological Survey**. In 2008, The Boeing Company performed a radiological survey to verify that Building 4006 met release criteria for unrestricted use. Exposure rate measurements, surface scans, and smear samples were taken at targeted locations. Exposure rate measurements were below the acceptable limit of 5 microroentgens per hour (μR/hr) above natural background. Surface residual radioactivity levels were below the 2008 acceptable limits identified in the table below. Building 4006 was recommended for release.[3]

Surface Residual Radioactivity Guidelines for SSFL Facilities

Radionuclide	Type of Radiation	Average over 1 m^2 (dpm/100 cm^2)	Maximum over 100 cm^2 (dpm/100 cm^2)	Removable (dpm/100 cm^2)
Uranium (U-234, U-235, U-238)	Alpha	5,000	15,000	1,000
Mixed Fission Products (Cesium-137)	Beta, Gamma	5,000	15,000	1,000
Activation Products (Manganese-54)	Beta, Gama	5,000	15,000	1,000
Tritium	Beta	---	---	10,000

Radiological Use Authorizations: Radiological Use Authorizations for Building 4006 include the following:

- Use Authorization No. 66 (September 28, 1973) specified that sodium (Na) would be added to canisters containing uranium oxide (UO_2) in Building 4006.[4]

- Use Authorization No. 81 (June 26, 1974) permitted the use of tritiated titanium (H-3) foils (i.e, a thin, sheet of metal) as gas chromatograph detectors. The foils were declared excess in 1986 and removed from the building.[5]

[1] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 –Area IV Site Summaries*, May 2005, pgs. O-5–O-6.
[2] Cabrera Services, *Final Radiological Final Status Survey of Building 4006*, June 2008, pgs. vi, 8-9, 38.
[3] Cabrera Services, *Final Radiological Final Status Survey of Building 4006*, June 2008, pgs. vi, 8-9, 38.
[4] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. O-5.
[5] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. O-5.

- Use Authorization No. 101 (April 8, 1976) permitted the handling of 0.5 microcuries (μCi) of manganese-54 (Mn-54) contained in sections of activated piping with frozen sodium. This piping was packaged in aluminum piping; the unpacking occurred in Building 4006.[1]

Former Radiological Burial or Disposal Locations: None found.

Aerial Photographs: Building 4006 is first identified in a 1959 aerial photograph. It is included in a processing area (PA) designated PA-1 in the Environmental Protection Agency's (EPA's) aerial photograph analysis. Because multiple buildings are included in PA-1, aerial photograph analysis for this area cannot be attributed to specific buildings, unless explicitly stated. A 1959 aerial photograph shows a possible stain just north of Building 4006. A 1962/63 aerial photograph identifies overhead pipes and ground scarring in PA-1. Aerial photographs from 1965 through 1995 denote possible storage tanks and overhead pipes in PA-1. Open storage areas are noted in PA-1 in 1978, 1980, and 1995. In 1967 and 1978, a stain was identified in PA-1. In 1980 and 1983, a possible stain was noted in PA-1. A probable stain was identified in PA-1 in 1995. By 1998, all of the previously identified features in PA-1 were no longer present. In 2005, Building 4006 is one of only two buildings observed in PA-1.[2]

Radionuclides of Concern: Building 4006 was predominantly a non-radiological facility, but there are records of minor uses of radioactive materials, including UO_2, Mn-54, H-3 foils in gas chromatographs, and sodium loop level gauges possibly employing cesium-137 (Cs-137) sources. Radionuclides that may be present as a result of residual radioactivity in Building 4006 include: Cs-137, Mn-54, H-3, and natural and enriched uranium (U-234, U-235, U-238).[3] Radionuclides associated with potential migration from Systems for Nuclear Auxiliary Power (SNAP) Buildings 4010, 4012, and 4024 include: antimony-125 (Sb-125), americium-241 (Am-241), Cs-134, Cs-137, cobalt-60 (Co-60), europium isotopes (Eu-152, Eu-154), isotopes of plutonium (Pu-238, Pu-239, Pu-240, Pu-241), strontium-90 (Sr-90), H-3, and U-234, U-235, U-238.[4,5,6] All radionuclides of concern listed, with the exception of Mn-54, are included for analysis in the August 2009 *Final Field Sampling Plan, Radiological Background Study, Santa Susana Field Laboratory*. Mn-54 has a half-life of less than one year and thus does not meet the criteria for analysis. Table 3.3 presents a summary of radiological contaminants of concern.

Drainage Pathways: A lined drainage channel following 17th Street to the southeast begins approximately 100 feet southeast of Building 4006.[7] A 1988 memorandum references a Building

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[1] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. O-5.
[2] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.
[3] Cabrera Services, *Final Radiological Final Status Survey of Building 4006*, June 2008, pgs. vi, 8-9, 38.
[4] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 1 – Methodology*, May 2005, p. 2-9.
[5] Unknown Author, *Facility Information, Building 012*, Unknown Date, HDMSP001828011.
[6] Zwetzig, G.B., *Survey of Fission- and Corrosion-Product Activity in Sodium- or NaK-Cooled Reactors, AI-AEC-MEMO-12790*, Atomics International, a Division of North American Rockwell Corporation, February 28, 1969, pgs. 5, 10.
[7] Map located at: http://dtsc-ssfl.com/files/maps/SSFL%20-%20Western%20Half.pdf.

4006 ditch that leads to the G and 17th Street exit.[1] Aerial photographs from 1957 to 2005 indicate that drainage followed 17th Street to the south and continued to impoundments in Areas III and IV. The Area IV impoundment is identified as IM-5 on aerial photograph analysis and as the 17th Street Drainage in this technical memorandum.[2] The 17th Street Drainage is discussed later in this section. The general slope of Area IV is in a southerly direction. Water runoff is directed to the retention reservoirs which are part of the SSFL industrial effluent control system. Liquid effluent discharge from the final retention pond into the Bell Canyon drainage occurs only after controlled effluent holdup and sampling.[3,4] Because the general slope of Area IV is in a southerly direction, runoff from SNAP Buildings 4010, 4012, and 4024 could potentially impact Building 4006. The SNAP buildings handled radioactive materials and generated radionuclides, which means there is a possibility of radiological contamination in the area of Building 4006.

Radiological Contamination Potential: Class 2 because regulated radiological material was handled in Building 4006, aerial photograph analysis noted possible stains, and there is potential for radioactive material migration via surface water flow or airborne release from SNAP Buildings 4010, 4012, and 4024.

Recommended Locations for Sediment/Soil Sampling:

Plate 1 and Figure 2.3 provide a convenient reference for the following recommendations.

Due to regulated radiological material use, possible stains noted in aerial photographs, and the potential of radioactive material migration via surface water flow or airborne release from SNAP Buildings 4010, 4012, and 4024, there is a possibility that radionuclide concentrations in soil will exceed the standard required by the December 2010 Administrative Order on Consent. Therefore, additional characterization is recommended for the Building 4006 area. This includes the following Building 4006 areas:

- Former Building 4006 septic tank area presumably on the southwest side of the building. If radioactive materials were released into the septic system, residual contamination may exist in the materials surrounding the former septic tank.

- Former Building 4005/4006 leach field west of the Building 4006 footprint. If radioactive materials were released into the septic system, residual contamination may exist in the materials surrounding the former leach field.

[1] Memorandum from Fujikawa, N., to Those Concerned, *Reference: SCTI Support*, October 14, 1988, HDMSE00600015.
[2] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.
[3] Chapman, J. A., *Radiological Survey of Buildings T019 and T013; An Area Northwest of T059, T019, T013, and T012; And a Storage Yard West of Buildings T626 and T038, GEN-ZR-0010,* Rockwell International, Rocketdyne Division, August 26, 1988, p. 17.
[4] Map located at: http://www.dtsc-ssfl.com/files/maps/SSFL%20-%20Western%20Half.pdf.

- Drainage pathway along 17th Street, east of the Building 4006 footprint. If radioactive materials drained from the SNAP facilities to the north, residual contamination may exist along the 17th Street drainage east of Building 4006.

- Building 4006 ditch, if location can be determined. If radioactive materials were released into the ditch, residual contamination may exist in the surrounding the area.
- Area north of Building 4006 where a possible stain is noted in aerial photograph. An unknown stain could be a potential source of contamination.

- Drainage pathways associated with the Building 4006 area and outside Area IV as proposed by the field sampling plan. Residual contamination may exist in drainages outside of Area IV.

2.3.2 Building 4402 Area

Site Description: The Building 4402 area comprises Building 4402 and the land surrounding it west of 17th Street. Building 4402 was constructed between 1964 and 1967 and is identified on industrial planning maps as the MHD Experiment. It is last identified on a March 1975 industrial planning map. Building 4402 was a small structure located between Hydrogen Recombiner Test Canopy Building 4816 and Sodium Laboratory Instrument Building 4607.[1,2] These buildings are discussed elsewhere in this section. Figure 2.3.2a provides a current photograph. The research team was unable to find building-specific drawing(s). No as-built drawings were located for Building 4402. Plate 1 presents a summary of all identified features for this site.

Building Features: No information was located.

Former Use(s): Building 4402 was a non-radiological facility.[3] No other information could be located.

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: Demolished.[4] Based on available information, the dimensions of the excavation made during building demolition are unknown.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): Radiological surveys specific to Building 4402 were not conducted. The Building 4402 area was covered as part of the Rockwell/Rocketdyne 1994-1995 Area IV Radiological Characterization

[1] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[2] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. O-9.
[3] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. O-9.
[4] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. O-9.

Survey. A walkabout gamma survey was conducted in the area of Building 4402. Only areas showing elevated gamma activity in the walkabout survey were followed up with an ambient gamma survey. Walkabout data was not reported in the characterization survey report. However, the walkabout survey results were reported to be consistent with ambient gamma survey measurements. The average gamma exposure rate for the developed areas of the Santa Susana Field Laboratory Area IV was 13.6 microroentgens per hour (μR/hr) with a maximum rate of 19.4 μR/hr. The average exposure rate for all of Area IV was 14.6 μR/hr with a maximum rate of 21.4 μR/hr. The local background exposure rate outside of Area IV was 15.6 μR/hr with a maximum value of 20.5 μR/hr. According to the survey report, the gamma radiation distribution of Area IV was statistically indistinguishable from the local background gamma radiation distribution. The U.S. Nuclear Regulatory Commission and the State of California specify a limit of 5 μR/hr above the average background of the data set for release of land for radiologically unrestricted use. Ambient gamma regulatory limits were below these acceptable limits.[1]

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Location: None found.

Aerial Photographs: Building 4402 is first clearly visible in a 1967 aerial photograph and is included in a processing area (PA) designated PA-1 in the Environmental Protection Agency's aerial photograph analysis. Because multiple buildings are included in PA-1, aerial photograph analysis for this area cannot be attributed to specific buildings, unless explicitly stated. Aerial photographs from 1967 through 1995 denote possible storage tanks and overhead pipes in PA-1. Open storage areas are noted in PA-1 in 1978, 1980, and 1995. In 1967 and 1978, a stain was identified in PA-1. In 1980 and 1983, a possible stain was noted in PA-1. A probable stain was identified in PA-1 in 1995, but Building 4402 is no longer present in PA-1.[2]

A 1978 aerial photograph identifies a probable horizontal tank and possible leakage causing a stain located southeast of Building 4402 and outside of PA-1. A 1980 aerial photograph notes that a drainage path follows along a dirt road that travels southeast along the west side of Building 4402 and curves east toward 17th Street. A large probable stained area is located southeast of Building 4402 and outside of PA-1, where the drainage appears to run before reaching 17th Street.[3]

Radionuclides of Concern: The research team did not find evidence of radioactive material use in Building 4402. Radionuclides associated with potential migration from Building 4006 include: cesium-137 (Cs-137), manganese-54 (Mn-54), tritiated titanium (H-3), natural and enriched uranium (U-234, U-235, U-238), and uranium oxide (UO_2).[4] Radionuclides associated with potential migration from Systems for Nuclear Auxiliary Power (SNAP) Buildings 4010 and

[1] Rockwell International/Rocketdyne Division, *Area IV Radiological Characterization Survey, A4CM-ZR-0011, Rev. A*, August 15, 1996.
[2] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.
[3] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.
[4] Cabrera Services, *Final Radiological Final Status Survey of Building 4006*, June 2008, pgs. vi, 8-9, 38.

4012 include: antimony-125 (Sb-125), americium-241 (Am-241), Cs-134, Cs-137, cobalt-60 (Co-60), europium isotopes (Eu-152, Eu-154), isotopes of plutonium (Pu-238, Pu-239, Pu-240, Pu-241), strontium-90 (Sr-90), H-3, U-234, U-235, and U-238.[1,2,3] All radionuclides of concern listed, with the exception of Mn-54, are included for analysis in the August 2009 *Final Field Sampling Plan, Radiological Background Study, Santa Susana Field Laboratory*. Mn-54 has a half-life of less than one year and thus does not meet the criteria for analysis. Table 3.3 presents a summary of radiological contaminants of concern.

Drainage Pathways: A 1980 aerial photograph notes that a drainage path follows along a dirt road that travels southeast along the west side of Building 4402 and curves east toward 17th Street. Aerial photographs from 1957 to 2005 indicate that drainage from PA-1 followed 17th Street to the south and continued to impoundments in Areas III and IV. The Area IV impoundment is identified as IM-5 on aerial photograph analysis and as the 17th Street Drainage in this technical memorandum.[4] The 17th Street Drainage is discussed later in this section. The general slope of Area IV is in a southerly direction. Water runoff is directed to the retention reservoirs which are part of the SSFL industrial effluent control system. Liquid effluent discharge from the final retention pond into the Bell Canyon drainage occurs only after controlled effluent holdup and sampling.[5,6] Because the general slope of Area IV is in a southerly direction, runoff from Sodium Laboratory Building 4006, and SNAP Buildings 4010 and 4012 could potentially impact Building 4402. Building 4006 had minor use of radioactive materials. The SNAP buildings handled radioactive materials and generated radionuclides, which means there is a possibility of radiological contamination in the area of Building 4402.

Radiological Contamination Potential: Class 2 because of potential radioactive material migration via surface water flow or airborne release from Buildings 4006, 4010 and 4012, and lack of site investigation.

Recommended Locations for Sediment/Soil Sampling:

Plate 1 and Figure 2.3 provide a convenient reference for the following recommendations.

Due to the potential of radioactive material migration via surface water flow or airborne release from Buildings 4006, 4010, and 4012, and the lack of site investigation, there is a possibility that radionuclide concentrations in soil will exceed the standard required by the December 2010 Administrative Order on Consent. Therefore, additional characterization is recommended for the Building 4402 area. This includes the following Building 4402 areas:

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[1] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume I – Methodology*, May 2005, p. 2-9.
[2] Zwetzig, G.B., *Survey of Fission- and Corrosion-Product Activity in Sodium- or NaK-Cooled Reactors, AI-AEC-MEMO-12790*, Atomics International, a Division of North American Rockwell Corporation, February 28, 1969, p. 5.
[3] Unknown Author, *Facility Information, Building 012*, Unknown Date, HDMSP001828011.
[4] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.
[5] Chapman, J. A., *Radiological Survey of Buildings T019 and T013; An Area Northwest of T059, T019, T013, and T012; And a Storage Yard West of Buildings T626 and T038, GEN-ZR-0010*, Rockwell International, Rocketdyne Division, August 26, 1988, p. 17.
[6] Map located at: http://www.dtsc-ssfl.com/files/maps/SSFL%20-%20Western%20Half.pdf.

- Drainage pathway located west and south of the Building 4402 footprint. If radioactive materials drained from facilities to the north, residual contamination may exist along the drainage pathways west and south of Building 4402.

- Stained area identified on aerial photographs located southeast of the Building 4402 footprint. An unknown stain could be a potential source of contamination.

- Drainage pathways associated with the Building 4006 area and outside Area IV as proposed by the field sampling plan. Residual contamination may exist in drainages outside of Area IV.

2.3.3 Parking Lot 4506 Area

Site Description: The Parking Lot 4506 area comprised Parking Lot 4506 and the land surrounding it between 17th Street and the eastern side of Building 4006. Parking Lot 4506 was first identified by name on a 1967 industrial planning map. However, a 1959 aerial photograph shows the area being used as a parking lot. The site served as a parking lot for Buildings 4005, 4006, 4024, 4025, and adjacent facilities.[1,2,3] Figure 2.3.3a provides a current photograph. The research team was unable to find building-specific drawing(s). Buildings east of 17th Street are discussed in the Subarea HSA-5A TM. Buildings 4606, 4607, 4615, and 4816 are discussed elsewhere in this section. No as-built drawings were located for Parking Lot 4506. Plate 1 presents a summary of all identified features for this site.

Building Features: No information was located.

Former Use(s): Parking Lot 4506 is a parking lot servicing Buildings 4005, 4006, 4024, 4025, and adjacent facilities.[4]

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: The parking lot is still present in 2010.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): Radiological surveys specific to Parking Lot 4506 were not conducted. The Parking Lot 4506 area was covered as part of the Rockwell/Rocketdyne 1994-1995 Area IV Radiological Characterization Survey. A walkabout gamma survey was conducted in the Parking Lot 4506 area. Only areas showing elevated gamma activity in the walkabout survey were followed up with an ambient gamma survey. Walkabout data was not reported in the characterization survey

[1] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. O-11.
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[3] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.
[4] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. O-11.

report. However, the walkabout survey results were reported to be consistent with ambient gamma survey measurements. The average gamma exposure rate for the developed areas of the Santa Susana Field Laboratory Area IV was 13.6 microroentgens per hour (μR/hr) with a maximum rate of 19.4 μR/hr. The average exposure rate for all of Area IV was 14.6 μR/hr with a maximum rate of 21.4 μR/hr. The local background exposure rate outside of Area IV was 15.6 μR/hr with a maximum value of 20.5 μR/hr. According to the survey report, the gamma radiation distribution of Area IV was statistically indistinguishable from the local background gamma radiation distribution. The U.S. Nuclear Regulatory Commission and the State of California specify a limit of 5 μR/hr above the average background of the data set for release of land for radiologically unrestricted use. Ambient gamma regulatory limits were below these acceptable limits.[1]

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Location: None found.

Aerial Photographs: Parking Lot 4506 appears on a 1959 aerial photograph. In 1978, a large stained area is noted south of the parking lot. A probable stain is located in the same area south of Parking Lot 4506 in 1980. In 1983 and 1988, a pipeline is identified south of Parking Lot 4506 running southeast along 17th Street. By 1995, the portion of the pipeline nearest the parking lot has been removed. The Parking Lot is still visible in a 2005 aerial photograph.[2]

Radionuclides of Concern: The research team did not find evidence of radioactive material use in Parking Lot 4506. Radionuclides associated with potential migration from Building 4006 include: cesium-137 (Cs-137), manganese-54 (Mn-54), tritiated titanium (H-3), natural and enriched uranium (U-234, U-235, U-238), and uranium oxide (UO_2).[3] Radionuclides associated with potential migration from Systems for Nuclear Auxiliary Power (SNAP) Buildings 4010 and 4012 include: antimony-125 (Sb-125), americium-241 (Am-241), Cs-134, Cs-137, cobalt-60 (Co-60), europium isotopes (Eu-152, Eu-154), isotopes of plutonium (Pu-238, Pu-239, Pu-240, Pu-241), strontium-90 (Sr-90), H-3, U-234, U-235, and U-238.[4,5,6] All radionuclides of concern listed, with the exception of Mn-54, are included for analysis in the August 2009 *Final Field Sampling Plan, Radiological Background Study, Santa Susana Field Laboratory*. Mn-54 has a half-life of less than one year and thus does not meet the criteria for analysis. Table 3.3 presents a summary of radiological contaminants of concern.

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[1] Rockwell International/Rocketdyne Division, *Area IV Radiological Characterization Survey, A4CM-ZR-0011, Rev. A*, August 15, 1996.

[2] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.

[3] Cabrera Services, *Final Radiological Final Status Survey of Building 4006*, June 2008, pgs. vi, 8-9, 38.

[4] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 1 –Methodology*, May 2005, p. 2-9.

[5] Zwetzig, G.B., *Survey of Fission- and Corrosion-Product Activity in Sodium- or NaK-Cooled Reactors, Al-AEC-MEMO-12790*, Atomics International, a Division of North American Rockwell Corporation, February 28, 1969, p. 5.

[6] Unknown Author, *Facility Information, Building 012*, Unknown Date, HDMSP001828011.

Drainage Pathways: A lined drainage channel runs southeast along 17th Street from the south end of the parking lot.[1] Aerial photographs from 1957 to 2005 indicate that drainage from PA-1 followed 17th Street to the south and continued to impoundments in Areas III and IV. The Area IV impoundment is identified as IM-5 on aerial photograph analysis and as the 17th Street Drainage in this technical memorandum.[2] The 17th Street Drainage is discussed later in this section. The general slope of Area IV is in a southerly direction. Water runoff is directed to the retention reservoirs which are part of the SSFL industrial effluent control system. Liquid effluent discharge from the final retention pond into the Bell Canyon drainage occurs only after controlled effluent holdup and sampling.[3,4] Because the general slope of Area IV is in a southerly direction and drainage follows 17th Street along the east side of Parking Lot 4506, runoff from SNAP Buildings 4010, 4012, and 4024 could potentially impact Parking Lot 4506. The SNAP buildings handled radioactive materials and generated radionuclides, which means there is a possibility of radiological contamination in the area of Parking Lot 4506.

Radiological Contamination Potential: Class 2 because of potential radioactive material migration via surface water flow or airborne release from Buildings 4006, 4010, 4012, and 4024, and lack of site investigation.

Recommended Locations for Sediment/Soil Sampling:

Plate 1 and Figure 2.3 provide a convenient reference for the following recommendations.

Due to the potential of radioactive material migration via surface water flow or airborne release from Buildings 4006, 4010, 4012, and 4024, and the lack of site investigation, there is a possibility that radionuclide concentrations in soil will exceed the standard required by the December 2010 Administrative Order on Consent. Therefore, additional characterization is recommended for the Parking Lot 4506 area, including the drainage pathways associated with the Building 4006 area and outside Area IV as proposed by the field sampling plan. Residual contamination may exist in drainages outside of Area IV.

2.3.4 Building 4606 Area

Site Description: The Building 4606 area comprises Building 4606, Hydrogen Recombiner Test Building 4816, and the land surrounding these buildings. Building 4606 was constructed prior to March 1962 and was identified as Sodium Laboratory Instrument Building A. It was a small structure located off 17th Street south of Building 4006.[5,6] Figures 2.3.4a through 2.3.4d provide a current photograph and the best available building-specific drawing(s) that the research

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[1] Map located at: http://www.dtsc-ssfl.com/files/maps/SSFL%20-%20Western%20Half.pdf.

[2] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.

[3] Chapman, J. A., *Radiological Survey of Buildings T019 and T013; An Area Northwest of T059, T019, T013, and T012; And a Storage Yard West of Buildings T626 and T038, GEN-ZR-0010*, Rockwell International, Rocketdyne Division, August 26, 1988, p. 17.

[4] Map located at: http://www.dtsc-ssfl.com/files/maps/SSFL%20-%20Western%20Half.pdf.

[5] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. O-13.

[6] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.

team could find. Sodium Laboratory Building 4006 and its associated structures. Sodium Laboratory Instrument Building 4607. and MHD Experiment Building 4402 are discussed elsewhere in this section. Figure 2.3.4b presents a wireway diagram for Buildings 4606 and 4816. Figure 2.2.4c presents an electrical plan for the Building 4606 yard area. Figure 2.2.4d presents an as-built drawing for Hydrogen Recombiner Test Building 4816 and its roof extension. Plate 1 presents a summary of all identified features for this site.

Building Features: Figure 2.3.4c notes there was an electric substation west of Building 4606.[1] Figure 2.3.4d notes that Building 4816 had two bays measuring 15 feet by 30 feet.[2]

Former Use(s): Building 4606 was initially identified as Sodium Laboratory Instrument Building A. In 1972. the building was identified as MHD Support Building. By 1975. the building was identified as the Hydrogen Recombiner Test Building and retained this designation through the early 1990s.[3] As the Hydrogen Recombiner Test Building. Building 4606 was used to test the capacity of the Hydrogen Recombiner. a devise developed by Atomics International to mix the hydrogen and regular air to create water. useful in an emergency situation if a reactor produced excess hydrogen.[4]

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: Building 4606 was demolished sometime after June 2005.[5,6] Based on available information, the dimensions of the excavation made during building demolition are unknown.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): Radiological surveys specific to Building 4606 were not conducted. The Building 4606 area was covered as part of the Rockwell/Rocketdyne 1994-1995 Area IV Radiological Characterization Survey. A walkabout gamma survey was conducted in the area of Building 4606. Only areas showing elevated gamma activity in the walkabout survey were followed up with an ambient gamma survey. Walkabout data was not reported in the characterization survey report. However, the walkabout survey results were reported to be consistent with ambient gamma survey measurements. The average gamma exposure rate for the developed areas of the Santa Susana Field Laboratory Area IV was 13.6 microroentgens per hour (μR/hr) with a maximum rate of 19.4 μR/hr. The average exposure rate for all of Area IV was 14.6 μR/hr with a maximum rate of 21.4 μR/hr. The local background exposure rate outside of Area IV was 15.6 μR/hr with a maximum value of 20.5 μR/hr. According to the survey report, the gamma

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[1] *Susana Bldg 606 Yard Area Electrical Plan, 303-606-E2*, Rockwell International, Unknown Date.
[2] *Santa Susana Facility Bldg Hydrogen Recombiner Test Facility Canopy Roof - Plan & Details, 303-816-S1*, Atomics International, Unknown Date.
[3] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[4] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. O-13.
[5] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. O-13.
[6] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.

radiation distribution of Area IV was statistically indistinguishable from the local background gamma radiation distribution. The U.S. Nuclear Regulatory Commission and the State of California specify a limit of 5 μR/hr above the average background of the data set for release of land for radiologically unrestricted use. Ambient gamma regulatory limits were below these acceptable limits.[1]

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Location: None found.

Aerial Photographs: Building 4606 is first identified as a new building in a 1978 aerial photograph, although there are structures located in the area prior to 1978. Building 4606 is included in a processing area (PA) designated PA-1 in the Environmental Protection Agency's aerial photograph analysis. Because multiple buildings are included in PA-1, aerial photograph analysis for this area cannot be attributed to specific buildings, unless explicitly stated. A 1962/63 aerial photograph identifies overhead pipes and ground scarring in PA-1. Aerial photographs from 1965 through 1995 denote possible storage tanks and overhead pipes in PA-1. Open storage areas are noted in PA-1 in 1978, 1980, and 1995. In 1967 and 1978, a stain was identified in PA-1. In 1980 and 1983, a possible stain was noted in PA-1. A probable stain was identified in PA-1 in 1995. By 1998, all of the previously identified features in PA-1 were no longer present. Building 4606 is still standing in a 2005 aerial photograph.[2]

A 1978 aerial photograph identifies a probable horizontal tank and possible leakage causing a stain located southeast of Building 4606 and outside the PA-1 area. A 1980 photograph notes that drainage follows along a dirt road that travels southeast along the west side of Building 4606 and curves east toward 17th Street. A large probable stained area is located southeast of Building 4606, where the drainage appears to run before reaching 17th Street. The 1980 aerial photograph also notes a smaller stain south of Building 4606.[3]

Radionuclides of Concern: The research team did not find evidence of radioactive material use in Building 4606. Radionuclides associated with potential migration from Building 4006 include: cesium-137 (Cs-137), manganese-54 (Mn-54), tritiated titanium (H-3), natural and enriched uranium (U-234, U-235, U-238), and uranium oxide (UO_2).[4] Radionuclides associated with potential migration from Systems for Nuclear Auxiliary Power (SNAP) Buildings 4010 and 4012 include: antimony-125 (Sb-125), americium-241 (Am-241), Cs-134, Cs-137, cobalt-60 (Co-60), europium isotopes (Eu-152, Eu-154), isotopes of plutonium (Pu-238, Pu-239, Pu-240, Pu-241), strontium-90 (Sr-90), H-3, U-234, U-235, and U-238.[5,1,2] All radionuclides of concern

[1] Rockwell International/Rocketdyne Division, *Area IV Radiological Characterization Survey, A4CM-ZR-0011, Rev. A*, August 15, 1996.
[2] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.
[3] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.
[4] Cabrera Services, *Final Radiological Final Status Survey of Building 4006*, June 2008, pgs. vi, 8-9, 38.
[5] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 1 – Methodology*, May 2005, p. 2-9.

listed, with the exception of Mn-54, are included for analysis in the August 2009 *Final Field Sampling Plan, Radiological Background Study, Santa Susana Field Laboratory*. Mn-54 has a half-life of less than one year and thus does not meet the criteria for analysis. Table 3.3 presents a summary of radiological contaminants of concern.

Drainage Pathways: A lined drainage channel following 17th Street to the southeast begins approximately 55 feet southeast of Building 4606.[3] Aerial photographs from 1957 to 2005 indicate that drainage from PA-1 followed 17th Street to the south and continued to impoundments in Areas III and IV. The Area IV impoundment is identified as IM-5 on aerial photograph analysis and as the 17th Street Drainage in this technical memorandum. The 17th Street Drainage is discussed later in this section. A 1980 aerial photograph notes that drainage also follows along a dirt road that travels southeast along the west side of Building 4606 and curves east toward 17th Street.[4] The general slope of Area IV is in a southerly direction. Water runoff is directed to the retention reservoirs which are part of the SSFL industrial effluent control system. Liquid effluent discharge from the final retention pond into the Bell Canyon drainage occurs only after controlled effluent holdup and sampling.[5,6] Because the general slope of Area IV is in a southerly direction, runoff from Sodium Laboratory Building 4006 and SNAP Buildings 4010 and 4012 could potentially impact Building 4606. Building 4006 had minor uses of radioactive material. The SNAP buildings handled radioactive materials and generated radionuclides, which means there is a possibility of radiological contamination in the area of Building 4606.

Radiological Contamination Potential: Class 2 because of potential radioactive material migration via surface water flow or airborne release from Buildings 4006, 4010 and 4012, and lack of site investigation.

Recommended Locations for Sediment/Soil Sampling:

Plate 1 and Figure 2.3 provide a convenient reference for the following recommendations.

Due to the potential of radioactive material migration via surface water flow or airborne release from Buildings 4006, 4010, and 4012, and the lack of site investigation, there is a possibility that radionuclide concentrations in soil will exceed the standard required by the December 2010 Administrative Order on Consent. Therefore, additional characterization is recommended for the Building 4606 area. This includes the following Building 4606 areas:

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[1] Zwetzig, G.B., *Survey of Fission- and Corrosion-Product Activity in Sodium- or NaK-Cooled Reactors, AI-AEC-MEMO-12790*, Atomics International, a Division of North American Rockwell Corporation, February 28, 1969, p. 5.
[2] Unknown Author, *Facility Information, Building 012*, Unknown Date, HDMSP001828011.
[3] Map located at: http://www.dtsc-ssfl.com/files/maps/SSFL%20-%20Western%20Half.pdf.
[4] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory - Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.
[5] Chapman, J. A., *Radiological Survey of Buildings T019 and T013; An Area Northwest of T059, T019, T013, and T012; And a Storage Yard West of Buildings T626 and T038, GEN-ZR-0010*, Rockwell International, Rocketdyne Division, August 26, 1988, p. 17.
[6] Map located at: http://www.dtsc-ssfl.com/files/maps/SSFL%20-%20Western%20Half.pdf.

- Drainage pathway located east and west of the Building 4606 footprint. If radioactive materials drained from facilities to the north, residual contamination may exist along the drainage pathways east and west of Building 4606.

- Stained area identified on aerial photographs located southeast of the Building 4606 footprint. An unknown stain could be a potential source of contamination.

- Drainage pathways associated with the Building 4006 area and outside Area IV as proposed by the field sampling plan. Residual contamination may exist in drainages outside of Area IV.

2.3.5 Building 4607 Area

Site Description: The Building 4607 area comprises Building 4607 and the land surrounding it. Building 4607 was constructed prior to March 1962 and identified as Sodium Laboratory Instrument Building B. It was a small structure located off 17th Street, south of MHD Experiment Building 4402.[1,2] Figure 2.3.5a provides a current photograph. The research team was unable to find building-specific drawing(s). No as-built drawings have been located for Building 4607. Plate 1 presents a summary of all identified features for this site.

Building Features: No information was located.

Former Use(s): Building 4607 was initially identified as the Sodium Laboratory Instrument Building B. In 1972, it was identified as a Storage Building. The last legible industrial planning map that specifically identifies Building 4607 is a 1982 map. Building 4607 was used for non-radiological storage.[3,4]

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: Building 4607 presumably was demolished in the 1980s.[5] Based on available information, the dimensions of the excavation made during building demolition are unknown.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): Radiological surveys specific to Building 4607 were not conducted. The Building 4607 area was covered as part of the Rockwell/Rocketdyne 1994-1995 Area IV Radiological Characterization Survey. A walkabout gamma survey was conducted in the area of Building 4607. Only areas

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[1] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. O-15.
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[3] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. O-15.
[4] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[5] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.

showing elevated gamma activity in the walkabout survey were followed up with an ambient gamma survey. Walkabout data was not reported in the characterization survey report. However, the walkabout survey results were reported to be consistent with ambient gamma survey measurements. The average gamma exposure rate for the developed areas of the Santa Susana Field Laboratory Area IV was 13.6 microroentgens per hour (μR/hr) with a maximum rate of 19.4 μR/hr. The average exposure rate for all of Area IV was 14.6 μR/hr with a maximum rate of 21.4 μR/hr. The local background exposure rate outside of Area IV was 15.6 μR/hr with a maximum value of 20.5 μR/hr. According to the survey report, the gamma radiation distribution of Area IV was statistically indistinguishable from the local background gamma radiation distribution. The U.S. Nuclear Regulatory Commission and the State of California specify a limit of 5 μR/hr above the average background of the data set for release of land for radiologically unrestricted use. Ambient gamma regulatory limits were below these acceptable limits.[1]

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Location: None found.

Aerial Photographs: Building 4607 is first identified in 1962/63 and is included in a processing area (PA) designated PA-1 in the Environmental Protection Agency's aerial photograph analysis. Because multiple buildings are included in PA-1, aerial photograph analysis for this area cannot be attributed to specific buildings, unless explicitly stated. A 1962/63 aerial photograph identifies overhead pipes and ground scarring in PA-1. Aerial photographs from 1965 through 1995 denote possible storage tanks and overhead pipes in PA-1. Open storage areas are noted in PA-1 in 1978, 1980, and 1995. In 1967 and 1978, a stain was identified in PA-1. In 1980 and 1983, a possible stain was noted in PA-1. Building 4607 cannot be identified on aerial photographs from 1983 and 1988 and is not visible on a 1995 aerial photograph.[2]

A 1978 aerial photograph identifies a probable horizontal tank and possible leakage causing a stain located southeast of Building 4607 and outside the PA-1 area. A 1980 photograph notes that drainage follows along a dirt road that travels southeast along the west side of Building 4607 and curves east toward 17th Street. A large probable stained area is located southeast of Building 4607, where the drainage appears to run before reaching 17th Street. The 1980 aerial photograph also notes a smaller stain in the vicinity of Building 4607.[3]

Radionuclides of Concern: The research team did not find evidence of radioactive material use in Building 4607. Radionuclides associated with potential migration from Building 4006 include: cesium-137 (Cs-137), manganese-54 (Mn-54), tritiated titanium (H-3), natural and enriched uranium (U-234, U-235, U-238), and uranium oxide (UO_2).[4] Radionuclides associated with potential migration from Systems for Nuclear Auxiliary Power (SNAP) Buildings 4010 and

[1] Rockwell International/Rocketdyne Division, *Area IV Radiological Characterization Survey, A4CM-ZR-0011, Rev. A*, August 15, 1996.
[2] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.
[3] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.
[4] Cabrera Services, *Final Radiological Final Status Survey of Building 4006*, June 2008, pgs. vi, 8-9, 38.

4012 include: antimony-125 (Sb-125), americium-241 (Am-241), Cs-134, Cs-137, cobalt-60 (Co-60), europium isotopes (Eu-152, Eu-154), isotopes of plutonium (Pu-238, Pu-239, Pu-240, Pu-241), strontium-90 (Sr-90), H-3, U-234, U-235, and U-238.[1,2,3] All radionuclides of concern listed, with the exception of Mn-54, are included for analysis in the August 2009 *Final Field Sampling Plan, Radiological Background Study, Santa Susana Field Laboratory*. Mn-54 has a half-life of less than one year and thus does not meet the criteria for analysis. Table 3.3 presents a summary of radiological contaminants of concern.

Drainage Pathways: A lined drainage channel following 17th Street to the southeast begins approximately 100 feet east of Building 4607.[4] Aerial photographs from 1957 to 2005 indicate that drainage from PA-1 followed 17th Street to the south and continued to impoundments in Areas III and IV. The Area IV impoundment is identified as IM-5 on aerial photograph analysis and as the 17th Street Drainage in this technical memorandum.[5] The 17th Street Drainage is discussed later in this section. The general slope of Area IV is in a southerly direction. Water runoff is directed to the retention reservoirs which are part of the SSFL industrial effluent control system. Liquid effluent discharge from the final retention pond into the Bell Canyon drainage occurs only after controlled effluent holdup and sampling.[6,7] Because the general slope of Area IV is in a southerly direction, runoff from Sodium Laboratory Building 4006 and SNAP Buildings 4010 and 4012 could potentially impact Building 4607. Building 4006 had minor uses of radioactive material. The SNAP buildings handled radioactive materials and generated radionuclides. This presents a possibility of radiological contamination in the area of Building 4607.

Radiological Contamination Potential: Class 2 because of potential radioactive material migration via surface water flow or airborne release from Buildings 4006, 4010 and 4012, stained area and possible leakage noted in aerial photographs, and lack of site investigation.

Recommended Locations for Sediment/Soil Sampling:

Plate 1 and Figure 2.3 provide a convenient reference for the following recommendations.

Due to the lack of site investigation, potential of radioactive material migration via surface water flow or airborne release from Buildings 4006, 4010, and 4012, and stained area and possible leakage, there is a possibility that radionuclide concentrations in soil will exceed the standard required by the December 2010 Administrative Order on Consent. Therefore, additional

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[1] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume I – Methodology*, May 2005, p. 2-9.
[2] Zwetzig, G.B., *Survey of Fission- and Corrosion-Product Activity in Sodium- or NaK-Cooled Reactors, AI-AEC-MEMO-12790*, Atomics International, a Division of North American Rockwell Corporation, February 28, 1969, p. 5.
[3] Unknown Author, *Facility Information, Building 012*, Unknown Date, HDMSP001828011.
[4] Map located at: http://www.dtsc-ssfl.com/files/maps/SSFL%20-%20Western%20Half.pdf.
[5] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.
[6] Chapman, J. A., *Radiological Survey of Buildings T019 and T013; An Area Northwest of T059, T019, T013, and T012; And a Storage Yard West of Buildings T626 and T038, GEN-ZR-0010*, Rockwell International, Rocketdyne Division, August 26, 1988, p. 17.
[7] Map located at: http://www.dtsc-ssfl.com/files/maps/SSFL%20-%20Western%20Half.pdf.

characterization is recommended for the Building 4607 area. This includes the following Building 4607 areas:

- Drainage pathway located south and west of the Building 4607 footprint. If radioactive materials drained from facilities to the north, residual contamination may exist along the drainage pathways south and west of Building 4606.

- Stained area and possible leakage area identified on aerial photographs located southeast of the Building 4607 footprint. An unknown stain could be a potential source of contamination.
- Drainage pathways associated with the Building 4607 area and outside Area IV as proposed by the field sampling plan. Residual contamination may exist in drainages outside of Area IV.

2.3.6 Building 4615 Area

Site Description: The Building 4615 area comprises Building 4615 and the land surrounding it near the intersection of B Street and 17th Street. Building 4615 was constructed in the early 1980s as a Combustion Test Facility. The structure was located north of Sodium Laboratory Building 4006.[1] Figure 2.3.6a provides a current photograph. The research team was unable to find building-specific drawing(s). No as-built drawings were located for Building 4615. Plate 1 presents a summary of all identified features for this site.

Building Features: No information was located.

Former Use(s): Building 4615 was identified as a Combustion Test Facility.[2]

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: Demolished.[3] Based on available information, the dimensions of the excavation made during building demolition are unknown.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): Radiological surveys specific to Building 4651 were not conducted. The Building 4615 area was covered as part of the Rockwell/Rocketdyne 1994-1995 Area IV Radiological Characterization Survey. A walkabout gamma survey was conducted in the area of Building 4615. Only areas showing elevated gamma activity in the walkabout survey were followed up with an ambient gamma survey. Walkabout data was not reported in the characterization survey report. However, the walkabout survey results were reported to be consistent with ambient gamma survey measurements. The average gamma exposure rate for the developed areas of the Santa

[1] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. O-17.
[2] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. O-17.
[3] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. O-17.

Susana Field Laboratory Area IV was 13.6 microroentgens per hour (μR/hr) with a maximum rate of 19.4 μR/hr. The average exposure rate for all of Area IV was 14.6 μR/hr with a maximum rate of 21.4 μR/hr. The local background exposure rate outside of Area IV was 15.6 μR/hr with a maximum value of 20.5 μR/hr. According to the survey report, the gamma radiation distribution of Area IV was statistically indistinguishable from the local background gamma radiation distribution. The U.S. Nuclear Regulatory Commission and the State of California specify a limit of 5 μR/hr above the average background of the data set for release of land for radiologically unrestricted use. Ambient gamma regulatory limits were below these acceptable limits.[1]

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Location: None found.

Aerial Photographs: A structure appears at the northeast end of Building 4006 in a 1978 aerial photograph, but it is not clear if this is Building 4615. Another structure appears at the northwest end of Building 4006 in 1980, but it is unclear if this is Building 4615. Building 4615 is included in a processing area (PA) designated PA-1 in the Environmental Protection Agency's aerial photograph analysis. Because multiple buildings are included in PA-1, aerial photograph analysis for this area cannot be attributed to specific buildings, unless explicitly stated. In 1978, PA-1 contains possible storage tanks, overhead pipes, open storage, and a stain. In 1980 and 1983, a possible stain was noted in PA-1. No structures are visible north of Building 4006 in aerial photographs following 1980.[2]

Radionuclides of Concern: The research team did not find evidence of radioactive material use in Building 4615. Radionuclides associated with potential migration from Building 4006 include: cesium-137 (Cs-137), manganese-54 (Mn-54), tritiated titanium (H-3), natural and enriched uranium (U-234, U-235, U-238), and uranium oxide (UO_2).[3] Radionuclides associated with potential migration from Systems for Nuclear Auxiliary Power (SNAP) Buildings 4010, 4012, and 4024 include: antimony-125 (Sb-125), americium-241 (Am-241), Cs-134, Cs-137, cobalt-60 (Co-60), europium isotopes (Eu-152, Eu-154), isotopes of plutonium (Pu-238, Pu-239, Pu-240, Pu-241), strontium-90 (Sr-90), H-3, U-234, U-235, and U-238.[4,5,6] All radionuclides of concern listed, with the exception of Mn-54, are included for analysis in the August 2009 *Final Field Sampling Plan, Radiological Background Study, Santa Susana Field Laboratory*. Mn-54 has a half-life of less than one year and thus does not meet the criteria for analysis. Table 3.3 presents a summary of radiological contaminants of concern.

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[1] Rockwell International/Rocketdyne Division, *Area IV Radiological Characterization Survey, A4CM-ZR-0011, Rev. A*, August 15, 1996.

[2] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.

[3] Cabrera Services, *Final Radiological Final Status Survey of Building 4006*, June 2008, pgs. vi, 8-9, 38.

[4] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 1 – Methodology*, May 2005, p. 2-9.

[5] Zwetzig, G.B., *Survey of Fission- and Corrosion-Product Activity in Sodium- or NaK-Cooled Reactors, AI-AEC-MEMO-12790*, Atomics International, a Division of North American Rockwell Corporation, February 28, 1969, p. 5.

[6] Unknown Author, *Facility Information, Building 012*, Unknown Date, HDMSP001828011.

Drainage Pathways: A storm drainage culvert was located north of Building 4615 on B Street and east of Building 4615 on 17th Street.[1] Aerial photographs from 1957 to 2005 indicate that drainage from PA-1 followed 17th Street to the south and continued to impoundments in Areas III and IV. The Area IV impoundment is identified as IM-5 on aerial photograph analysis and as the 17th Street Drainage in this technical memorandum.[2] The 17th Street Drainage is discussed later in this section. The general slope of Area IV is in a southerly direction. Water runoff is directed to the retention reservoirs which are part of the SSFL industrial effluent control system. Liquid effluent discharge from the final retention pond into the Bell Canyon drainage occurs only after controlled effluent holdup and sampling.[3,4] Because the general slope of Area IV is in a southerly direction, runoff from SNAP Buildings 4010, 4012, and 4024 could have impacted the Building 4615 area. The SNAP buildings handled radioactive materials and generated radionuclides, which means there is a possibility of radiological contamination in the area of Building 4615.

Radiological Contamination Potential: Class 2 because of potential radioactive material migration via surface water flow or airborne release from Buildings 4006, 4010, 4012, and 4024, and lack of site investigation.

Recommended Locations for Sediment/Soil Sampling:

Plate 1 and Figure 2.3 provide a convenient reference for the following recommendations.

Due to the lack of site investigation and potential radioactive material migration via surface water flow or airborne release from Buildings 4006, 4010, 4012, and 4024, there is a possibility that radionuclide concentrations in soil will exceed the standard required by the December 2010 Administrative Order on Consent. Therefore, additional characterization is recommended for the Building 4615 area. This includes the following Building 4615 areas:

- Storm drainage channel located north and east of the Building 4615 footprint. The storm drain may have collected storm water from former SNAP Buildings 4010, 4012, and 4024. Residual contamination from the storm drain may exist.

- Drainage pathways associated with the Building 4615 area and outside Area IV as proposed by the field sampling plan. Residual contamination may exist in drainages outside of Area IV.

[1] *Technical Site Information, Energy Technology Engineering Center (ETEC), GEN-AT-0027, Revision B*, Rockwell International Corporation, August 1993, p. b-25.
[2] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.
[3] Chapman, J. A., *Radiological Survey of Buildings T019 and T013; An Area Northwest of T059, T019, T013, and T012; And a Storage Yard West of Buildings T626 and T038, GEN-ZR-0010*, Rockwell International, Rocketdyne Division, August 26, 1988, p. 17.
[4] Map located at: http://www.dtsc-ssfl.com/files/maps/SSFL%20-%20Western%20Half.pdf.

2.4 Group 4

The Group 4 index map is presented in Figure 2.4. Following Figure 2.4, the site photograph and layout drawings for each building area within HSA-5B Group 4 are presented. HSA-5B Group 4 includes four building areas containing the Small Component Test Loop (SCTL) Complex buildings. The SCTL Complex is comprised of Buildings 4026, 4226, and 4826. Building 4358, originally built to support the Sodium Component Test Installation, was later moved to support the SCTL. As a result, Building 4358 will be discussed as appropriate in Group 2 and Group 4 of this section.

2.4.1 Building 4026 Area

Site Description: The Building 4026 area comprises Building 4026, Electrical Substation 4726, Time Clock Building 4805, Uninterruptible Power Supply (UPS) Building 4426, and the land surrounding these buildings. Building 4026, part of the SCTL complex, was originally built as part of the Large Component Test Loop (LCTL) complex in 1958. Building 4026 was constructed in 1960 as the SCTL Control Building and was located between 17th and 20th Streets.[1,2,3,4] Figures 2.4.1a through 2.4.1d provide a current photograph and the best available building-specific drawing(s) that the research team could find. Buildings 4026, 4226, and 4826 together comprised the SCTL complex.[5] Buildings 4226 and 4826 are discussed elsewhere in this section. Plate 1 presents a summary of all identified features for this site.

Building Features: The STCL complex was 10,340 square feet with a 9,659-square-foot laboratory and 681 square feet of non-laboratory space. The SCTL complex consisted of an enclosed component test area, a sodium transport and storage system, an instrument and control system, and other interfacing systems. The sodium transport and storage system consists of four test loops, a thermal conditioning loop, and two liquid sodium storage/drain tanks that act as reservoirs for normal and emergency draining.[6,7,8]

Building 4026 was the SCTL Control Building. The frame, siding, and roof were constructed of steel. The building area was approximately 11,522 square feet. It had a restroom and central air. Ceiling heights were 9 feet and 74 feet.[9] Building 4026 housed the control room, electrical

[1] U.S. Department of Energy, *Small Component Test Loop*, Energy Technology Engineering Center (ETEC) Website, http://www.etec.energy.gov/History/Sodium/SCTL.html, accessed November 25, 2009, p.1.
[2] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. P-1.
[3] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962-November 1992.
[4] *Technical Site Information Energy Technology Engineering Center (ETEC), GEN-AT-0027, Revision B*, Rockwell International Corporation, August 1993, p. b-31.
[5] Rutherford, P.D., *Site Environmental Report for Calendar Year 1998 , DOE Operations at Rocketdyne Propulsion & Power, RD99-115*, The Boeing Company, Rocketdyne Propulsion & Power, September 22, 1999, p. 2-10.
[6] Cleveland, J.R., *Safety Hazards Report, GEN-ZR-0001*, Energy Technology Engineering Center, April 30, 1985, pg. 38.
[7] U.S. Department of Energy, *Small Component Test Loop*, Energy Technology Engineering Center (ETEC) Website, http://www.etec.energy.gov/History/Sodium/SCTL.html, accessed November 25, 2009, p.1.
[8] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. P-1.
[9] *Technical Site Information Energy Technology Engineering Center (ETEC), GEN-AT-0027, Revision B*, Rockwell International Corporation, August 1993, p. b-31.

equipment rooms, and a motor generator room. The control room was a 20 foot by 40 foot room containing facility instrumentation, control panels and an operational console. Recorders, controllers and data loggers displayed facility and test conditions. The electrical equipment rooms were 20 feet by 18 feet, and 20 feet by 21 feet in size and housed the electrical switchgear, motor control components, and storage for tools and supplies.[1] The motor generator room is identified in a 1977 electrical drawing. A 1,250 horse power motor generator is identified west of the control and electrical rooms.[2] Figure 2.4.1b presents a floor plan of SCTL Buildings 4026 and 4826 and Figure 2.4.1c is an electrical drawing pertaining to Building 4026. A 1996 building reconnaissance report states Building 4026 did not have any water, sewer, or gas connections.[3]

At least five tanks have been associated with Building 4026, including two vaulted sodium tanks with open pit secondary containment. These sodium tank pits may actually have been located in Building 4826 based on Figure 2.4.1b. Four of the tanks were sodium tanks, ranging from 5,000 gallons to 12,000 gallons in capacity, and the fifth tank was a 125-gallon lube oil tank.[4] A 1966 drawing depicts a below-grade pipe running from a floor drain on the east side of Building 4359 to a catch basin located between Buildings 4026 and 4355.[5]

Former Use(s): The SCTL was originally built as the LCTL and operations began in 1959 with a pump test.[6] This facility was used to test small components such as valves and pumps in liquid sodium.[7] The SCTL's principal purpose was to provide a test bed for non-nuclear qualification testing of typical liquid metal fast breeder reactor components and to obtain test data for verification of the elevated temperature design criteria of the piping design guide. In 1970, the LCTL was modified, expanded, and re-designated as the SCTL. In 1974, the facility was again modified and expanded. In 1978, a new control room was added onto the northwest corner of the facility, giving the complex its final appearance. Testing within the facility continued periodically from 1959 until 1985. Upon completion of the test programs, the sodium was drained into the facility sodium drain tanks and all systems were secured. The facility was maintained in inactive standby status, with the sodium systems under an inert cover gas, until late 1995.[8] In 1996, the sodium in the facility drain tanks (approximately 103,930 pounds) was removed and transferred to a sodium supplier for reuse. In 1997, the two below-grade drain tanks and the SCTL sodium piping system were removed and cleaned.[9] By the end of 1999, the facility was demolished and the foundations, pits, and utilities were removed. A void remained

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[1] Neely, H.H., *Sodium Component Test Laboratory (SCTL) System Design Description, 026-XC-0010*, Energy Technology Engineering Center, March 15, 1982 Revised September 30, 1987, pgs. 2-28, 2-91.
[2] *Santa Susana Field Laboratory Electric Meter Installation Sub Station Number 726 Building 026 and 1250 HP Motor Generator, 303-GEN-E266*, Rockwell International Corporation, June 1, 1977.
[3] Horton, P., *Appendix A, Building Reconnaissance Report, Building 026, GEN-??-0000*, September 30, 1996.
[4] *Technical Site Information Energy Technology Engineering Center (ETEC), GEN-AT-0027, Revision B*, Rockwell International Corporation, August 1993, p. b-41, b-45.
[5] *SSFL Area IV, Bldg. 359, Water/Sewer Distribution, Demolition & Installation, M359-68339-MI*, Rockwell International, December 12, 1966, HDMSe00455082.
[6] U.S. Department of Energy, *Small Component Test Loop*, Energy Technology Engineering Center (ETEC) Website, http://www.etec.energy.gov/History/Sodium/SCTL.html, accessed November 25, 2009, p.1.
[7] Rutherford, P.D., *Site Environmental Report for Calendar Year 1998 , DOE Operations at Rocketdyne Propulsion & Power, RD99-115*, The Boeing Company, Rocketdyne Propulsion & Power, September 22, 1999, p. 2-10.
[8] U.S. Department of Energy, *Small Component Test Loop*, Energy Technology Engineering Center (ETEC) Website, http://www.etec.energy.gov/History/Sodium/SCTL.html, accessed November 25, 2009, p.1.
[9] Rutherford, P.D., *Site Environmental Report for Calendar Year 1998 , DOE Operations at Rocketdyne Propulsion & Power, RD99-115*, The Boeing Company, Rocketdyne Propulsion & Power, September 22, 1999, p. 2-10.

where the concrete pits and foundations were removed.[1] Back filling with soil was completed in 2000.[2]

Information from Interviewees: A number of former employees were interviewed about their experience at the SSFL. One remembered the LCTL. Excerpts from this interview are included below.

Interviewee 83 worked at the Santa Susana Field Laboratory from March 1957 to June 1986 starting in the fire department and ending as a shift leader at the LCTL. The following excerpts were pulled from the interview.

> *"I was in the fire department and eventually I was the fire lieutenant. I understand you are interested in what I know about materials being disposed of on-site in Area IV. We did dispose of sodium-contamination at the sodium burn pit. When we had to get rid of something that was contaminated with sodium, we'd hit it with water and it would explode. I remember one time one of the guys hit a barrel with water and it was right below some large power lines. It shot up in the air. It was amazing; it went through those lines and didn't hit anything!*
>
> *When a facility had something to dispose of, some oil or chemicals or something, they would call the fire department and ask us to pick it up. Sometime before Saturday we'd pick up the material to be disposed; disposal happened on Saturdays. Stuff that was contaminated with sodium would go to the Sodium Burn Pit. Usually that was in big containers that were used in a test loop. We'd hit it with water and it would blow. Sometimes we would have to shoot the container or barrels to puncture them, to get them to sink and let water get in there so that they could blow up. I have heard that some people would take sodium home and use it for fishing – they'd put it in water and blow the fish out. None of the firemen did that though.*
>
> *We disposed of a lot of material by the north flats near the property line. We had a regular disposal area out there. It was near the northeast corner, almost to the property line. It was just out in the open area.*
>
> *After I was a fireman, I went to work in the LCTL; it was very interesting. Our job was to take large components that would go into reactors and then test them to see if we could make them fail. That's what I did after I stopped being a firefighter. You knew that stuff would break down eventually; we wanted to see how long it would take. The company was in the business of selling reactor parts, and we wanted to make sure how long the parts we sold would last. We needed to know when and how they would fail so we could protect the company's business.*

[1] The Boeing Company, Rocketdyne, *Site Environmental Report for Calendar Year 1999 DOE Operations at The Boeing Company Rocketdyne, RD00-159*, September 2000, p. 2-8.
[2] The Boeing Company, Rocketdyne Propulsion & Power, *Site Environmental Report for Calendar Year 2000 DOE Operations at The Boeing Company Rocketdyne Propulsion & Power, RD00-152*, September 2001, p. 2-9.

Eventually, I ended up being a shift leader at the LCTL. We sent a lot of the materials to the same disposal areas. Somebody in the Fire Department actually did the disposal."[1]

Radiological Incident Reports: There have been two incidents associated with Building 4026. The following table provides information presented in an incidents database provided by Boeing. Summaries of only the incident reports that resulted or may have resulted in releases to the environment are provided following the table, when available. Summaries of all available incident reports are provided in Attachment A.

Building 4026 Incident Report Summary

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A0465	9/10/1969	GAMMAGRAH SITE	Ir-192	EMPLOYEE DISREGARDED WARNING SIGNS AND ENTERED FIELD RADIOGRAPHIC OPERATION.
A0238	10/3/1979	SCTL	Ir-192	STUCK GAMMAGRAPH SOURCE RECOVERED.

Current Use: Demolished in 1999.[2] Based on available information, the dimensions of the excavation made during building demolition are unknown. A photograph of the Building 4026 site after demolition is shown in Figure 2.4.1d.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): Prior to removal of the SCTL drain tanks in 1996, sodium in the system was tested for radiological contamination and none reportedly was detected.[3]

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Location: None found.

Aerial Photographs: Building 4026 is first identified in a 1959 aerial photograph and is included in a processing area (PA) designated PA-1 in the Environmental Protection Agency's aerial photograph analysis. Because multiple buildings are included in PA-1, aerial photograph analysis for this area cannot be attributed to specific buildings, unless explicitly stated. A 1962/63 aerial photograph identifies overhead pipes and ground scarring in PA-1. Aerial photographs from 1965 through 1995 denote possible storage tanks and overhead pipes in PA-1. Open storage areas are noted in PA-1 in 1978, 1980, and 1995. In 1967 and 1978, a stain was identified in PA-1. In 1980 and 1983, a possible stain was noted in PA-1. A probable stain was identified in PA-1 in 1995. By 1998, all of the previously identified features in PA-1 were no

[1] Interview No. 83 conducted by DOE in 2010.
[2] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, pgs. P-1–P-2.
[3] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. P-2.

longer present. By 2003, Building 4026 was no longer present in PA-1. In 1978 and 1980 a large stained area is located southwest of Building 4026 and outside the PA-1 area.[1]

Aerial photograph analysis from 1959 to 2005 identifies a hazardous material storage area (HMSA) located north of Building 4026 inside PA-1. In 1959, a new building (possibly Building 4357), a possible below ground/recessed area, and a possible stain were observed. The possible recessed area remained visible in 1962/63 and a possible underground storage tank was noted. These features could not be confirmed on the 1965 or 1967 photographs. By 1978, a probable open storage area was observed housing approximately six to eight objects, each about one-fourth the size of an automobile. In 1980, probable staining was observed, and in 1983 and 1987 an area of dark-toned material was visible. In 1990 and 1992, areas of possible staining were noted. By 1993, this area no longer appeared active. In 1998, approximately 12 containers, each about the size of an automobile, were observed at this location. By 2002, the containers and the building had been removed from the former HMSA.[2]

Radionuclides of Concern: The research team did not find historical evidence indicating that unsealed regulated radioactive materials were handled at the SCTL facility.[3] Evidence of iridium-192 (Ir-192) sealed source use is seen in the Incident Report described below. This suggests other sealed sources could also have been used in Building 4026. Radionuclides associated with potential migration from Building 4006 include: cesium-137 (Cs-137), manganese-54 (Mn-54), tritiated titanium (H-3), natural and enriched uranium (U-234, U-235, U-238), and uranium oxide (UO_2).[4] Radionuclides associated with potential migration from Systems for Nuclear Auxiliary Power (SNAP) Buildings 4010 and 4012 include: antimony-125 (Sb-125), americium-241 (Am-241), Cs-134, Cs-137, cobalt-60 (Co-60), europium isotopes (Eu-152, Eu-154), isotopes of plutonium (Pu-238, Pu-239, Pu-240, Pu-241), strontium-90 (Sr-90), H-3, U-234, U-235, and U-238.[5,6,7] All radionuclides of concern listed, with the exception ofMn-54 and Ir-192, are included for analysis in the August 2009 *Final Field Sampling Plan, Radiological Background Study, Santa Susana Field Laboratory*. Mn-54 and Ir-192 have half-lives of less than one year and thus do not meet the criteria for analysis. Table 3.3 presents a summary of radiological contaminants of concern.

Drainage Pathways: Aerial photographs from 1957 to 2005 indicate that drainage from PA-1 followed 17th Street to the south and continued to impoundments in Areas III and IV. The Area IV impoundment is identified as IM-5 on aerial photograph analysis and as the 17th Street

[1] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.
[2] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.
[3] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. P-2.
[4] Cabrera Services, *Final Radiological Final Status Survey of Building 4006*, June 2008, pgs. vi, 8-9, 38.
[5] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 1 –Methodology*, May 2005, p. 2-9.
[6] Zwetzig, G.B., *Survey of Fission- and Corrosion-Product Activity in Sodium- or NaK-Cooled Reactors, AI-AEC-MEMO-12790*, Atomics International, a Division of North American Rockwell Corporation, February 28, 1969, p. 5.
[7] Unknown Author, *Facility Information, Building 012*, Unknown Date, HDMSP001828011.

Drainage in this technical memorandum.[1] The 17th Street Drainage is discussed later in this section. The general slope of Area IV is in a southerly direction. Water runoff is directed to the retention reservoirs which are part of the SSFL industrial effluent control system. Liquid effluent discharge from the final retention pond into the Bell Canyon drainage occurs only after controlled effluent holdup and sampling.[2,3] Because the general slope of Area IV is in a southerly direction, runoff from SNAP Buildings 4010, 4012, and 4024 could potentially impact Building 4026. The SNAP buildings handled radioactive materials and generated radionuclides, which means there is a possibility of radiological contamination in the area of Building 4026.

Radiological Contamination Potential: Class 2 because of sealed source use in Building 4026, incident, lack of site investigation, and potential radioactive material migration via surface water flow or airborne release from Buildings 4006, 4010, and 4012.

Recommended Locations for Sediment/Soil Sampling:

Plate 1 and Figure 2.4 provide a convenient reference for the following recommendations.

Due to the radioactive sealed source use, lack of site investigation, and potential radioactive material migration via surface water flow or airborne release from Buildings 4006, 4010, and 4012, there is a possibility that radionuclide concentrations in soil will exceed the standard required by the December 2010 Administrative Order on Consent. Therefore, additional characterization is recommended for the Building 4026 area. This includes the following Building 4026 areas:

- Former sodium tank vault locations. Based on Figure 2.4.1b, these vaults may have been located in the Building 4826 footprint despite being associated with Building 4026. If radiological materials migrated or were released into the pit, residual contamination may exist in the area.

- Former catch basin area located between the Building 4026 footprint and the Building 4355 footprint. Storm water originating from Buildings 4010 or 4012 could potentially discharge into this catch basin. Consequently, the catch basin may be an area with residual contamination.

- Area of probable leakage identified in aerial photograph at northwest corner of the Building 4026 footprint. If radioactive materials were released, residual contamination may exist.

- Eastern portion of the Building 4026 footprint where radiographic exposure occurred and residual contamination may exist.

[1] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory - Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.
[2] Chapman, J. A., *Radiological Survey of Buildings T019 and T013; An Area Northwest of T059, T019, T013, and T012; And a Storage Yard West of Buildings T626 and T038, GEN-ZR-0010*, Rockwell International, Rocketdyne Division, August 26, 1988, p. 17.
[3] Map located at: http://www.dtsc-ssfl.com/files/maps/SSFL%20-%20Western%20Half.pdf.

- Drainage pathways associated with the Building 4026 area and outside Area IV as proposed by the field sampling plan. Residual contamination may exist in drainages outside of Area IV.

2.4.2 Building 4226 Area

Site Description: The Building 4226 area comprises Building 4226 and the land surrounding it between 17th Street and 20th Street. Building 4226 was constructed between 1978 and 1980 as the Small Component Test Loop (SCTL) Motor Generator Building.[1,2] Buildings 4026, 4226, and 4826 together comprised the SCTL complex.[3] Figures 2.4.2a through 2.4.2c provide a current photograph and the best available building-specific drawing(s) that the research team could find. Buildings 4026 and 4826 are discussed elsewhere in this section. Plate 1 presents a summary of all identified features for this site.

Building Features: Building 4226 consisted of a concrete slab floor with a steel frame, roof, and siding. It measured 22 feet long, 27 feet wide and 12 feet high with 594 square feet of floor area.[4] Building 4226 did not contain any restrooms or heating and ventilation features.[5] Building 4226 was a 20 foot by 25 foot building that housed a motor generator unit with a 1,000 horsepower motor and an 875 kilovolt-ampere generator. A Dynamatic speed controller was also housed in the building.[6] Figure 2.4.2b presents a foundation and elevation drawing of Building 4226. Figure 2.4.2c presents more detail on the concrete case and fiberglass-lined sump associated with Building 4226.

Former Use(s): Building 4226 was identified as the SCTL Motor Generator Building and housed non-radiological hazardous materials.[7]

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: Demolished in 1999.[8] Based on available information, the dimensions of the excavation made during building demolition are unknown.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): At demolition and prior to offload, liquid sodium from the SCTL was tested for radioactivity and reportedly found to be free of contamination.[1]

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[1] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[2] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries,* May 2005, p. P-5.
[3] Rutherford, P.D., *Site Environmental Report for Calendar Year 1998 , DOE Operations at Rocketdyne Propulsion & Power, RD99-115*, The Boeing Company, Rocketdyne Propulsion & Power, September 22, 1999, p. 2-10.
[4] *Appendix A, Building Reconnaissance Report, Building 226, GEN-??-0000*, November 12, 1996, pgs. 31, 34.
[5] *Technical Site Information, Energy Technology Engineering Center (ETEC), GEN-AT-0027, Revision B*, Rockwell International Corporation, August 1993, p. b-35.
[6] *Appendix A, Building Reconnaissance Report, Building 226, GEN-??-0000*, November 12, 1996, pgs. 31, 34.
[7] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. P-5.
[8] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries,* May 2005, p. P-5.

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Location: None found.

Aerial Photographs: Building 4226 is first identified on a 1980 aerial photograph. It is located northeast of an area identified as having a probable stain in 1978. Building 4226 is included in a processing area (PA) designated PA-1 in the Environmental Protection Agency's aerial photograph analysis. Because multiple buildings are included in PA-1, aerial photograph analysis for this area cannot be attributed to specific buildings, unless explicitly stated. Aerial photographs from 1980 through 1995 denote possible storage tanks and overhead pipes in PA-1. Open storage areas are noted in PA-1 in 1978, 1980, and 1995. In 1980 and 1983, a possible stain was noted in PA-1. A probable stain was identified in PA-1 in 1995. By 1998, all of the previously identified features in PA-1 were no longer present. By 2005, Building 4226 was no longer present in PA-1.[2]

Radionuclides of Concern: The research team did not find evidence of radioactive material use in Building 4226.[3] Radionuclides associated with potential migration from Systems for Nuclear Auxiliary Power (SNAP) Buildings 4010 and 4012 include: antimony-125 (Sb-125), americium-241 (Am-241), Cs-134, Cs-137, cobalt-60 (Co-60), europium isotopes (Eu-152, Eu-154), isotopes of plutonium (Pu-238, Pu-239, Pu-240, Pu-241), strontium-90 (Sr-90), H-3, and U-234, U-235, U-238.[4,5,6] All radionuclides of concern listed are included for analysis in the August 2009 *Final Field Sampling Plan, Radiological Background Study, Santa Susana Field Laboratory*. Table 3.3 presents a summary of radiological contaminants of concern.

Drainage Pathways: Aerial photographs from 1957 to 2005 indicate that drainage from PA-1 followed 17th Street to the south and continued to impoundments in Areas III and IV. The Area IV impoundment is identified as IM-5 on aerial photograph analysis and as the 17th Street Drainage in this technical memorandum.[7] The 17th Street Drainage is discussed later in this section. The general slope of Area IV is in a southerly direction. Water runoff is directed to the retention reservoirs which are part of the SSFL industrial effluent control system. Liquid effluent discharge from the final retention pond into the Bell Canyon drainage occurs only after controlled effluent holdup and sampling.[8,1] Because the general slope of Area IV is in a

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[1] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. P-5.
[2] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.
[3] *Appendix A, Building Reconnaissance Report, Building 226, GEN-??-0000*, November 12, 1996, pgs. 31, 34.
[4] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 1 – Methodology*, May 2005, p. 2-9.
[5] Unknown Author, *Facility Information, Building 012*, Unknown Date, HDMSP001828011.
[6] Zwetzig, G.B., *Survey of Fission- and Corrosion-Product Activity in Sodium- or NaK-Cooled Reactors, AI-AEC-MEMO-12790*, Atomics International, a Division of North American Rockwell Corporation, February 28, 1969, pgs. 5, 10.
[7] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.
[8] Chapman, J. A., *Radiological Survey of Buildings T019 and T013; An Area Northwest of T059, T019, T013, and T012; And a Storage Yard West of Buildings T626 and T038, GEN-ZR-0010*, Rockwell International, Rocketdyne Division, August 26, 1988, p. 17.

southerly direction, runoff containing residual contamination from the former SNAP Buildings 4010 and 4012 could potentially impact Building 4226. The SNAP buildings handled radioactive materials and generated radionuclides, which means there is a possibility of radiological contamination in the area of Building 4226.

Radiological Contamination Potential: Class 2 because of potential radioactive material migration via surface water flow or airborne release from SNAP Buildings 4010 and 4012, and lack of site investigation.

Recommended Locations for Sediment/Soil Sampling:

Plate 1 and Figure 2.4 provide a convenient reference for the following recommendations.

Due to lack of site investigation, and potential radioactive material migration via surface water flow or airborne release from SNAP Buildings 4010 and 4012, there is a possibility that radionuclide concentrations in soil will exceed the standard required by the December 2010 Administrative Order on Consent. Therefore, additional characterization is recommended for the Building 4226 area. This includes the following Building 4226 areas:

- Former sump that appears to be located exterior to the Building 4226 footprint to the south. If radiological materials migrated or were released into the sump, residual contamination may exist in the area.
- Stained area identified in aerial photographs south of the Building 4226 footprint. An unknown stain could be a potential source of contamination.
- Drainage pathways associated with the Building 4226 area and outside Area IV as proposed by the field sampling plan. Residual contamination may exist in drainages outside of Area IV.

2.4.3 Building 4358 Area

Site Description: The Building 4358 area comprises Building 4358 and the land surrounding it. Building 4358 was constructed in 1967 as the Sodium Component Test Installation (SCTI) Chemical Storage Building. It was located northwest of SCTI Building 4656 at the corner of B and 20th Streets. In 1978, the building became a Small Component Test Loop (SCTL) Chemical Storage Building and was moved to a new location south of SCTL Building 4026 and west of 17th Street.[2,3,4] Because Building 4358 changed locations, it is discussed as part of Group 2 and Group 4 building areas. Figures 2.4.3a through 2.4.3b provide a current photograph and the best available building-specific drawing(s) that the research team could find. SCTL Buildings 4026, 4226, and 4826 are all discussed elsewhere in this section. No as-built drawings were located for Building 4358. Plate 1 presents a summary of all identified features for this site.

[1] Map located at: http://www.dtsc-ssfl.com/files/maps/SSFL%20-%20Western%20Half.pdf.
[2] *Appendix A, Building Reconnaissance Report, Building 358, GEN-??-0000*, November 15, 1996, p. 31.
[3] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[4] Wondolleck, John, *Area IV Santa Susana Field Laboratory, Environmental Impact Statement, Draft Gap Analysis Report*, CDM, June 1, 2008, Appendix A, p. 13.

Building Features: Building 4358 was constructed with a concrete slab floor and steel frame, siding, and roof. The building measured 22 feet long, 50 feet wide, and 12 feet high with 1,120 square feet of floor area.[1] Building 4358 did not contain any restrooms, but was heated.[2] A sanitary sewer map shows a sewer line that appears to be located south of the 1978 Building 4358 location.[3] Figure 2.4.3b presents a floor plan of Building 4358.

Former Use(s): Building 4358 was originally constructed as a chemical storage facility in support of SCTI and then became a chemical storage building in support of SCTL and Kalina operations.[4]

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: Building 4358 was demolished in 2003.[5] Building structures were removed followed by the below-grade pipes, ducts, trenches, tanks and pits. It doesn't appear that there were any large pits associated with Building 4358. The exact dimensions of the excavation are unknown. Backfilling and grading used onsite soil from the borrow area.[6,7]

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): During demolition, Building 4358 debris was surveyed daily for total and removable contamination. No radiological contamination reportedly was detected. This area was covered as part of Rockwell/Rocketdyne's 1994-1995 Area IV Radiological Characterization Survey. An ambient gamma and walkabout survey was conducted in the area of Building 4358. The average gamma exposure rate for the developed areas of the Santa Susana Field Laboratory Area IV was 13.6 microroentgens per hour (μR/hr) with a maximum rate of 19.4 μR/hr. The average exposure rate for all of Area IV was 14.6 μR/hr with a maximum rate of 21.4 μR/hr. The local background exposure rate outside of Area IV was 15.6 μR/hr with a maximum value of 20.5 μR/hr. According to the survey report, the gamma radiation distribution of Area IV was statistically indistinguishable from the local background gamma radiation distribution. The U.S. Nuclear Regulatory Commission and the State of California specify a limit of 5 μR/hr above the average background of the data set for release of land for radiologically unrestricted use. Ambient gamma regulatory limits were below these acceptable limits.[8]

Radiological Use Authorizations: None found.

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[1] *Appendix A, Building Reconnaissance Report, Building 358, GEN-??-0000*, November 15, 1996, p. 31.
[2] *Technical Site Information, Energy Technology Engineering Center (ETEC), GEN-AT-0027, Revision B*, Rockwell International Corporation, August 1993, p. b-36.
[3] *Technical Site Information, Energy Technology Engineering Center (ETEC), GEN-AT-0027, Revision B*, Rockwell International Corporation, August 1993, p. b-23.
[4] Wondolleck, John, *Area IV Santa Susana Field Laboratory, Environmental Impact Statement, Draft Gap Analysis Report*, CDM, June 1, 2008, Appendix A, p. 13.
[5] Wondolleck, John, *Area IV Santa Susana Field Laboratory, Environmental Impact Statement, Draft Gap Analysis Report*, CDM, June 1, 2008, Appendix A, p. 13.
[6] Kneff, et al., *Sodium Component Test Installation (SCTI) Demolition Final Report, EID-08336*, The Boeing Company, October 2003, p. 39.
[7] Correspondence from Lopez, J., Lopez General Engineering Contractors, Inc., to Robinson, K.S., The Boeing Company, *Reference: SCTI Demolition Buildings: 4355, 4356, 4357, 4358, 4457 & Associated, May 22, 2002.*
[8] Rockwell International, Rocketdyne Division, *Area IV Radiological Characterization Survey, A4CM-ZR-0011, Rev. A*, August 15, 1996.

Former Radiological Burial or Disposal Location: None found.

Aerial Photographs: Building 4358 is first identified in a 1967 aerial photograph and is included in a processing area (PA) designated PA-1 in the Environmental Protection Agency's aerial photograph analysis. In 1978, Building 4358 is relocated, but is still within PA-1. Because multiple buildings are included in PA-1, aerial photograph analysis for this area cannot be attributed to specific buildings, unless explicitly stated. Aerial photographs from 1965 through 1995 denote possible storage tanks and overhead pipes in PA-1. Open storage areas are noted in PA-1 in 1978, 1980, and 1995. In 1967 and 1978, a stain was identified in PA-1. In 1980 and 1983, a possible stain was noted in PA-1. A probable stain was identified in PA-1 in 1995. In 1988, possible saturated material was identified along the southeast side of Building 4358. By 1998, all of the previously identified features in PA-1 were no longer present. By 2005, Building 4358 was no longer present in PA-1.[1]

Radionuclides of Concern: The research team did not find evidence of radioactive material use in Building 4358. Radionuclides associated with potential migration from Systems for Nuclear Auxiliary Power (SNAP) Buildings 4010 and 4012 include: antimony-125 (Sb-125), americium-241 (Am-241), cesium isotopes (Cs-134, Cs-137), cobalt-60 (Co-60), europium isotopes (Eu-152, Eu-154), plutonium isotopes (Pu-238, Pu-239, Pu-240, Pu-241), strontium-90 (Sr-90), tritiated titanium (H-3), and natural and enriched uranium (U-234, U-235, U-238).[2,3,4] All radionuclides of concern listed are included for analysis in the August 2009 *Final Field Sampling Plan, Radiological Background Study, Santa Susana Field Laboratory*. Table 3.3 presents a summary of radiological contaminants of concern.

Drainage Pathways: Aerial photographs from 1957 to 2005 indicate that drainage from PA-1 followed 17th Street to the south and continued to impoundments in Areas III and IV. The Area IV impoundment is identified as IM-5 on aerial photograph analysis and as the 17th Street Drainage in this technical memorandum. The 17th Street Drainage is discussed later in this section. Aerial photographs from 1965 to 2005 also show drainage flowing south from 20th Street and continuing into Area III impoundments.[5] The general slope of Area IV is in a southerly direction. Water runoff is directed to the retention reservoirs which are part of the SSFL industrial effluent control system. Liquid effluent discharge from the final retention pond into the Bell Canyon drainage occurs only after controlled effluent holdup and sampling.[6,7] Because the general slope of Area IV is in a southerly direction, runoff from SNAP Buildings

[1] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.
[2] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume1 – Methodology*, May 2005, p. 2-9.
[3] Zwetzig, G.B., *Survey of Fission- and Corrosion-Product Activity in Sodium- or NaK-Cooled Reactors, AI-AEC-MEMO-12790*, Atomics International, a Division of North American Rockwell Corporation, February 28, 1969, p. 5.
[4] Unknown Author, *Facility Information, Building 012*, Unknown Date, HDMSP001828011.
[5] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.
[6] Chapman, J. A., *Radiological Survey of Buildings T019 and T013; An Area Northwest of T059, T019, T013, and T012; And a Storage Yard West of Buildings T626 and T038, GEN-ZR-0010*, Rockwell International, Rocketdyne Division, August 26, 1988, p. 17.
[7] Map located at: http://www.dtsc-ssfl.com/files/maps/SSFL%20-%20Western%20Half.pdf.

4010 and 4012 could potentially impact Building 4358. The SNAP buildings handled radioactive materials and generated radionuclides, which means there is a possibility of radiological contamination in the area of Building 4358.

Radiological Contamination Potential: Class 2 because of potential radioactive material migration via surface water flow or airborne release from SNAP Buildings 4010 and 4012.

Recommended Locations for Sediment/Soil Sampling:

Plate 1 and Figure 2.4 provide a convenient reference for the following recommendations.

Due to the limited site investigation and potential radioactive material migration via surface water flow or airborne release from SNAP Buildings 4010 and 4012, there is a possibility that radionuclide concentrations in soil will exceed the standard required by the December 2010 Administrative Order on Consent. Therefore, additional characterization is recommended for the 1978 Building 4358 area. This includes the following Building 4358 areas:

- Sanitary sewer south of Building 4358. If radioactive materials were released into the sewer lines, residual contamination may exist in the materials inside and surrounding the sewer lines.

- Drainage pathways associated with the Building 4358 area and outside Area IV as proposed by the field sampling plan. Residual contamination may exist in drainages outside of Area IV.

2.4.4 Building 4826 Area

Site Description: The Building 4826 area comprises Building 4826, Electrical Substation 4726, and the land surrounding these buildings. Building 4826, part of the Small Component Test Loop (SCTL) complex, was originally built as part of the Large Component Test Loop (LCTL) complex in 1958.[1] Buildings 4026, 4226, and 4826 together comprised the SCTL complex.[2] Building 4826 was the SCTL Test Facility located between 17th and 20th Streets. It was serviced by Electrical Substation 4726.[3,4] Figures 2.4.4a through 2.4.4c provide a current photograph and the best available building-specific drawing(s) that the research team could find. No as-built drawings were located for Building 4826. Plate 1 presents a summary of all identified features for this site.

Building Features: The STCL complex was 10,340 square feet with a 9,659-square-foot laboratory and 681 square feet of non-laboratory space. The SCTL complex consisted of an enclosed component test area, a sodium transport and storage system, an instrument and control

[1] U.S. Department of Energy, *Small Component Test Loop*, Energy Technology Engineering Center (ETEC) Website, http://www.etec.energy.gov/History/Sodium/SCTL.html, accessed November 25, 2009, p.1.
[2] Rutherford, P.D., *Site Environmental Report for Calendar Year 1998 , DOE Operations at Rocketdyne Propulsion & Power, RD99-115*, The Boeing Company, Rocketdyne Propulsion & Power, September 22, 1999, p. 2-10.
[3] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962-November 1992.
[4] DE-AC03-98SF21530, *Environmental Restoration and Remediation of the Former Energy Technology Engineering Center*, Contract Awarded to Boeing North American, Inc., Rocketdyne Propulsion & Power, December 31, 1998, Attachment 1, Appendix 2, pgs. 2-3.

system, and other interfacing systems. The sodium transport and storage system consists of four test loops, a thermal conditioning loop, and two liquid sodium storage/drain tanks that act as reservoirs for normal and emergency draining.[1,2,3]

Building 4826 was the SCTL Test Facility. The test facility building was steel-framed and fully enclosed. The roofing and walls are corrugated, galvanized sheet metal. The base is steel-lined concrete. Building 4826 housed the test tower, components test area, and drain tanks. The building provided weather protection for all sodium piping and vessels. The test tower was a 30 foot square by 80 foot high structure that supported the 9,500-gallon vertical core tank (T-1) containing liquid sodium and portions of the test loop. The drain tanks, housed in secondary containment pits, were located in Building 4826 and occupied an area of 16 feet by 40 feet. The pits were separated by a concrete partition, walled with steel plate, and surrounded by a curb to prevent surface water and ground level sodium spills from draining into the pits. Walls and floors were water-proofed to prevent intrusion of ground water. A sump pump was located nearby to remove any water that accumulated in the pits. The drain pits contained liquid sodium storage/drain tanks T-2 and T-3. T-2 had a capacity of approximately 9,050 gallons and T-3 had a capacity of 11,500 gallons. The tanks were mounted horizontally on structural steel stands 12 feet below grade to allow for gravity drainage.[4] Figure 2.4.4b presents a floor plan of SCTL Buildings 4026 and 4826. The floor plan notes the two drain tank pits in Building 4826. Figure 2.4.4c is a 1996 photograph showing the drain tanks and pits.

Former Use(s): The SCTL was originally built as the LCTL and operations began in 1959 with a pump test.[5] This facility was used to test small components such as valves and pumps in liquid sodium.[6] The SCTL's principal purpose was to provide a test bed for non-nuclear qualification testing of typical liquid metal fast breeder reactor components and to obtain test data for verification of the elevated temperature design criteria of the piping design guide. In 1970, the LCTL was modified, expanded, and re-designated as the SCTL. In 1974, the facility was again modified and expanded. In 1978 a new control room was added onto the northwest corner of the facility, giving the complex its final appearance. Testing within the facility continued periodically from 1959 until 1985. Upon completion of the test programs, the sodium was drained into the facility sodium drain tanks and all systems were secured. The facility was maintained in inactive standby status, with the sodium systems under an inert cover gas, until late 1995.[7] In 1996, the sodium in the facility drain tanks (approximately 103,930 pounds) was removed and transferred to a sodium supplier for reuse. In 1997, the two below-grade drain

[1] Cleveland, J.R., Safety Hazards Report, GEN-ZR-0001, Energy Technology Engineering Center, April 30, 1985, pg. 38.
[2] U.S. Department of Energy, *Small Component Test Loop*, Energy Technology Engineering Center (ETEC) Website, http://www.etec.energy.gov/History/Sodium/SCTL.html, accessed November 25, 2009, p.1.
[3] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. P-1.
[4] Neely, H.H., Sodium Component Test Laboratory (SCTL) System Design Description, 026-XC-0010, Energy Technology Engineering Center, March 15, 1982 Revised September 30, 1987, pgs. 1-8, 2-6, 2-28, 2-30, 2-70–2-72.
[5] U.S. Department of Energy, *Small Component Test Loop*, Energy Technology Engineering Center (ETEC) Website, http://www.etec.energy.gov/History/Sodium/SCTL.html, accessed November 25, 2009, p.1.
[6] Rutherford, P.D., *Site Environmental Report for Calendar Year 1998 , DOE Operations at Rocketdyne Propulsion & Power, RD99-115*, The Boeing Company, Rocketdyne Propulsion & Power, September 22, 1999, p. 2-10.
[7] U.S. Department of Energy, *Small Component Test Loop*, Energy Technology Engineering Center (ETEC) Website, http://www.etec.energy.gov/History/Sodium/SCTL.html, accessed November 25, 2009, p.1.

tanks and the SCTL sodium piping system were removed and cleaned.[1] By the end of 1999, the facility was demolished and the foundations, pits, and utilities were removed. A void remained where the concrete pits and foundations were removed.[2] Back filling with soil was completed in 2000.[3]

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: Demolished in 1998.[4] Based on available information, the dimensions of the excavation made during building demolition are unknown.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): Results of a building reconnaissance report conducted in July 1996 reportedly found the building to be free of radiological contamination. Prior to removal of the SCTL drain tanks in 1996, sodium in the system was tested for radiological contamination and none reportedly was detected.[5]

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Location: None found.

Aerial Photographs: Structures are located in the vicinity of Building 4826 on aerial photographs as early as 1959, but it is difficult to separate Building 4826 from Building 4026 given the continual growth of the SCTL complex over the years. Building 4826 is included in a processing area designated PA-1 in the Environmental Protection Agency's aerial photograph analysis. Because multiple buildings are included in PA-1, aerial photograph analysis for this area cannot be attributed to specific buildings, unless explicitly stated. A 1962/63 aerial photograph identifies overhead pipes and ground scarring in PA-1. Aerial photographs from 1965 through 1995 denote possible storage tanks and overhead pipes in PA-1. Open storage areas are noted in PA-1 in 1978, 1980, and 1995. In 1967 and 1978, a stain was identified in PA-1. In 1980 and 1983, a possible stain was noted in PA-1. A probable stain was identified in PA-1 in 1995. By 1998, all of the previously identified features in PA-1 were no longer present. By 2005, Building 4026 was no longer present in PA-1.[6]

Radionuclides of Concern: The research team did not find evidence of radioactive material use in Building 4826. Radionuclides associated with potential migration from Building 4006

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[1] Rutherford, P.D., *Site Environmental Report for Calendar Year 1998 , DOE Operations at Rocketdyne Propulsion & Power, RD99-115*, The Boeing Company, Rocketdyne Propulsion & Power, September 22, 1999, p. 2-10.
[2] The Boeing Company, Rocketdyne, *Site Environmental Report for Calendar Year 1999 DOE Operations at The Boeing Company Rocketdyne, RD00-159*, September 2000, p. 2-8.
[3] The Boeing Company, Rocketdyne Propulsion & Power, *Site Environmental Report for Calendar Year 2000 DOE Operations at The Boeing Company Rocketdyne Propulsion & Power, RD00-152*, September 2001, p. 2-9.
[4] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. P-51.
[5] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. P-51.
[6] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.

include: cesium-137 (Cs-137), manganese-54 (Mn-54), tritiated titanium (H-3), natural and enriched uranium (U-234, U-235, U-238), and uranium oxide (UO_2).[1] Radionuclides associated with potential migration from Systems for Nuclear Auxiliary Power (SNAP) Buildings 4010 and 4012 include: antimony-125 (Sb-125), americium-241 (Am-241), Cs-134, Cs-137, cobalt-60 (Co-60), europium isotopes (Eu-152, Eu-154), isotopes of plutonium (Pu-238, Pu-239, Pu-240, Pu-241), strontium-90 (Sr-90), H-3, U-234, U-235, and U-238.[2,3,4] All radionuclides of concern listed, with the exception of Mn-54, are included for analysis in the August 2009 *Final Field Sampling Plan, Radiological Background Study, Santa Susana Field Laboratory*. Mn-54 has a half-life of less than one year and thus does not meet the criteria for analysis. Table 3.3 presents a summary of radiological contaminants of concern.

Drainage Pathways: Aerial photographs from 1957 to 2005 indicate that drainage from PA-1 followed 17th Street to the south and continued to impoundments in Areas III and IV. The Area IV impoundment is identified as IM-5 on aerial photograph analysis and as the 17th Street Drainage in this technical memorandum.[5] The 17th Street Drainage is discussed later in this section. The general slope of Area IV is in a southerly direction. Water runoff is directed to the retention reservoirs which are part of the SSFL industrial effluent control system. Liquid effluent discharge from the final retention pond into the Bell Canyon drainage occurs only after controlled effluent holdup and sampling.[6,7] Because the general slope of Area IV is in a southerly direction, runoff from Sodium Laboratory Building 4006 and the SNAP Buildings 4010 and 4012 could potentially impact Building 4826. Building 4006 had minor use of radioactive material. The SNAP buildings handled radioactive materials and generated radionuclides, which means there is a possibility of radiological contamination in the area of Building 4826.

Radiological Contamination Potential: Class 2 because of potential radioactive material migration via surface water flow or airborne release from Buildings 4006, 4010, and 4012, and lack of site investigation.

Recommended Locations for Sediment/Soil Sampling:

Plate 1 and Figure 2.4 provide a convenient reference for the following recommendations.

Due to the limited site investigation and potential radioactive material migration via surface water flow or airborne release from Buildings 4006, 4010, and 4012, there is a possibility that

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[1] Cabrera Services, *Final Radiological Final Status Survey of Building 4006*, June 2008, pgs. vi, 8-9, 38.
[2] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 1 – Methodology*, May 2005, p. 2-9.
[3] Zwetzig, G.B., *Survey of Fission- and Corrosion-Product Activity in Sodium- or NaK-Cooled Reactors, AI-AEC-MEMO-12790*, Atomics International, a Division of North American Rockwell Corporation, February 28, 1969, p. 5.
[4] Unknown Author, *Facility Information, Building 012*, Unknown Date, HDMSP001828011.
[5] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.
[6] Chapman, J. A., *Radiological Survey of Buildings T019 and T013; An Area Northwest of T059, T019, T013, and T012; And a Storage Yard West of Buildings T626 and T038, GEN-ZR-0010*, Rockwell International, Rocketdyne Division, August 26, 1988, p. 17.
[7] Map located at: http://www.dtsc-ssfl.com/files/maps/SSFL%20-%20Western%20Half.pdf.

radionuclide concentrations in soil will exceed the standard required by the December 2010 Administrative Order on Consent. Therefore, additional characterization is recommended for the Building 4826 area. This includes the following Building 4826 areas:

- Former drain pits located in the Building 4826 footprint. If radiological materials migrated or were released into the drain pits, residual contamination may exist in the area.

- Drainage pathways associated with the Building 4826 area and outside Area IV as proposed by the field sampling plan. Residual contamination may exist in drainages outside of Area IV.

2.5 Group 5

The Group 5 index map is presented in Figure 2.5. Following Figure 2.5, the site photograph and layout drawings for each building area within HSA-5B Group 5 are presented. HSA-5B Group 5 includes two building areas containing the Kalina Complex buildings. The Kalina Complex is comprised of Buildings 4334 and 4335.

2.5.1 Building 4334 Area

Site Description: The Building 4334 area comprises Building 4334 and the land surrounding it east of 20th Street. Building 4334 was constructed in 1991 as part of the Kalina Cycle Demonstration Power Plant.[1] Building 4334 was the Kalina Control Room and Office Building. It was located near Kalina Turbine Generator Building 4335, which is discussed later in this section.[2] Together, Buildings 4334 and 4335 were known as the Kalina Complex. Figure 2.5.1a provides a current photograph. The research team was unable to find building-specific drawing(s). The Kalina Complex was located southwest of Small Component Test Loop Buildings 4026 and 4226. These buildings are discussed elsewhere in this section. No as-built drawings were located for Building 4334. Plate 1 presents a summary of all identified features for this site.

Building Features: Building 4334 was a 6,256-square-foot structure on a 36,000-square-foot site that also included Building 4335 and the associated tanks, piping, and pumps for the power plant.[3] Building 4334 served as a control room and office facility for the Kalina Complex.[4] Nine aboveground ammonia tanks and one lube oil tank were associated with the Kalina Complex. Secondary containment included at least three concrete pits.[5]

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[1] U.S. Department of Energy, *Environmental Assessment Kalina Cycle Demonstration Power Plan at the Energy Technology Engineering Center Santa Susana Field Laboratory*, October 1990, pgs. 2, 23.
[2] Correspondence from Ludwig, B., The Boeing Company, Environmental Protection, to Flores, J., Ventura County Air Pollution Control District, *Reference: Kalina Complex – Buildings 4334 and 4335 Area IV, Santa Susana Field Laboratory*, dated May 5, 2003.
[3] Correspondence from Ludwig, B., The Boeing Company, Environmental Protection, to Flores, J., Ventura County Air Pollution Control District, *Reference: Kalina Complex – Buildings 4334 and 4335 Area IV, Santa Susana Field Laboratory*, dated May 5, 2003.
[4] Correspondence from Ludwig, B., The Boeing Company, Environmental Protection, to Flores, J., Ventura County Air Pollution Control District, *Reference: Kalina Complex – Buildings 4334 and 4335 Area IV, Santa Susana Field Laboratory*, dated May 5, 2003.
[5] *Technical Site Information, Energy Technology Engineering Center (ETEC), GEN-AT-0027, Revision B*, Rockwell International Corporation, August 1993, pgs. b-42–b43, b46–b47.

Former Use(s): The Kalina Complex was developed by Kalina Technology, Ltd., to demonstrate new technology for converting heat to electricity more efficiently than conventional Rankine steam cycle power plants. It was a private venture between Rockwell International Corporation and Kalina Technology Ltd., which later became Exergy, Inc. The major unique features of the Kalina cycle power plant were the use of an ammonia and water mixture to provide variability in the temperature boiling and condensing process, as well as the use of a distillation/condensation subsystem installed between the turbine and condenser. The Kalina Complex was operated using waste heat from the SCTI and because of this was physically connected to various SCTI systems.[1,2]

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: Demolished in mid- to late-2003.[3] A demolition contractor estimated 300 tons of scrap metal and 1,200 yards of concrete and other material would be removed during the Kalina Complex demolition. Approximately, 600 yards of material would be required to grade the site to match natural contours.[4] Based on available information, the dimensions of the excavation made during building demolition are unknown.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): Radiological surveys specific to Building 4334 were not conducted. The Building 4334 area was covered as part of the Rockwell/Rocketdyne 1994-1995 Area IV Radiological Characterization Survey. A walkabout gamma survey was conducted in the area of Building 4334. Only areas showing elevated gamma activity in the walkabout survey were followed up with an ambient gamma survey. Walkabout data was not reported in the characterization survey report. However, the walkabout survey results were reported to be consistent with ambient gamma survey measurements. The average gamma exposure rate for the developed areas of the Santa Susana Field Laboratory Area IV was 13.6 microroentgens per hour (μR/hr) with a maximum rate of 19.4 μR/hr. The average exposure rate for all of Area IV was 14.6 μR/hr with a maximum rate of 21.4 μR/hr. The local background exposure rate outside of Area IV was 15.6 μR/hr with a maximum value of 20.5 μR/hr. According to the survey report, the gamma radiation distribution of Area IV was statistically indistinguishable from the local background gamma radiation distribution. The U.S. Nuclear Regulatory Commission and the State of California specify a limit of 5 μR/hr above the average background of the data set for release of land for radiologically unrestricted use. Ambient gamma regulatory limits were below these acceptable limits.[5]

Radiological Use Authorizations: None found.

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[1] U.S. Department of Energy, *Environmental Assessment Kalina Cycle Demonstration Power Plan at the Energy Technology Engineering Center Santa Susana Field Laboratory*, October 1990, pgs. 1-2, 13, 23.
[2] Internal correspondence from Lafflam, S.R. to Keller, J.H., Rockwell International, *Reference: Environmental Weekly Activity Report*, December 1, 1987.
[3] Kalina Demolition Trucking Forms, July 2003 – November 2003, HDMSP00039841 – HDMSP00040025.
[4] Correspondence from Mayes, R., Standard Industries, to The Boeing Company, *Reference: Technical Proposal; Kalina Plan Demolition*, May 8, 2003.
[5] Rockwell International/Rocketdyne Division, *Area IV Radiological Characterization Survey, A4CM-ZR-0011, Rev. A*, August 15, 1996.

Former Radiological Burial or Disposal Location: None found.

Aerial Photographs: Building 4334 is first identified on a 1995 aerial photograph and is included in a processing area (PA) designated PA-1 in the Environmental Protection Agency's aerial photograph analysis. Because multiple buildings are included in PA-1, aerial photograph analysis for this area cannot be attributed to specific buildings, unless explicitly stated. In 1995, storage tanks, overhead pipes, open storage areas, a smokestack, and a probable stain are identified in PA-1. Building 4334 is not present on a 2005 aerial photograph.[1]

Radionuclides of Concern: The Kalina Complex was not a radiological facility and no radiological controls were required for its demolition or waste disposition.[2] Radionuclides associated with potential migration from Systems for Nuclear Auxiliary Power (SNAP) Building 4019 include: americium-241 (Am-241), cesium-137 (Cs-137), plutonium isotopes (Pu-238, Pu-239, Pu-240, Pu-241), strontium-90 (Sr-90), and natural and enriched uranium (U-234, U-235, U-238).[3,4] All radionuclides of concern listed are included for analysis in the August 2009 *Final Field Sampling Plan, Radiological Background Study, Santa Susana Field Laboratory*. Table 3.3 presents a summary of radiological contaminants of concern.

Drainage Pathways: The Building 4005/4006 leach field was 480 linear feet and located south of Building 4334.[5] The Kalina Complex site surface was described as a flat area with a slight slope to the south that provides for drainage.[6] Aerial photographs from 1957 to 2005 indicate that drainage from PA-1 followed 17th Street to the south and continued to impoundments in Areas III and IV. The Area IV impoundment is identified as IM-5 on aerial photograph analysis and as the 17th Street Drainage in this technical memorandum. The 17th Street Drainage is discussed later in this section. Aerial photographs from 1965 to 2005 also show drainage flowing south from 20th Street and continuing into Area III impoundments.[7] Because Building 4334 is located near 20th Street, it is possible drainage from the building went south along 20th Street instead of 17th Street. The general slope of Area IV is in a southerly direction. Water runoff is directed to the retention reservoirs which are part of the SSFL industrial effluent control system. Liquid effluent discharge from the final retention pond into the Bell Canyon drainage occurs only after controlled effluent holdup and sampling.[8,1] It is possible that runoff from

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[1] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.

[2] Alex, Gregory J. et al., *Kalina Complex Statement of Work and Building Demolition Assessment Checklist*, May 2003, p. 3.

[3] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume1 – Methodology*, May 2005, p. 2-9.

[4] Unknown Author, *Log Book, Building 4019, 1/20/64 to 6/3/65*, January 20, 1964, HDMSP001853462.

[5] ICF Kaiser Engineers, *Current Conditions Report and Draft RCRA Facility Investigation Work Plan, Area IV Santa Susana Field Laboratory, Ventura County, California, Part 1-Current Conditions Report, Volume 1*, October 1993, pgs. 4-83, 4-87.

[6] U.S. Department of Energy, *Environmental Assessment Kalina Cycle Demonstration Power Plan at the Energy Technology Engineering Center Santa Susana Field Laboratory*, October 1990, p. 35.

[7] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.

[8] Chapman, J. A., *Radiological Survey of Buildings T019 and T013; An Area Northwest of T059, T019, T013, and T012; And a Storage Yard West of Buildings T626 and T038, GEN-ZR-0010*, Rockwell International, Rocketdyne Division, August 26, 1988, p. 17.

SNAP Building 4019 could potentially impact Building 4334. The SNAP building handled radioactive materials and generated radionuclides, which means there is a possibility of radiological contamination in the area of Building 4334.

Radiological Contamination Potential: Class 2 because of potential radioactive material migration via surface water flow or airborne release from SNAP Building 4019 and the Building 4005/4006 leach field, and lack of site investigation.

Recommended Locations for Sediment/Soil Sampling:

Plate 1 and Figure 2.5 provide a convenient reference for the following recommendations.

Due to the lack of site investigation and potential radioactive material migration via surface water flow or airborne release from SNAP Building 4019 and the Building 4005/4006 leach field, there is a possibility that radionuclide concentrations in soil will exceed the standard required by the December 2010 Administrative Order on Consent. Therefore, additional characterization is recommended for the Building 4334 area. This includes the following Building 4334 areas:

- Southern portion of site closest to former Building 4005/4006 leach field. If radioactive materials were released into the septic system, residual contamination may exist in the materials surrounding the former leach field.

- Western portion of the Building 4334 footprint closest to 20th Street drainage. The 20th Street storm drain collects storm water from SNAP Building 4019; consequently, residual contamination may exist in the materials surrounding the 20th Street drainage.

- Former tank, pump, and secondary containment pits associated with Building 4334. Although Building 4334 was not a radiological facility, areas containing former appurtenances should be sampled to ensure there was no cross contamination or migration from radiological facilities.

- Drainage pathways associated with the Building 4334 area and outside Area IV as proposed by the field sampling plan. Residual contamination may exist in drainages outside of Area IV.

2.5.2 Building 4335 Area

Site Description: The Building 4335 area comprises Building 4335 and the land surrounding it east of 20th Street. Building 4335 was constructed in 1991 as part of the Kalina Cycle Demonstration Power Plant.[2] Building 4335 was the Kalina Turbine Generator Building. It was located near Kalina Control Room and Office Building 4334, which is discussed earlier in this

[1] Map located at: http://www.dtsc-ssfl.com/files/maps/SSFL%20-%20Western%20Half.pdf.
[2] U.S. Department of Energy, *Environmental Assessment Kalina Cycle Demonstration Power Plan at the Energy Technology Engineering Center Santa Susana Field Laboratory*, October 1990, pgs. 1-2, 13, 23.

section.[1] Together, Buildings 4334 and 4335 were known as the Kalina Complex. Figure 2.5.2a provides a current photograph. The research team was unable to find building-specific drawing(s). The Kalina Complex was located southwest of Small Component Test Loop Buildings 4026 and 4226. These buildings are discussed elsewhere in this section. No as-built drawings were located for Building 4335. Plate 1 presents a summary of all identified features for this site.

Building Features: Building 4335 was a 940-square-foot structure on a 36,000-square-foot site that also included Building 4334 and the associated tanks, piping, and pumps for the power plant.[2] Building 4335 included a turbine generating structure and exhaust stack for the Kalina Complex.[3] Nine aboveground ammonia tanks and one lube oil tank were associated with the Kalina Complex. Secondary containment included at least three concrete pits.[4]

Former Use(s): The Kalina Complex was developed by Kalina Technology, Ltd., to demonstrate new technology for converting heat to electricity more efficiently than conventional Rankine steam cycle power plants. It was a private venture between Rockwell International Corporation and Kalina Technology Ltd., which later became Exergy, Inc. The major unique features of the Kalina cycle power plant were the use of an ammonia and water mixture to provide variability in the temperature boiling and condensing process, as well as the use of a distillation/condensation subsystem installed between the turbine and condenser. The Kalina Complex was operated using waste heat from the SCTI and because of this was physically connected to various SCTI systems.[5,6]

Information from Interviewees: A number of former employees were interviewed about their experience at the SSFL. One remembered Building 4335. Excerpts from this interview are included below.
Interviewee 195 started working in Area IV on the hill in 1968. The following excerpt was pulled from the interview.

> *"I also worked at the Kalina facility, an ammonia turbo-generator facility, where they used ammonia in a specialized cycle. They took the excess heat out of the SCTI's heaters and ran it over to the Kalina facility thru a turbine to produce electrical power."*[7]

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[1] Correspondence from Ludwig, B., The Boeing Company, Environmental Protection, to Flores, J., Ventura County Air Pollution Control District, *Reference: Kalina Complex – Buildings 4334 and 4335 Area IV, Santa Susana Field Laboratory*, dated May 5, 2003.
[2] Correspondence from Ludwig, B., The Boeing Company, Environmental Protection, to Flores, J., Ventura County Air Pollution Control District, *Reference: Kalina Complex – Buildings 4334 and 4335 Area IV, Santa Susana Field Laboratory*, dated May 5, 2003.
[3] Correspondence from Ludwig, B., The Boeing Company, Environmental Protection, to Flores, J., Ventura County Air Pollution Control District, *Reference: Kalina Complex – Buildings 4334 and 4335 Area IV, Santa Susana Field Laboratory*, dated May 5, 2003.
[4] *Technical Site Information, Energy Technology Engineering Center (ETEC), GEN-AT-0027, Revision B*, Rockwell International Corporation, August 1993, pgs. b-42–b43, b46–b47.
[5] U.S. Department of Energy, *Environmental Assessment Kalina Cycle Demonstration Power Plan at the Energy Technology Engineering Center Santa Susana Field Laboratory*, October 1990, pgs. 1-2, 13, 23.
[6] Internal correspondence from Lafflam, S.R. to Keller, J.H., Rockwell International, *Reference: Environmental Weekly Activity Report*, December 1, 1987.
[7] Interview No. 195 conducted by DOE in 2010.

Radiological Incident Reports: None found.

Current Use: Demolished in mid- to late-2003.[1] A demolition contractor estimated 300 tons of scrap metal and 1,200 yards of concrete and other material would be removed during the Kalina Complex demolition. Approximately, 600 yards of material would be required to grade the site to match natural contours.[2] Based on available information, the dimensions of the excavation made during building demolition are unknown.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): Radiological surveys specific to Building 4335 were not conducted. The Building 4335 area was covered as part of the Rockwell/Rocketdyne 1994-1995 Area IV Radiological Characterization Survey. A walkabout gamma survey was conducted in the area of Building 4335. Only areas showing elevated gamma activity in the walkabout survey were followed up with an ambient gamma survey. Walkabout data was not reported in the characterization survey report. However, the walkabout survey results were reported to be consistent with ambient gamma survey measurements. The average gamma exposure rate for the developed areas of the Santa Susana Field Laboratory Area IV was 13.6 microroentgens per hour (μR/hr) with a maximum rate of 19.4 μR/hr. The average exposure rate for all of Area IV was 14.6 μR/hr with a maximum rate of 21.4 μR/hr. The local background exposure rate outside of Area IV was 15.6 μR/hr with a maximum value of 20.5 μR/hr. According to the survey report, the gamma radiation distribution of Area IV was statistically indistinguishable from the local background gamma radiation distribution. The U.S. Nuclear Regulatory Commission and the State of California specify a limit of 5 μR/hr above the average background of the data set for release of land for radiologically unrestricted use. Ambient gamma regulatory limits were below these acceptable limits.[3]

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Location: None found.

Aerial Photographs: Prior to the construction of Building 4335, in 1978, a stain was identified in what was to become the northeast portion of Building 4335. Building 4335 is first identified in a 1995 aerial photograph and is included in a processing area (PA) designated PA-1 in the Environmental Protection Agency's aerial photograph analysis. Because multiple buildings are included in PA-1, aerial photograph analysis for this area cannot be attributed to specific buildings, unless explicitly stated. In 1995, storage tanks, overhead pipes, open storage areas, a smokestack, and a probable stain are identified in PA-1. Building 4335 is not present on a 2005 aerial photograph.[4]

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[1] Kalina Demolition Trucking Forms, July 2003 – November 2003, HDMSP00039841 – HDMSP00040025.
[2] Correspondence from Mayes, R., Standard Industries, to The Boeing Company, *Reference: Technical Proposal; Kalina Plan Demolition*, May 8, 2003.
[3] Rockwell International/Rocketdyne Division, *Area IV Radiological Characterization Survey, A4CM-ZR-0011, Rev. A*, August 15, 1996.
[4] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.

Radionuclides of Concern: The Kalina Complex was not a radiological facility and no radiological controls were required for its demolition or waste disposition.[1] Radionuclides associated with potential migration from SNAP Building 4019 include: americium-241 (Am-241), cesium-137 (Cs-137), plutonium isotopes (Pu-238, Pu-239, Pu-240, Pu-241), strontium-90 (Sr-90), and natural and enriched uranium (U-234, U-235, U-238).[2,3] All radionuclides of concern listedare included for analysis in the August 2009 Final Field Sampling Plan, Radiological Background Study, Santa Susana Field Laboratory. Table 3.3 presents a summary of radiological contaminants of concern.

Drainage Pathways: The Kalina Complex site surface was described as a flat area with a slight slope to the south that provides for drainage.[4] Aerial photographs from 1957 to 2005 indicate that drainage from PA-1 followed 17th Street to the south and continued to impoundments in Areas III and IV. The Area IV impoundment is identified as IM-5 on aerial photograph analysis and as the 17th Street Drainage in this technical memorandum. The 17th Street Drainage is discussed later in this section. Aerial photographs from 1965 to 2005 also show drainage flowing south from 20th Street and continuing into Area III impoundments.[5] Because Building 4335 is located near 20th Street, it is possible drainage from the building went south along 20th Street instead of 17th Street. The general slope of Area IV is in a southerly direction. Water runoff is directed to the retention reservoirs which are part of the SSFL industrial effluent control system. Liquid effluent discharge from the final retention pond into the Bell Canyon drainage occurs only after controlled effluent holdup and sampling.[6,7] It is possible that runoff from SNAP Building 4019 could impact Building 4335. The SNAP building handled radioactive materials and generated radionuclides, which means there is a possibility of radiological contamination in the area of Building 4335.

Radiological Contamination Potential: Class 2 because of potential radioactive material migration via surface water flow or airborne release from SNAP Building 4019, a stain identified in aerial photographs, and lack of site investigation.

Recommended Locations for Sediment/Soil Sampling:

Plate 1 and Figure 2.5 provide a convenient reference for the following recommendations.

Due to the lack of site investigation, potential radioactive material migration via surface water flow or airborne release from SNAP Building 4019, and a stain identified in aerial photographs,

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[1] Alex, Gregory J. et al., *Kalina Complex Statement of Work and Building Demolition Assessment Checklist*, May 2003, p. 3.
[2] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume1 – Methodology*, May 2005, p. 2-9.
[3] Unknown Author, *Log Book, Building 4019, 1/20/64 to 6/3/65*, January 20, 1964, HDMSP001853462.
[4] U.S. Department of Energy, *Environmental Assessment Kalina Cycle Demonstration Power Plan at the Energy Technology Engineering Center Santa Susana Field Laboratory*, October 1990, p. 35.
[5] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.
[6] Chapman, J. A., *Radiological Survey of Buildings T019 and T013; An Area Northwest of T059, T019, T013, and T012; And a Storage Yard West of Buildings T626 and T038, GEN-ZR-0010*, Rockwell International, Rocketdyne Division, August 26, 1988, p. 17.
[7] Map located at: http://www.dtsc-ssfl.com/files/maps/SSFL%20-%20Western%20Half.pdf.

there is a possibility that radionuclide concentrations in soil will exceed the standard required by the December 2010 Administrative Order on Consent. Therefore, additional characterization is recommended for the Building 4335 area. This includes the following Building 4335 areas:

- Western portion of the Building 4335 footprint, closet to the 20th Street drainage. The 20th Street storm drain collects storm water from SNAP Building 4019; consequently, residual contamination may exist in the materials surrounding the 20th Street drainage.

- Stain identified in aerial photograph located in northeast portion of the Building 4335 footprint. An unknown stain could be a potential source of contamination.

- Former tank, pump, and secondary containment pits associated with Building 4335. Although Building 4335 was not a radiological facility, areas containing former appurtenances should be sampled to ensure there was no cross contamination or migration from radiological facilities.

- Drainage pathways associated with the Building 4335 area and outside Area IV as proposed by the field sampling plan. Residual contamination may exist in drainages outside of Area IV.

2.6 Group 6

The Group 6 index map is presented in Figure 2.6. Following Figure 2.6, the site photograph and layout drawings for each building area within HSA-5B Group 6 are presented. HSA-5B Group 6 includes eight building areas containing the Building 4354 Control Element Test Structure, the Building 4714 Power Pak Interconnecting Facility, the Building 4293 Time Clock 4293, the Building 4310 Portable Change Room, Parking Lot 4502, the Building 4639 Office Trailer, Electrical Substation 4704, and a Fuel Tank 4735. Group 6 contains the Building 4005/4006 leach field, which is also discussed under Group 3. Note that Building 4310, the portable change room, was moved from an area near Systems for Nuclear Auxiliary Power (SNAP) Building 4010 to support the Small Component Test Loop (SCTL). As a result, Building 4310 will be discussed as appropriate in Group 1 and Group 6 of this section.

2.6.1 Building 4293 Area

Site Description: The Building 4293 area includes Building 4293 and the land surrounding it. Building 4293 was built in approximately 1971 as a construction shack. Building 4293 was located south of SCTL Buildings 4026 and 4826 between 17th and 20th Streets. Figure 2.6.1a provides a current photograph. The research team was unable to find building-specific drawing(s). SCTL Building 4226 was not constructed until after Building 4293 was demolished. Similarly, Building 4358, an SCTL chemical storage building, was not located east of Building 4293 until after Building 4293 was demolished.[1,2] These buildings are discussed elsewhere in this section. No as-built drawings were located for Building 4293. Plate 1 presents a summary of all identified features for this site.

[1] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[2] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. P-7.

Building Features: No information was located.

Former Use(s): Although designated as a construction/storage facility, Building 4293 served as a time clock station.[1]

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: Demolished after June 1995.[2] Based on available information, the dimensions of the excavation made during building demolition are unknown.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): Radiological surveys specific to Building 4293 were not conducted. This area was covered as part of Rockwell/Rocketdyne's 1994-1995 Area IV Radiological Characterization Survey. An ambient gamma and walkabout survey was conducted in the area of Building 4293. The average gamma exposure rate for the developed areas of the Santa Susana Field Laboratory Area IV was 13.6 microroentgens per hour (μR/hr) with a maximum rate of 19.4 μR/hr. The average exposure rate for all of Area IV was 14.6 μR/hr with a maximum rate of 21.4 μR/hr. The local background exposure rate outside of Area IV was 15.6 μR/hr with a maximum value of 20.5 μR/hr. According to the survey report, the gamma radiation distribution of Area IV was statistically indistinguishable from the local background gamma radiation distribution. The U.S. Nuclear Regulatory Commission and the State of California specify a limit of 5 μR/hr above the average background of the data set for release of land for radiologically unrestricted use. Ambient gamma regulatory limits were below these acceptable limits.[3]

Radiological Use Authorizations: None found.

Former Burial Radiological or Disposal Location: None found.

Aerial Photographs: Building 4293 is first identified on a 1980 aerial photograph. It is located southeast of an area identified as having a probable stain in 1978. Building 4293 is included in a processing area (PA) designated PA-1 in the Environmental Protection Agency's aerial photograph analysis. Because multiple buildings are included in PA-1, aerial photograph analysis for this area cannot be attributed to specific buildings, unless explicitly stated. Building 4293 appears on a 1983 aerial photograph, but is not visible in a 1988 photograph. Aerial photographs from 1980 through 1995 denote possible storage tanks and overhead pipes in PA-1. Open storage areas are noted in PA-1 in 1978 and 1980. In 1980 and 1983, a possible stain was

[1] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. P-7.
[2] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.
[3] Rockwell International, Rocketdyne Division, *Area IV Radiological Characterization Survey, A4CM-ZR-0011, Rev. A*, August 15, 1996.

noted in PA-1. Building 4293 appears to be present in a 1995 aerial photograph, but not in a 2005 aerial photograph.[1]

Radionuclides of Concern: The research team did not find evidence of radioactive material use in Building 4293. Radionuclides associated with potential migration from former SNAP Buildings 4010 and 4012 include: antimony-125 (Sb-125), americium-241 (Am-241), cesium isotopes (Cs-134, Cs-137), cobalt-60 (Co-60), europium isotopes (Eu-152, Eu-154), isotopes of plutonium (Pu-238, Pu-239, Pu-240, Pu-241), strontium-90 (Sr-90), and natural and enriched uranium isotopes (U-234, U-235, U-238).[2,3,4] All radionuclides of concern listed are included for analysis in the August 2009 *Final Field Sampling Plan, Radiological Background Study, Santa Susana Field Laboratory*. Table 3.3 presents a summary of radiological contaminants of concern.

Drainage Pathways: Aerial photographs from 1957 to 2005 indicate that drainage from PA-1 followed 17th Street to the south and continued to impoundments in Areas III and IV. The Area IV impoundment is identified as IM-5 on aerial photograph analysis and as the 17th Street Drainage in this technical memorandum.[5] The 17th Street Drainage is discussed later in this section. The general slope of Area IV is in a southerly direction. Water runoff is directed to the retention reservoirs which are part of the SSFL industrial effluent control system. Liquid effluent discharge from the final retention pond into the Bell Canyon drainage occurs only after controlled effluent holdup and sampling.[6,7] Because the general slope of Area IV is in a southerly direction, runoff from SNAP Buildings 4010 and 4012 could potentially impact Building 4293. The SNAP buildings handled radioactive materials and generated radionuclides, which means there is a slight possibility of radiological contamination in the area of Building 4293.

Radiological Contamination Potential: Class 2 because of potential radioactive material migration via surface water flow or airborne release from SNAP Buildings 4010 and 4012 and limited site investigation.

Recommended Locations for Sediment/Soil Sampling:

Plate 1 and Figure 2.6 provide a convenient reference for the following recommendations.

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[1] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.

[2] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 1 –Methodology*, May 2005, p. 2-9.

[3] Zwetzig, G.B., *Survey of Fission- and Corrosion-Product Activity in Sodium- or NaK-Cooled Reactors, AI-AEC-MEMO-12790*, Atomics International, a Division of North American Rockwell Corporation, February 28, 1969, p. 5.

[4] Unknown Author, *Facility Information, Building 012*, Unknown Date, HDMSP001828011.

[5] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.

[6] Chapman, J. A., *Radiological Survey of Buildings T019 and T013; An Area Northwest of T059, T019, T013, and T012; And a Storage Yard West of Buildings T626 and T038, GEN-ZR-0010*, Rockwell International, Rocketdyne Division, August 26, 1988, p. 17.

[7] Map located at: http://www.dtsc-ssfl.com/files/maps/SSFL%20-%20Western%20Half.pdf.

Due to limited site investigation and potential radioactive material migration via surface water flow or airborne release from SNAP Buildings 4010 and 4012, there is a possibility that radionuclide concentrations in soil will exceed the standard required by the December 2010 Administrative Order on Consent. Therefore, additional characterization is recommended for the Building 4293 area, including drainage pathways associated with the Building 4293 area and outside Area IV as proposed by the field sampling plan. Residual contamination above agricultural PRCs may exist in drainages outside of Area IV.

2.6.2 Building 4310 Area

Site Description: The Building 4310 area comprises Building 4310 and the land surrounding it. Building 4310 was constructed in the early 1960s. It was a small, portable structure. Building 4310 appears near Systems for Nuclear Auxiliary Power (SNAP) Experimental Reactor Building 4010 on a January 1967 industrial planning map. It appears near Small Component Test Loop (SCTL) Buildings 4826, and Control Element Test Structure 4354 on industrial planning maps from 1971 through 1973.[1,2] Because Building 4310 changed locations, it is discussed as part of Group 1 and Group 6 building areas. Figure 2.6.2a provides a current photograph. The research team was unable to find building-specific drawing(s). Buildings 4010, 4026, 4226, 4228 and their associated structures are discussed elsewhere in this section. Building 4358 was not located west of Building 4310 until after Building 4310 had been demolished. No as-built drawings were located for Building 4310. Plate 1 presents a summary of all identified features for this site.

Building Features: A sanitary sewer map shows a sewer line that appears to be located south of Building 4310.[3]

Former Use(s): Building 4310 was identified as a portable change room on industrial planning maps.[4]

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: Building 4310 was demolished between March 1973 and March 1975.[5] As a portable structure, it is not clear how Building 4310 was demolished.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): Radiological surveys specific to the final location of Building 4310 were not conducted. The Building 4310 area was covered as part of the Rockwell/Rocketdyne 1994-1995 Area IV

[1] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. P-9.
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[3] *Technical Site Information, Energy Technology Engineering Center (ETEC), GEN-AT-0027, Revision B*, Rockwell International Corporation, August 1993, p. b-23.
[4] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[5] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.

Radiological Characterization Survey. A walkabout gamma survey was conducted in the area of Building 4310. Only areas showing elevated gamma activity in the walkabout survey were followed up with an ambient gamma survey. Walkabout data was not reported in the characterization survey report. However, the walkabout survey results were reported to be consistent with ambient gamma survey measurements. The average gamma exposure rate for the developed areas of the Santa Susana Field Laboratory Area IV was 13.6 microroentgens per hour (μR/hr) with a maximum rate of 19.4 μR/hr. The average exposure rate for all of Area IV was 14.6 μR/hr with a maximum rate of 21.4 μR/hr. The local background exposure rate outside of Area IV was 15.6 μR/hr with a maximum value of 20.5 μR/hr. According to the survey report, the gamma radiation distribution of Area IV was statistically indistinguishable from the local background gamma radiation distribution. The U.S. Nuclear Regulatory Commission and the State of California specify a limit of 5 μR/hr above the average background of the data set for release of land for radiologically unrestricted use. Ambient gamma regulatory limits were below these acceptable limits.[1]

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Location: None found.

Aerial Photographs: By 1972, Building 4310 was included in a processing area (PA) designated PA-1 in the Environmental Protection Agency's aerial photograph analysis. Because multiple buildings are included in PA-1, aerial photograph analysis for this area cannot be attributed to specific buildings, unless explicitly stated. In 1972, possible storage tanks were noted in PA-1. Building 4310 is not present in 1978.[2]

Radionuclides of Concern: The research team did not find evidence of radioactive material use in Building 4310. Radionuclides associated with potential migration from SNAP Buildings 4010 and 4012 include: antimony-125 (Sb-125), americium-241 (Am-241), cesium isotopes (Cs-134, Cs-137), cobalt-60 (Co-60), europium isotopes (Eu-152, Eu-154), isotopes of plutonium (Pu-238, Pu-239, Pu-240, Pu-241), strontium-90 (Sr-90), and natural and enriched uranium isotopes (U-234, U-235, U-238).[3,4,5] All radionuclides of concern listed are included for analysis in the August 2009 *Final Field Sampling Plan, Radiological Background Study, Santa Susana Field Laboratory*. Table 3.3 presents a summary of radiological contaminants of concern.

Drainage Pathways: Aerial photographs from 1957 to 2005 indicate that drainage from PA-1 followed 17th Street to the south and continued to impoundments in Areas III and IV. The Area IV impoundment is identified as IM-5 on aerial photograph analysis and as the 17th Street

[1] Rockwell International/Rocketdyne Division, *Area IV Radiological Characterization Survey, A4CM-ZR-0011, Rev. A*, August 15, 1996.
[2] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.
[3] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 1 – Methodology*, May 2005, p. 2-9.
[4] Zwetzig, G.B., *Survey of Fission- and Corrosion-Product Activity in Sodium- or NaK-Cooled Reactors, AI-AEC-MEMO-12790*, Atomics International, a Division of North American Rockwell Corporation, February 28, 1969, p. 5.
[5] Unknown Author, *Facility Information, Building 012*, Unknown Date, HDMSP001828011.

Drainage in this technical memorandum.[1] The 17th Street Drainage is discussed later in this section. The general slope of Area IV is in a southerly direction. Water runoff is directed to the retention reservoirs which are part of the SSFL industrial effluent control system. Liquid effluent discharge from the final retention pond into the Bell Canyon drainage occurs only after controlled effluent holdup and sampling.[2,3] Because the general slope of Area IV is in a southerly direction, runoff from SNAP Buildings 4010 and 4012 could potentially impact Building 4310. The SNAP buildings handled radioactive materials and generated radionuclides, which means there is a possibility of radiological contamination in the area of Building 4310.

Radiological Contamination Potential: Class 2 for 1971 Building 4310 area because building was relocated from a Class 1 area, potential radioactive material migration via surface water flow or airborne release from SNAP Buildings 4010 and 4012, and limited site investigation had been conducted.

Recommended Locations for Sediment/Soil Sampling:

Plate 1 and Figure 2.6 provide a convenient reference for the following recommendations.

Due to limited site investigation, possible residual radioactive contamination from being located in a Class 1 area, and potential radioactive material migration via surface water flow or airborne release from SNAP Buildings 4010 and 4012, there is a possibility that radionuclide concentrations in soil will exceed the standard required by the December 2010 Administrative Order on Consent. Therefore, additional characterization is recommended for the 1971 Building 4310 area. This includes the following Building 4310 areas:

- Sanitary sewer located south of the site. If radiological materials were released into the sewer system, residual contamination may exist in the materials inside and surrounding the sewer lines.

- Drainage pathways associated with the Building 4310 area and outside Area IV as proposed by the field sampling plan. Residual contamination may exist in drainages outside of Area IV.

2.6.3 Building 4354 Area

Site Description: The Building 4354 area comprises Building 4354 and the land surrounding it. Building 4354 is first identified on a 1962 industrial planning map and a 1962/63 aerial photograph. It is listed on industrial planning maps as a Control Element Test Structure. Building 4354 is located west of Sodium Laboratory Building 4006, east of Portable Change Room Building 4310, and south of Small Component Test Loop (SCTL) Buildings 4026, 4226,

[1] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.
[2] Chapman, J. A., *Radiological Survey of Buildings T019 and T013; An Area Northwest of T059, T019, T013, and T012; And a Storage Yard West of Buildings T626 and T038, GEN-ZR-0010*, Rockwell International, Rocketdyne Division, August 26, 1988, p. 17.
[3] Map located at: http://www.dtsc-ssfl.com/files/maps/SSFL%20-%20Western%20Half.pdf.

and 4826.[1,2,3] Figure 2.6.3a provides a current photograph. The research team was unable to find building-specific drawing(s). Buildings 4026, 4226, 4310, 4358, 4714, and 4826 and their associated structures are discussed elsewhere in this section. No as-built drawings have been located for Building 4354. Plate 1 presents a summary of all identified features for this site.

Building Features: Building 4354 was 800 square feet with a steel roof, frame, and siding.[4] A sanitary sewer map shows a sewer line that appears to be located at the south of Building 4354.[5]

Former Use(s): Building 4354 is identified as the Control Element Test Structure and was part of the SCTI.[6] Building 4354 was a non-radiological facility used to test the mechanical systems by which control rods were moved in support of the Fast Breeder Reactor.[7]

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: Demolished in the mid-1980s.[8] A 1992 industrial planning map identifies Building 4354 as foundation only.[9] A 2005 aerial photograph indicates the foundation was removed.[10] Based on available information, the dimensions of the excavation made during building demolition are unknown.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): Radiological surveys specific to Building 4354 were not conducted. The Building 4354 area was covered as part of the Rockwell/Rocketdyne 1994-1995 Area IV Radiological Characterization Survey. A walkabout gamma survey was conducted in the area of Building 4354. Only areas showing elevated gamma activity in the walkabout survey were followed up with an ambient gamma survey. Walkabout data was not reported in the characterization survey report. However, the walkabout survey results were reported to be consistent with ambient gamma

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[1] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume2 – Area IV Site Summaries*, May 2005, p. P-15.
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[3] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.
[4] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume2 – Area IV Site Summaries*, May 2005, p. P-15.
[5] *Technical Site Information, Energy Technology Engineering Center (ETEC), GEN-AT-0027, Revision B*, Rockwell International Corporation, August 1993, p. b-23.
[6] DE-AC03-98SF21530, *Environmental Restoration and Remediation of the Former Energy Technology Engineering Center*, Contract Awarded to Boeing North American, Inc., Rocketdyne Propulsion & Power, December 31, 1998, Attachment 1, Appendix 2, p. 1.
[7] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume2 – Area IV Site Summaries*, May 2005, p. P-15.
[8] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume2 – Area IV Site Summaries*, May 2005, p. P-15.
[9] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[10] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.

survey measurements. The average gamma exposure rate for the developed areas of the Santa Susana Field Laboratory Area IV was 13.6 microroentgens per hour (μR/hr) with a maximum rate of 19.4 μR/hr. The average exposure rate for all of Area IV was 14.6 μR/hr with a maximum rate of 21.4 μR/hr. The local background exposure rate outside of Area IV was 15.6 μR/hr with a maximum value of 20.5 μR/hr. According to the survey report, the gamma radiation distribution of Area IV was statistically indistinguishable from the local background gamma radiation distribution. The U.S. Nuclear Regulatory Commission and the State of California specify a limit of 5 μR/hr above the average background of the data set for release of land for radiologically unrestricted use. Ambient gamma regulatory limits were below these acceptable limits.[1]

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Location: None found.

Aerial Photographs: Building 4354 is first identified in a 1962/63 aerial photograph and is included in a processing area (PA) designated PA-1 in the Environmental Protection Agency's aerial photograph analysis. Because multiple buildings are included in PA-1, aerial photograph analysis for this area cannot be attributed to specific buildings, unless explicitly stated. A 1962/63 aerial photograph identifies overhead pipes and ground scarring in PA-1. Aerial photographs from 1965 through 1995 denote possible storage tanks and overhead pipes in PA-1. Open storage areas are noted in PA-1 in 1978, 1980, and 1995. In 1967 and 1978, a stain was identified in PA-1. A possible stain was noted in 1980 and 1983 and a probable stain was identified in PA-1 in 1995. By 1998, all of the previously identified features in PA-1 were no longer present. In 2005, not even the foundation of Building 4354 is visible in PA-1.[2]

Radionuclides of Concern: The research team did not find evidence of radioactive material use in Building 4354. Radionuclides associated with potential migration from Building 4006 include: cesium-137 (Cs-137), manganese-54 (Mn-54), tritiated titanium (H-3), natural and enriched uranium (U-234, U-235, U-238), and uranium oxide (UO_2).[3] Radionuclides associated with potential migration from Systems for Nuclear Auxiliary Power (SNAP) Buildings 4010 and 4012 include: antimony-125 (Sb-125), americium-241 (Am-241), Cs-134, Cs-137, cobalt-60 (Co-60), europium isotopes (Eu-152, Eu-154), isotopes of plutonium (Pu-238, Pu-239, Pu-240, Pu-241), strontium-90 (Sr-90), H-3, U-234, U-235, and U-238.[4,5,6] All radionuclides of concern listed, with the exception of Mn-54, are included for analysis in the August 2009 *Final Field Sampling Plan, Radiological Background Study, Santa Susana Field Laboratory*. Mn-54 has

[1] Rockwell International/Rocketdyne Division, *Area IV Radiological Characterization Survey, A4CM-ZR-0011, Rev. A*, August 15, 1996.
[2] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.
[3] Cabrera Services, *Final Radiological Final Status Survey of Building 4006*, June 2008, pgs. vi, 8-9, 38.
[4] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 1 – Methodology*, May 2005, p. 2-9.
[5] Zwetzig, G.B., *Survey of Fission- and Corrosion-Product Activity in Sodium- or NaK-Cooled Reactors, AI-AEC-MEMO-12790*, Atomics International, a Division of North American Rockwell Corporation, February 28, 1969, p. 5.
[6] Unknown Author, *Facility Information, Building 012*, Unknown Date, HDMSP001828011.

half-life of less than one year and thus does not meet the criteria for analysis. Table 3.3 presents a summary of radiological contaminants of concern.

Drainage Pathways: Aerial photographs from 1957 to 2005 indicate that drainage from PA-1 followed 17th Street to the south and continued to impoundments in Areas III and IV. The Area IV impoundment is identified as IM-5 on aerial photograph analysis and as the 17th Street Drainage in this technical memorandum.[1] The 17th Street Drainage is discussed later in this section. The general slope of Area IV is in a southerly direction. Water runoff is directed to the retention reservoirs which are part of the SSFL industrial effluent control system. Liquid effluent discharge from the final retention pond into the Bell Canyon drainage occurs only after controlled effluent holdup and sampling.[2,3] Because the general slope of Area IV is in a southerly direction, runoff from SNAP Buildings 4010 and 4012 could potentially impact Building 4354. The SNAP buildings handled radioactive materials and generated radionuclides, which means there is a possibility of radiological contamination in the area of Building 4354.

Radiological Contamination Potential: Class 2 because of potential radioactive material migration via surface water flow or airborne release from Buildings 4006, 4010 and 4012, and limited site investigation.

Recommended Locations for Sediment/Soil Sampling:

Plate 1 and Figure 2.6 provide a convenient reference for the following recommendations.

Due to limited site investigation and potential radioactive material migration via surface water flow or airborne release from Buildings 4006, 4010, and 4012, there is a possibility that radionuclide concentrations in soil will exceed the standard required by the December 2010 Administrative Order on Consent. Therefore, additional characterization is recommended for the Building 4354 area. This includes the following Building 4354 areas:

- Sanitary sewer located south of the Building 4354 footprint. If radiological materials were released into the sewer system, residual contamination may exist in the materials inside and surrounding the sewer lines.

- Drainage pathways associated with the Building 4354 area and outside Area IV as proposed by the field sampling plan. Residual contamination may exist in drainages outside of Area IV.

[1] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.
[2] Chapman, J. A., *Radiological Survey of Buildings T019 and T013; An Area Northwest of T059, T019, T013, and T012; And a Storage Yard West of Buildings T626 and T038, GEN-ZR-0010,* Rockwell International, Rocketdyne Division, August 26, 1988, p. 17.
[3] Map located at: http://www.dtsc-ssfl.com/files/maps/SSFL%20-%20Western%20Half.pdf.

2.6.4 Parking Lot 4502 Area

Site Description: The Parking Lot 4502 area comprised Parking Lot 4502, Time Clock 4806, Guard Shack 4657, and the land surrounding these buildings. Aerial photographs indicate that grading for the northern portion of Parking Lot 4502 occurred in 1959. This area is visible as a parking lot in a 1962/63 aerial photograph. By 1965, the southern portion of the parking lot is completed. Parking Lot 4502 runs along F Street and 20th Street.[1] The site served as a parking lot for Building 4006 and the surrounding area.[2] It was serviced by Time Clock 4806 and Guard Shack 4657.[3] Parking Lot 4502 is located south of Kalina Building 4334 and includes Industrial Engineering Office Trailer Building 4639. Both of these buildings are discussed elsewhere in this section. Figures 2.6.4a through 2.6.4b provide a current photograph and the best available building-specific drawing(s) that the research team could find. Figure 2.6.4b is an as-built power and lighting plan for Parking Lot 4502 and Time Clock Building 4806. Plate 4 presents a summary of all identified features for this site.

Building Features: The Building 4005/4006 leach field was located in the northwest end of Parking Lot 4502. It was removed in 2001. The leach field (identified as AI-Z8) was 480 linear feet and located in Parking Lot 4502, approximately 150 feet northeast of Building 4062. Although Building 4005 handled depleted and enriched uranium for 9 months in 1966-1967, it is not likely to have impacted the Building 4005/4006 leach field as the leach field was disconnected and abandoned in 1960-1961 when the sewer treatment plant was constructed.[4,5] A sanitary sewer map shows a sewer line located parallel to 20th Street and west of Parking Lot 4502.[6]

Former Use(s): Parking Lot 4502 served as a parking lot for Building 4006.[7]

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

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[1] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.

[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.

[3] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, pgs. P-49, Site Summary Group P Figure.

[4] ICF Kaiser Engineers, *Current Conditions Report and Draft RCRA Facility Investigation Work Plan, Area IV Santa Susana Field Laboratory, Ventura County, California, Part 1-Current Conditions Report, Volume 1*, October 1993, p. 4-87.

[5] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. P-49.

[6] *Technical Site Information, Energy Technology Engineering Center (ETEC), GEN-AT-0027, Revision B*, Rockwell International Corporation, August 1993, pgs. b-23.

[7] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. P-49.

Current Use: A 1995 aerial photograph indicates the southern portion of Parking Lot 4502 had been removed. By 2005, the entire parking Lot 4502 was re-vegetated.[1] Based on available information, the dimensions of the excavation made during demolition are unknown.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): Radiological surveys specific to Parking Lot 4502 were not conducted. The Parking Lot 4502 area was covered as part of the Rockwell/Rocketdyne 1994-1995 Area IV Radiological Characterization Survey. A walkabout gamma survey was conducted in the Parking Lot 4502 area. Only areas showing elevated gamma activity in the walkabout survey were followed up with an ambient gamma survey. Walkabout data was not reported in the characterization survey report. However, the walkabout survey results were reported to be consistent with ambient gamma survey measurements. The average gamma exposure rate for the developed areas of the Santa Susana Field Laboratory Area IV was 13.6 microroentgens per hour (μR/hr) with a maximum rate of 19.4 μR/hr. The average exposure rate for all of Area IV was 14.6 μR/hr with a maximum rate of 21.4 μR/hr. The local background exposure rate outside of Area IV was 15.6 μR/hr with a maximum value of 20.5 μR/hr. According to the survey report, the gamma radiation distribution of Area IV was statistically indistinguishable from the local background gamma radiation distribution. The U.S. Nuclear Regulatory Commission and the State of California specify a limit of 5 μR/hr above the average background of the data set for release of land for radiologically unrestricted use. Ambient gamma regulatory limits were below these acceptable limits.[2]

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Location: None found.

Aerial Photographs: A 1959 aerial photograph shows a graded area that was to become the northern portion of Parking Lot 4502. By 1962/63 the northern portion of the parking lot was constructed, and in 1965 the southern portion of the parking lot had been completed. In 1978, 1980, and 1983, a pipeline is shown terminating at the eastern edge of Parking Lot 4502. This pipeline originates from Fuel Tank 4735. In 1988, instead of terminating at one point along the eastern edge of the parking lot, the pipeline continues north along the eastern edge of the parking lot terminating near the northern point of the parking lot. Also noted in 1988 is possible saturated material running along the northwest side of the parking lot. In 1995, two pipelines originating from Fuel Tank 4735 run west to Parking Lot 4502. One pipeline terminates at the eastern edge of the parking lot and one pipeline continues north along the eastern edge of the parking lot. The southern portion of the parking lot appears to be demolished. By 2005 the entire parking lot is demolished and re-vegetated.[3]

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[1] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.

[2] Rockwell International/Rocketdyne Division, *Area IV Radiological Characterization Survey, A4CM-ZR-0011, Rev. A*, August 15, 1996.

[3] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.

Radionuclides of Concern: The research team did not find evidence of radioactive material use at Parking Lot 4502. Radionuclides associated with potential migration from Systems for Nuclear Auxiliary Power (SNAP) Building 4019 include: americium-241 (Am-241), cesium-137 (Cs-137), plutonium isotopes (Pu-238, Pu-239, Pu-240, Pu-241), strontium-90 (Sr-90), and natural and enriched uranium (U-234, U-235, U-238).[1,2] All radionuclides of concern listed are included for analysis in the August 2009 *Final Field Sampling Plan, Radiological Background Study, Santa Susana Field Laboratory*. Table 3.3 presents a summary of radiological contaminants of concern.

Drainage Pathways: The Building 4005/4006 leach field was located in the northwest end of Parking Lot 4502. It was removed in 2001.[3,4] A storm drainage culvert runs parallel to 20th Street and west of Parking Lot 4502.[5] Aerial photographs from 1965 to 2005 show drainage from 20th Street continuing south into Area III impoundments.[6] The general slope of Area IV is in a southerly direction. Water runoff is directed to the retention reservoirs which are part of the SSFL industrial effluent control system. Liquid effluent discharge from the final retention pond into the Bell Canyon drainage occurs only after controlled effluent holdup and sampling.[7,8] Because the general slope of Area IV is in a southerly direction and Parking Lot 4502 is located along 20th Street, drainage from the parking lot may have traveled south along 20th Street. It is also possible that runoff from SNAP Building 4019 could potentially impact Parking Lot 4502. The building handled radioactive materials and generated radionuclides. This presents a possibility of radiological contamination in the area of Parking Lot 4502.

Radiological Contamination Potential: Class 2 because of potential radioactive material migration via surface water flow or airborne release from SNAP Building 4019, and lack of site investigation.

Recommended Locations for Sediment/Soil Sampling:

Plate 1 and Figure 2.6 provide a convenient reference for the following recommendations.

Due to the lack of site investigation and potential radioactive material migration via surface water flow or airborne release from SNAP Building 4019, there is a possibility that radionuclide concentrations in soil will exceed the standard required by the December 2010 Administrative

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[1] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume1 Methodology*, May 2005, p. 2-9.
[2] Unknown Author, *Log Book, Building 4019, 1/20/64 to 6/3/65*, January 20, 1964, HDMSP001853462.
[3] ICF Kaiser Engineers, *Current Conditions Report and Draft RCRA Facility Investigation Work Plan, Area IV Santa Susana Field Laboratory, Ventura County, California, Part 1-Current Conditions Report, Volume 1*, October 1993, pgs. 4-83, 4-87.
[4] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 Area IV Site Summaries*, May 2005, p. P-49.
[5] *Technical Site Information, Energy Technology Engineering Center (ETEC), GEN-AT-0027, Revision B*, Rockwell International Corporation, August 1993, p. b-25.
[6] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.
[7] Chapman, J. A., *Radiological Survey of Buildings T019 and T013; An Area Northwest of T059, T019, T013, and T012; And a Storage Yard West of Buildings T626 and T038, GEN-ZR-0010*, Rockwell International, Rocketdyne Division, August 26, 1988, p. 17.
[8] Map located at: http://www.dtsc-ssfl.com/files/maps/SSFL%20-%20Western%20Half.pdf.

Order on Consent. Therefore, additional characterization is recommended for the Parking Lot 4502 area. This includes the following Parking Lot 4502 areas:

- Former Building 4005/4006 leach field located at northwest end of the Parking Lot 4502 footprint. If radioactive materials were released into the septic system, residual contamination may exist in the materials surrounding the former leach field.

- Western portion of the Parking Lot 4502 footprint, closet to the 20th Street drainage. The 20th Street storm drain collects storm water from SNAP Building 4019; consequently, residual contamination may exist in the materials surrounding the 20th Street drainage.

- Northern portion of the Parking Lot 4502 footprint where possible saturated material was identified in aerial photographs. If this saturated material contained any radioactive materials, residual contamination may exist in this area.

- Northeastern perimeter of the Parking Lot 4502 footprint where pipeline from Fuel Tank 4735 is noted in aerial photographs. Although the pipeline contained fuel, it could have provided drainage pathways or low lying areas that would collect migrating radiological contamination.

- Drainage pathways associated with the Parking Lot 4502 area and outside Area IV as proposed by the field sampling plan. Residual contamination may exist in drainages outside of Area IV.

2.6.5 Building 4639 Area

Site Description: The Building 4639 Area comprises Building 4639 and the land surrounding it. Building 4639 was listed in the margin of a March 1962 industrial planning map as an Industrial Engineering Officer Trailer Complex. A July 1964 industrial planning map depicts Building 4639 as a structure located at the south end of Parking Lot 4502, near the intersection of F and 20th Streets. Figure 2.6.5a provides a current photograph. The research team was unable to find building-specific drawing(s). The building was not identified on any other industrial planning maps.[1] No as-built drawings were located for Building 4639. Plate 1 presents a summary of all identified features for this site.

Building Features: No information was located.

Former Use(s): Building 4639 was identified as an Industrial Engineering Officer Trailer Complex.[2] A 2005 historical site assessment states that Building 4639 was likely planned, but never constructed.[3]

Information from Interviewees: None to date.

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[1] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.

[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.

[3] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. Not Built-7.

Radiological Incident Reports: None found.

Current Use: Demolished.[1]

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): Radiological surveys specific to Building 4639 were not conducted. The Building 4639 area was covered as part of the Rockwell/Rocketdyne 1994-1995 Area IV Radiological Characterization Survey. A walkabout gamma survey was conducted in the area of Building 4639. Only areas showing elevated gamma activity in the walkabout survey were followed up with an ambient gamma survey. Walkabout data was not reported in the characterization survey report. However, the walkabout survey results were reported to be consistent with ambient gamma survey measurements. The average gamma exposure rate for the developed areas of the Santa Susana Field Laboratory Area IV was 13.6 microroentgens per hour (μR/hr) with a maximum rate of 19.4 μR/hr. The average exposure rate for all of Area IV was 14.6 μR/hr with a maximum rate of 21.4 μR/hr. The local background exposure rate outside of Area IV was 15.6 μR/hr with a maximum value of 20.5 μR/hr. According to the survey report, the gamma radiation distribution of Area IV was statistically indistinguishable from the local background gamma radiation distribution. The U.S. Nuclear Regulatory Commission and the State of California specify a limit of 5 μR/hr above the average background of the data set for release of land for radiologically unrestricted use. Ambient gamma regulatory limits were below these acceptable limits.[2]

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Location: None found.

Aerial Photographs: Building 4639 appears to be identified on a January 7, 1963 aerial photograph, but has not been identified on any other aerial photographs.[3,4]

Radionuclides of Concern: The research team did not find evidence of radioactive material use in Building 4639. Radionuclides associated with potential migration from Building 4011 include: americium-241 (Am-241), cesium-137 (Cs-137), cobalt-60 (Co-60), europium isotopes (Eu-152, Eu-154), iridium-192 (Ir-192), lead-210 (Pb-210), plutonium isotopes (Pu-238, Pu-239, Pu-240, Pu-241), potassium-40 (K-40), radium-226 (Ra-226), strontium-90 (Sr-90), tantalum-182 (Ta-182), technetium-99 (Tc-99), thorium isotopes (Th-230, Th-232), tritium (H-3), and uranium isotopes (U-234, U-235, U-238).[5,1] All radionuclides of concern listed, with the

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[1] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.

[2] Rockwell International/Rocketdyne Division, *Area IV Radiological Characterization Survey, A4CM-ZR-0011, Rev. A*, August 15, 1996.

[3] *Santa Susana Area IV Aerial Photograph, January 7, 1963*, University of California Santa Barbara, accessed at http://www.dtsc-ssfl.com/files/lib_aerial_photos/aerial_photos/1963_January07.pdf.

[4] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.

[5] Rockwell International, Rocketdyne Division, *Application for Renewal, State of California Broad Scope "A" Radioactive Materials License #0015-70, RI/RD-93-160, Exhibit 10: Inventory of Radioactive Sources*, Revised August 7, 1995, p. 6.

exception of Ir-192 and Ta-182, are included for analysis in the August 2009 *Final Field Sampling Plan, Radiological Background Study, Santa Susana Field Laboratory*. Ir-192 and Ta-182 have half-lives of less than one year and thus do not meet the criteria for analysis. Table 3.3 presents a summary of radiological contaminants of concern.

Drainage Pathways: A short storm drainage culvert runs west from the intersection of F Street and 20th Street to the storm drainage culvert that parallels the west side of 20th Street.[2] Aerial photographs from 1965 to 2005 identify a drainage pathway that flows south from 20th Street to impoundments in Area III.[3] The general slope of Area IV is in a southerly direction. Water runoff is directed to the retention reservoirs which are part of the SSFL industrial effluent control system. Liquid effluent discharge from the final retention pond into the Bell Canyon drainage occurs only after controlled effluent holdup and sampling.[4,5]

Radiological Contamination Potential: Class 2 because of potential radioactive material migration via surface water flow or airborne release from Building 4011, and lack of site investigation.

Recommended Locations for Sediment/Soil Sampling:

Plate 1 and Figure 2.6 provide a convenient reference for the following recommendations.

Due to lack of site investigation and potential radioactive material migration via surface water flow or airborne release from Building 4011, there is a possibility that radionuclide concentrations in soil will exceed the standard required by the December 2010 Administrative Order on Consent. Therefore, additional characterization is recommended for the Building 4639 area, including the drainage pathways associated with the Building 4639 area and outside Area IV as proposed by the field sampling plan. Residual contamination may exist in drainages outside of Area IV.

2.6.6 Building 4704 Area

Site Description: The Building 4704 area comprises Building 4704 and the land surrounding it. Building 4704 was constructed prior to March 1962 as an Electrical Substation for Edison Power. The structure was located along 17th Street, near the intersection with F Street. Building 4704 is located north of Sodium Storage Building 4007 and south of Uranium Carbide Fuel Pilot Plan Building 4005.[6] Figures 2.6.6a through 2.6.6b provide a current photograph and the best

[1] Internal Correspondence from Bresson, J.F. to Heine, W.F., North American Rockwell Corporation, *Reference: Inspection of Santa Susana Radiographic Installation*, April 18, 1969.
[2] *Technical Site Information, Energy Technology Engineering Center (ETEC), GEN-AT-0027, Revision B*, Rockwell International Corporation, August 1993, p. b-25.
[3] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.
[4] Chapman, J. A., *Radiological Survey of Buildings T019 and T013; An Area Northwest of T059, T019, T013, and T012; And a Storage Yard West of Buildings T626 and T038, GEN-ZR-0010*, Rockwell International, Rocketdyne Division, August 26, 1988, p. 17.
[5] Map located at: http://www.dtsc-ssfl.com/files/maps/SSFL%20-%20Western%20Half.pdf.
[6] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.

available building-specific drawing(s) that the research team could find. Power Pak Interconnecting Facility Building 4714 is discussed elsewhere in this section. Buildings east of 17th Street are discussed in the Subarea HSA-5A TM. Plate 1 presents a summary of all identified features for this site.

Building Features: Figure 2.6.6b presents a single-line diagram of the Building 4704 substation.

Former Use(s): Building 4704 was identified as an Electrical Substation for Edison Power.[1]

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: Building 4704 was scheduled for demolition in 2004, but it is still standing.[2]

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): Radiological surveys specific to Building 4704 were not conducted. The Building 4704 area was covered as part of the Rockwell/Rocketdyne 1994-1995 Area IV Radiological Characterization Survey. A walkabout gamma survey was conducted in the area of Building 4704. Only areas showing elevated gamma activity in the walkabout survey were followed up with an ambient gamma survey. Walkabout data was not reported in the characterization survey report. However, the walkabout survey results were reported to be consistent with ambient gamma survey measurements. The average gamma exposure rate for the developed areas of the Santa Susana Field Laboratory Area IV was 13.6 microroentgens per hour (μR/hr) with a maximum rate of 19.4 μR/hr. The average exposure rate for all of Area IV was 14.6 μR/hr with a maximum rate of 21.4 μR/hr. The local background exposure rate outside of Area IV was 15.6 μR/hr with a maximum value of 20.5 μR/hr. According to the survey report, the gamma radiation distribution of Area IV was statistically indistinguishable from the local background gamma radiation distribution. The U.S. Nuclear Regulatory Commission and the State of California specify a limit of 5 μR/hr above the average background of the data set for release of land for radiologically unrestricted use. Ambient gamma regulatory limits were below these acceptable limits.[3]

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Location: None found.

Aerial Photographs: Building 4704 is identified on a 1959 aerial photograph. In 1978, a large stained area is noted north of Building 4704 and a pipeline is identified originating from Fuel Tank 4735, discussed later in this section, and terminating along 17th Street at Building 4704. In

[1] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[2] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. O-19.
[3] Rockwell International/Rocketdyne Division, *Area IV Radiological Characterization Survey, A4CM-ZR-0011, Rev. A*, August 15, 1996.

1983 and 1988, this pipeline is shown extending further northwest along 17th Street. Building 4704 is still present on a 2005 aerial photograph.[1]

Radionuclides of Concern: The research team did not find evidence of radioactive material use in Building 4704. Radionuclides associated with potential migration from Building 4005 include natural and enriched uranium (U-234, U-235, U-238).[2] Radionuclides associated with potential migration from Building 4006 include: cesium-137 (Cs-137), manganese-54 (Mn-54), tritiated titanium (H-3), U-234, U-235, U-238, and uranium oxide (UO_2).[3] Radionuclides associated with potential migration from Systems for Nuclear Auxiliary Power (SNAP) Buildings 4010, 4012, and 4024 include: antimony-125 (Sb-125), americium-241 (Am-241), Cs-134, Cs-137, cobalt-60 (Co-60), europium isotopes (Eu-152, Eu-154), isotopes of plutonium (Pu-238, Pu-239, Pu-240, Pu-241), strontium-90 (Sr-90), H-3, U-234, U-235, and U-238.[4,5,6] All radionuclides of concern listed, with the exception of Mn-54, are included for analysis in the August 2009 *Final Field Sampling Plan, Radiological Background Study, Santa Susana Field Laboratory*. Mn-54 has a half-life of less than one year and thus does not meet the criteria for analysis. Table 3.3 presents a summary of radiological contaminants of concern.

Drainage Pathways: A lined drainage channel is located along the northeast side of Building 4704 and runs southeast along 17th Street.[7,8] Aerial photographs from 1957 to 2005 indicate that drainage from PA-1 followed 17th Street to the south and continued to impoundments in Areas III and IV. The Area IV impoundment is identified as IM-5 on aerial photograph analysis and as the 17th Street Drainage in this technical memorandum.[9] The 17th Street Drainage is discussed later in this section. The general slope of Area IV is in a southerly direction. Water runoff is directed to the retention reservoirs which are part of the SSFL industrial effluent control system. Liquid effluent discharge from the final retention pond into the Bell Canyon drainage occurs only after controlled effluent holdup and sampling.[10,11] Because the general slope of Area IV is in a southerly direction and drainage follows 17th Street along the east side of Building 4704, runoff from Buildings 4005, 4006, 4010, 4012, and 4024 could potentially impact Building 4704.

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[1] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.
[2] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 1 –Methodology*, May 2005, p. 2-11.
[3] Cabrera Services, *Final Radiological Final Status Survey of Building 4006*, June 2008, pgs. vi, 8-9, 38.
[4] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 1 –Methodology*, May 2005, p. 2-9.
[5] Zwetzig, G.B., *Survey of Fission- and Corrosion-Product Activity in Sodium- or NaK-Cooled Reactors, AI-AEC-MEMO-12790*, Atomics International, a Division of North American Rockwell Corporation, February 28, 1969, p. 5.
[6] Unknown Author, *Facility Information, Building 012*, Unknown Date, HDMSP001828011.
[7] *Technical Site Information, Energy Technology Engineering Center (ETEC), GEN-AT-0027, Revision B*, Rockwell International Corporation, August 1993, p. b-25.
[8] Map located at: http://dtsc-ssfl.com/files/maps/SSFL%20-%20Western%20Half.pdf.
[9] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.
[10] Chapman, J. A., *Radiological Survey of Buildings T019 and T013; An Area Northwest of T059, T019, T013, and T012; And a Storage Yard West of Buildings T626 and T038, GEN-ZR-0010*, Rockwell International, Rocketdyne Division, August 26, 1988, p. 17.
[11] Map located at: http://www.dtsc-ssfl.com/files/maps/SSFL%20-%20Western%20Half.pdf.

All of these buildings handled radioactive materials, which means there is a possibility of radiological contamination in the area of Building 4704.

Radiological Contamination Potential: Class 2 because of potential radioactive material migration via surface water flow or airborne release from Buildings 4005, 4006, 4010, 4012, and 4024, and lack of site investigation.

Recommended Locations for Sediment/Soil Sampling:

Plate 1 and Figure 2.6 provide a convenient reference for the following recommendations.

Due to lack of site investigation and potential radioactive material migration via surface water flow or airborne release from Buildings 4005, 4006, 4010, 4012, and 4024, there is a possibility that radionuclide concentrations in soil will exceed the standard required by the December 2010 Administrative Order on Consent. Therefore, additional characterization is recommended for the Building 4704 area. This includes the following Building 4704 areas:

- East side of Building 4704 along the 17th Street drainage where radioactive material may have drained from radioactive facilities to the north. Residual contamination may exist along the 17th Street drainage east of Building 4704.

- Drainage pathways associated with the Building 4704 area and outside Area IV as proposed by the field sampling plan. Residual contamination may exist in drainages outside of Area IV.

2.6.7 Building 4714 Area

Site Description: The Building 4714 area comprises Building 4714 and the land surrounding it. Building 4714was identified on a November 1992 industrial planning map as the Power Pak Interconnecting Facility. Earlier industrial planning maps identify a Building 4714 used as a research and development shop associated with the Sodium Reactor Experiment complex. It is thought that the 4714 designation was used for two separate buildings, as opposed to one building that moved. Building 4714 was located west of Cooling Tower 4616 and south of Control Element Test Building 4354.[1,2] Figure 2.6.7a provides a current photograph. The research team was unable to find building-specific drawing(s). No as-built drawings were located for Building 4714. Plate 1 presents a summary of all identified features for this site.

Building Features: No information was located.

Former Use(s): Building 4714 was identified on a November 1992 industrial planning map as the Power Pak Interconnecting Facility.[3] The "other" Building 4714, used for research and development at the SRE complex will be discussed in the HSA-6 TM.

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[1] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[2] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. G-73.
[3] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: The foundation appears in a 2005 aerial photograph.[1] The foundation has since been removed. Based on available information, the dimensions of the excavation made during building demolition are unknown.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): Radiological surveys specific to Building 4714 were not conducted. The Building 4714 area was covered as part of the Rockwell/Rocketdyne 1994-1995 Area IV Radiological Characterization Survey. A walkabout gamma survey was conducted in the area of Building 4714. Only areas showing elevated gamma activity in the walkabout survey were followed up with an ambient gamma survey. Walkabout data was not reported in the characterization survey report. However, the walkabout survey results were reported to be consistent with ambient gamma survey measurements. The average gamma exposure rate for the developed areas of the Santa Susana Field Laboratory Area IV was 13.6 microroentgens per hour (μR/hr) with a maximum rate of 19.4 μR/hr. The average exposure rate for all of Area IV was 14.6 μR/hr with a maximum rate of 21.4 μR/hr. The local background exposure rate outside of Area IV was 15.6 μR/hr with a maximum value of 20.5 μR/hr. According to the survey report, the gamma radiation distribution of Area IV was statistically indistinguishable from the local background gamma radiation distribution. The U.S. Nuclear Regulatory Commission and the State of California specify a limit of 5 μR/hr above the average background of the data set for release of land for radiologically unrestricted use. Ambient gamma regulatory limits were below these acceptable limits.[2]

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Location: None found.

Aerial Photographs: Building 4714 is identified in a 1995 aerial photograph just south of a processing area (PA) designated PA-1 in the Environmental Protection Agency's aerial photograph analysis. In 1995, PA-1 contains storage tanks, overhead pipes, an open storage area, and a probable stain. Building 4714 was also located west of a dirt road that ran to 17th Street and had been noted as a drainage pathway in a previous aerial photograph. The foundation of Building 4714 appears to be visible in a 2005 aerial photograph.[3]

Radionuclides of Concern: The research team did not find evidence of radioactive material use in Building 4714. Radionuclides associated with potential migration from Building 4006 include: cesium-137 (Cs-137), manganese-54 (Mn-54), tritiated titanium (H-3), natural and

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[1] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.

[2] Rockwell International, Rocketdyne Division, *Area IV Radiological Characterization Survey, A4CM-ZR-0011, Rev. A*, August 15, 1996.

[3] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.

enriched uranium (U-234, U-235, U-238), and uranium oxide (UO_2).[1] Radionuclides associated with potential migration from Systems for Nuclear Auxiliary Power (SNAP) Buildings 4010 and 4012 include: antimony-125 (Sb-125), americium-241 (Am-241), Cs-134, Cs-137, cobalt-60 (Co-60), europium isotopes (Eu-152, Eu-154), isotopes of plutonium (Pu-238, Pu-239, Pu-240, Pu-241), strontium-90 (Sr-90), H-3, U-234, U-235, and U-238.[2,3,4] All radionuclides of concern listed, with the exception of Mn-54, are included for analysis in the August 2009 *Final Field Sampling Plan, Radiological Background Study, Santa Susana Field Laboratory*. Mn-54 has a half-life of less than one year and thus does not meet the criteria for analysis. Table 3.3 presents a summary of radiological contaminants of concern.

Drainage Pathways: Aerial photographs from 1957 to 2005 indicate that drainage from PA-1 followed 17th Street to the south and continued to impoundments in Areas III and IV. The Area IV impoundment is identified as IM-5 on aerial photograph analysis and as the 17th Street Drainage in this technical memorandum. The 17th Street Drainage is discussed later in this section. A dirt road located east of Building 4714 was shown to be a drainage pathway at one time.[5] The general slope of Area IV is in a southerly direction. Water runoff is directed to the retention reservoirs which are part of the SSFL industrial effluent control system. Liquid effluent discharge from the final retention pond into the Bell Canyon drainage occurs only after controlled effluent holdup and sampling.[6,7] Because the general slope of Area IV is in a southerly direction, runoff from Sodium Laboratory Building 4006 and SNAP Buildings 4010 and 4012 could have impacted the Building 4714 area. Building 4006 handled radioactive materials. The SNAP buildings handled radioactive materials and generated radionuclides, which means there is a possibility of radiological contamination in the area of Building 4714.

Radiological Contamination Potential: Class 2 because of potential radioactive material migration via surface water flow or airborne release from Buildings 4006, 4010 and 4012, and limited site investigation.

Recommended Locations for Sediment/Soil Sampling:

Plate 1 and Figure 2.6 provide a convenient reference for the following recommendations.

Due to limited site investigation and potential radioactive material migration via surface water flow or airborne release from Buildings 4006, 4010, and 4012, there is a possibility that radionuclide concentrations in soil will exceed the standard required by the December 2010

[1] Cabrera Services, *Final Radiological Final Status Survey of Building 4006*, June 2008, pgs. vi, 8-9, 38.
[2] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 1 –Methodology*, May 2005, p. 2-9.
[3] Zwetzig, G.B., *Survey of Fission- and Corrosion-Product Activity in Sodium- or NaK-Cooled Reactors, AI-AEC-MEMO-12790*, Atomics International, a Division of North American Rockwell Corporation, February 28, 1969, p. 5.
[4] Unknown Author, *Facility Information, Building 012*, Unknown Date, HDMSP001828011.
[5] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.
[6] Chapman, J. A., *Radiological Survey of Buildings T019 and T013; An Area Northwest of T059, T019, T013, and T012; And a Storage Yard West of Buildings T626 and T038, GEN-ZR-0010*, Rockwell International, Rocketdyne Division, August 26, 1988, p. 17.
[7] Map located at: http://www.dtsc-ssfl.com/files/maps/SSFL%20-%20Western%20Half.pdf.

Administrative Order on Consent. Therefore, additional characterization is recommended for the Building 4714 area, including the drainage pathways associated with the Building 4714 area and outside Area IV as proposed by the field sampling plan. Residual contamination may exist in drainages outside of Area IV.

2.6.8 Fuel Tank 4735 Area

Site Description: The Fuel Tank 4735 area comprises Fuel Tank 4735 and the land surrounding it. The area was fenced. Fuel Tank 4735 was constructed in 1977. Fuel Tank 4735 was located north of Building 4011 and F Street, and west of a rock outcropping.[1,2,3] Figure 2.6.8a provides a current photograph. The research team was unable to find building-specific drawing(s). No as-built drawings were located for Fuel Tank 4735. Plate 1 presents a summary of all identified features for this site.

Building Features: Fuel Tank 4735 was 26 feet in diameter and 24 feet tall with a capacity of 86,000 gallons. It was an aboveground, vented tank constructed of carbon steel. A pump station was adjacent to Fuel Tank 4735 and it contained a concrete pad with two pumps.[4]

Former Use(s): Fuel Tank 4735 stored fuel that was pumped by the pump station to the Sodium Component Test Installation facility. Building 4320, the Fuel Oil Pump Building, filled the tank from the Fuel Tank Farm. Carbon steel piping connected the facilities. Bulk oil was removed in 1990 and Fuel Tank 4735 was cleaned in 1991.[5]

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: Fuel Tank 4735 was demolished with the Fuel Tank Farm in 1999. Based on available information, the dimensions of the excavation made during building demolition are unknown.[6]

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): Radiological surveys specific to Fuel Tank 4735 were not conducted. The Fuel Tank 4735 area was covered as part of the Rockwell/Rocketdyne 1994-1995 Area IV Radiological Characterization Survey. A walkabout gamma survey was conducted in the area of Fuel Tank 4735. Only areas showing elevated gamma activity in the walkabout survey were followed up

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[1] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. R-19.
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[3] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.
[4] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. R-19.
[5] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. R-19.
[6] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. R-19.

with an ambient gamma survey. Walkabout data was not reported in the characterization survey report. However, the walkabout survey results were reported to be consistent with ambient gamma survey measurements. The average gamma exposure rate for the developed areas of the Santa Susana Field Laboratory Area IV was 13.6 microroentgens per hour (μR/hr) with a maximum rate of 19.4 μR/hr. The average exposure rate for all of Area IV was 14.6 μR/hr with a maximum rate of 21.4 μR/hr. The local background exposure rate outside of Area IV was 15.6 μR/hr with a maximum value of 20.5 μR/hr. According to the survey report, the gamma radiation distribution of Area IV was statistically indistinguishable from the local background gamma radiation distribution. The U.S. Nuclear Regulatory Commission and the State of California specify a limit of 5 μR/hr above the average background of the data set for release of land for radiologically unrestricted use. Ambient gamma regulatory limits were below these acceptable limits.[1]

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Location: None found.

Aerial Photographs: Fuel Tank 4735 is identified in a 1978 aerial photograph. Two pipelines are identified originating at the fuel tank. One pipeline terminates west near Parking Lot 4502 and the other pipeline travels northeast along F Street before turning northwest up 17th Street ending at Building 4704. In 1983, the pipeline along 17th Street extended further north to the south side of Building 4006. In 1988, the pipeline near Parking Lot 4502 is extended further north along the edge of the parking lot and terminates at the northern end of Parking Lot 4502. In 1995, another vertical tank appears to be located next to Fuel Tank 4735. Fuel Tank 4735 appears to have two pipeline originating from it and running west to Parking Lot 4502, while the pipeline running east to 17th Street appears to originate at the other vertical tank. A tank is still visible in a 2005 aerial photograph, but it does not appear to be Fuel Tank 4735. No pipelines are visible in 2005.[2]

Radionuclides of Concern: The research team did not find evidence of radioactive material use in Fuel Tank 4735. Radionuclides associated with potential migration from Building 4011 include: americium-241 (Am-241), cesium-137 (Cs-137), cobalt-60 (Co-60), europium isotopes (Eu-152, Eu-154), iridium-192 (Ir-192), lead-210 (Pb-210), plutonium isotopes (Pu-238, Pu-239, Pu-240, Pu-241), potassium-40 (K-40), radium-226 (Ra-226), strontium-90 (Sr-90), tantalum-182 (Ta-182), technetium-99 (Tc-99), thorium isotopes (Th-230, Th-232), tritium (H-3), and uranium isotopes (U-234, U-235, U-238).[3,4] All radionuclides of concern listed, with the exception of Ir-192 and Ta-182, are included for analysis in the August 2009 *Final Field Sampling Plan, Radiological Background Study, Santa Susana Field Laboratory*. Ir-192 and Ta-

[1] Rockwell International/Rocketdyne Division, *Area IV Radiological Characterization Survey, A4CM-ZR-0011, Rev. A*, August 15, 1996.
[2] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.
[3] Rockwell International, Rocketdyne Division, *Application for Renewal, State of California Broad Scope "A" Radioactive Materials License #0015-70, RI/RD-93-160, Exhibit 10: Inventory of Radioactive Sources*, Revised August 7, 1995, p. 6.
[4] Internal Correspondence from Bresson, J.F. to Heine, W.F., North American Rockwell Corporation, *Reference: Inspection of Santa Susana Radiographic Installation*, April 18, 1969.

182 have half-lives of less than one year and thus do not meet the criteria for analysis. Table 3.3 presents a summary of radiological contaminants of concern.

Drainage Pathways: Aerial photographs from 1965 to 2005 identify a drainage pathway that flows south from 20th Street to impoundments in Area III. Aerial photographs from 1957 to 2005 indicate that drainage from PA-1 followed 17th Street to the south and continued to impoundments in Areas III and IV. The Area IV impoundment is identified as IM-5 on aerial photograph analysis and as the 17th Street Drainage in this technical memorandum. The 17th Street Drainage is discussed later in this section.[1] The general slope of Area IV is in a southerly direction. Water runoff is directed to the retention reservoirs which are part of the SSFL industrial effluent control system. Liquid effluent discharge from the final retention pond into the Bell Canyon drainage occurs only after controlled effluent holdup and sampling.[2,3]

Radiological Contamination Potential: Class 2 because of potential radioactive material migration via surface water flow or airborne release from Building 4011, and limited site investigation.

Recommended Locations for Sediment/Soil Sampling:

Plate 1 and Figure 2.6 provide a convenient reference for the following recommendations.

Due to limited site investigation and potential radioactive material migration via surface water flow or airborne release from Building 4011, there is a possibility that radionuclide concentrations in soil will exceed the standard required by the December 2010 Administrative Order on Consent. Therefore, additional characterization is recommended for the Fuel Tank 4735 area. This includes the following Fuel Tank 4735 areas:

- Pipelines located east and west of the Fuel Tank 4735 site footprint. Although the pipeline contained fuel, it could have provided drainage pathways or low lying areas that would collect migrating radiological contamination.

- Drainage pathways associated with the Fuel Tank 4735 area and outside Area IV as proposed by the field sampling plan. Residual contamination may exist in drainages outside of Area IV.

2.7 Group 7

The Group 7 index map is presented in Figure 2.7. Following Figure 2.7, the site photograph and layout drawings for each building area within HSA-5B Group 7 are presented. HSA-5B Group 7 includes nine building areas containing the Building 4007 Sodium Storage Building, the Building 4008 Flammable Materials Storage Building, the Building 4011 Radiation Instrument

[1] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory - Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.
[2] Chapman, J. A., *Radiological Survey of Buildings T019 and T013; An Area Northwest of T059, T019, T013, and T012; And a Storage Yard West of Buildings T626 and T038, GEN-ZR-0010*, Rockwell International, Rocketdyne Division, August 26, 1988, p. 17.
[3] Map located at: http://www.dtsc-ssfl.com/files/maps/SSFL%20-%20Western%20Half.pdf.

Control Laboratory, X-Ray Buildings 4171 and 4172, the Building 4500 Gas Bottle Dock, Parking Lot 4521, the Building 4611 Paint Spray Booth Canopy, and Maintenance Building 4612.

2.7.1 Building 4007 Area

Site Description: The Building 4007 area comprises Building 4007 and the land surrounding the building located at the corner of F Street and 17th Street. Building 4007 was constructed in 1958 as the Sodium Storage Building.[1,2] Figures 2.7.1a through 2.7.1b provide a current photograph and the best available building-specific drawing(s) that the research team could find. Figure 2.7.1b is an as-built paving and grading plan for Building 4007. Plate 1 presents a summary of all identified features for this site.

Building Features: Building 4007 was a 1,500-square-foot concrete structure with a steel roof. There were no restrooms associated with Building 4007.[3] Presumably, this indicates no sewer connections or septic systems are associated with Building 4007.[4] Five aboveground tanks were associated with Building 4007, including two 60-gallon diesel tanks, and three 600-gallon tanks of unknown contents.[5] The locations of these tanks are currently unknown.

Former Use(s): Building 4007 was identified as a sodium storage building and used for storage of non-radiological hazardous materials.[6]

Information from Interviewee(s): None to date.

Radiological Incident Reports: None found.

Current Use: Demolished in 1996.[7] Based on available information, the dimensions of the excavation made during building demolition are unknown.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): Radiological surveys specific to Building 4007 were not conducted. The Building 4007 area was covered as part of the Rockwell/Rocketdyne 1994-1995 Area IV Radiological Characterization Survey. A walkabout gamma survey was conducted in the area of Building 4007. Only areas showing elevated gamma activity in the walkabout survey were followed up with an ambient gamma survey. Walkabout data was not reported in the characterization survey report. However, the walkabout survey results were reported to be consistent with ambient gamma

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[1] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962-November 1992.
[2] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 - Area IV Site Summaries*, May 2005, p. Q-1.
[3] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 - Area IV Site Summaries*, May 2005, p. Q-1.
[4] *B0008 Warehouse* Notes, Unknown Author, February 11, 2000, HDMSP001786349.
[5] Correspondence from Tessier, M., Rockwell International, to LeChevalier, R., United States Department of Energy, *Reference: Storage Tanks at DOE Facilities in SSFL Area IV*, dated December 23, 1992.
[6] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 - Area IV Site Summaries*, May 2005, p. Q-1.
[7] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 - Area IV Site Summaries*, May 2005, p. Q-1.

survey measurements. The average gamma exposure rate for the developed areas of the Santa Susana Field Laboratory Area IV was 13.6 microroentgens per hour (μR/hr) with a maximum rate of 19.4 μR/hr. The average exposure rate for all of Area IV was 14.6 μR/hr with a maximum rate of 21.4 μR/hr. The local background exposure rate outside of Area IV was 15.6 μR/hr with a maximum value of 20.5 μR/hr. According to the survey report, the gamma radiation distribution of Area IV was statistically indistinguishable from the local background gamma radiation distribution. The U.S. Nuclear Regulatory Commission and the State of California specify a limit of 5 μR/hr above the average background of the data set for release of land for radiologically unrestricted use. Ambient gamma regulatory limits were below these acceptable limits.[1]

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Locations: None found.

Aerial Photographs: Building 4007 is first identified on a 1959 aerial photograph. In 1967, a pipeline begins just north of Building 4007 on 17th Street and continues southeast to G Street where the pipeline turns and runs southwest on G Street to Building 4500. In 1978, a pipeline is noted to the north of Building 4007 along F Street. The pipeline extends from Building 4008 to 17th Street. This pipeline is not noted in any other aerial photographs. Building 4007 is not present on a 2005 aerial photograph.[2]

Radionuclides of Concern: The research team did not find evidence of radioactive material use in Building 4007. Radionuclides associated with potential migration from Buildings 4005, 4006, 4010, 4012, and 4024 that may affect Building 4007 include: antimony-125 (Sb-125), americium-241 (Am-241), cesium isotopes (Cs-134, Cs-137) cobalt-60 (Co-60), europium isotopes (Eu-152, Eu-154), manganese-54 (Mn-54), isotopes of plutonium (Pu-238, Pu-239, Pu-240, Pu-241), strontium-90 (Sr-90), tritiated titanium (H-3), and natural and enriched uranium (U-234, U-235, U-238).[3,4,5,6] All radionuclides of concern listed, with the exception of Mn-54, are included for analysis in the August 2009 Final Field Sampling Plan, Radiological Background Study, Santa Susana Field Laboratory. Mn-54 has a half-life of less than one year and thus does not meet the criteria for analysis. Table 3.3 presents a summary of radiological contaminants of concern.

Drainage Pathways: A lined drainage channel following 17th Street to the southeast is located on the east side of Building 4007.[7] Aerial photographs from 1957 to 2005 indicate that drainage

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[1] Rockwell International/Rocketdyne Division, *Area IV Radiological Characterization Survey, A4CM-ZR-0011, Rev. A*, August 15, 1996.
[2] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.
[3] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 1 - Methodology*, May 2005, pgs. 2-6, 2-9, 2-11.
[4] Cabrera Services, *Final Radiological Final Status Survey of Building 4006*, June 2008, pgs. vi, 8-9, 38.
[5] Unknown Author, *Facility Information, Building 012*, Unknown Date, HDMSP001828011.
[6] Zwetzig, G.B., *Survey of Fission- and Corrosion-Product Activity in Sodium- or NaK-Cooled Reactors, AI-AEC-MEMO-12790*, Atomics International, a Division of North American Rockwell Corporation, February 28, 1969, pgs. 5, 10.
[7] Map located at: http://www.dtsc-ssfl.com/files/maps/SSFL%20-%20Western%20Half.pdf.

followed 17th Street to the south and continued to an impoundment in Area IV. This impoundment is identified as IM-5 on aerial photograph analysis and as the 17th Street Drainage in this technical memorandum.[1] The 17th Street Drainage is discussed later in this section. The general slope of Area IV is in a southerly direction. Water runoff is directed to the retention reservoirs which are part of the SSFL industrial effluent control system. Liquid effluent discharge from the final retention pond into the Bell Canyon drainage occurs only after controlled effluent holdup and sampling.[2,3] Because the general slope of Area IV is in a southerly direction and drainage follows 17th Street along the east side of Building 4007, runoff from Buildings 4005, 4006, 4010, 4012, and 4024 could potentially impact Building 4007. Buildings 4005 and 4006 handled radioactive materials. Buildings 4010, 4012, and 4024 are Systems for Nuclear Auxiliary Power buildings that handled radioactive materials and generated radionuclides. Drainage from these buildings results in the possibility of radiological contamination in the area of Building 4007.

Contamination Potential: Class 2 because of potential radioactive material migration via surface water flow or airborne release from Buildings 4005, 4006, 4010, 4012, and 4024, and lack of site investigation.

Recommended Locations for Sediment/Soil Sampling:

Plate 1 and Figure 2.7 provide a convenient reference for the following recommendations.

Due to lack of site investigation and potential radioactive material migration via surface water flow or airborne release from Buildings 4005, 4006, 4010, 4012, and 4024, there is a possibility that radionuclide concentrations in soil will exceed the standard required by the December 2010 Administrative Order on Consent. Therefore, additional characterization is recommended for the Building 4007 area. This including the following Building 4007 areas:

- East side of Building 4007 footprint along the 17th Street drainage where radioactive material may have drained from radioactive facilities to the north. Residual contamination may exist along the 17th Street drainage east of Building 4007.

- Drainage pathways associated with the Building 4007 area and outside Area IV as proposed by the field sampling plan. Residual contamination may exist in drainages outside of Area IV.

[1] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.
[2] Chapman, J. A., *Radiological Survey of Buildings T019 and T013; An Area Northwest of T059, T019, T013, and T012; And a Storage Yard West of Buildings T626 and T038, GEN-ZR-0010,* Rockwell International, Rocketdyne Division, August 26, 1988, p. 17.
[3] Map located at: http://www.dtsc-ssfl.com/files/maps/SSFL%20-%20Western%20Half.pdf.

2.7.2 Building 4008 Area

Site Description: The Building 4008 area comprises Building 4008 and the land surrounding the building located on F Street between Building 4007 and Parking Lot 4521. Building 4008 was constructed in 1958 as the Flammable Material Storage Building.[1,2] Figures 2.7.2a through 2.7.2b provide a current photograph and the best available building-specific drawing(s) that the research team could find. Figure 2.7.2b is an as-built paving and grading plan for Building 4008. Plate 1 presents a summary of all identified features for this site.

Building Features: Building 4008 was a 1,500-square-foot concrete structure with a steel roof.[3] A leach field associated with Building 4008 was identified as an area of concern in a 1993 Current Conditions Report and Draft Resource Conservation and Recovery Act Facility Investigation (RFI) Work Plan, but no drawings or other references have been found to further describe the potential leach field. Building and field investigation has also failed to locate a leach field.[4] A 2000 RFI site review and notes on Building 4008 indicate there were no leach fields, septic tanks, or even restroom facilities associated with Building 4008.[5,6] Exploratory trench logs in the area of Building 4008 note that all surfaces were composed of disturbed soil. This disturbed soil could indicate a former leach field excavation.[7]

Former Use(s): Building 4008 was used for storage of non-radiological flammable materials.[8]

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: Demolished in 1996.[9] Based on available information, the dimensions of the excavation made during building demolition are unknown.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): Radiological surveys specific to Building 4008 were not conducted. The Building 4008 area was covered as part of the Rockwell/Rocketdyne 1994-1995 Area IV Radiological Characterization Survey. A walkabout gamma survey was conducted in the area of Building 4008. Only areas

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[1] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. Q-3.
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962-November 1992.
[3] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. Q-3.
[4] ICF Kaiser Engineers, *Current Conditions Report and Draft RCRA Facility Investigation Work Plan, Area IV Santa Susana Field Laboratory, Ventura County, California, Part 1-Current Conditions Report, Volume 1*, October 1993, pgs. 4-82, 4-85–4-88.
[5] *RFI Site Review Status, Leach Field Area IV B008 Warehouse*, Unknown Author, February 16, 2000, HDMSE00506904.
[6] *B008 Warehouse* Notes, Unknown Author, February 11, 2000, HDMSP001786349.
[7] Stewart, B., *Trench Logs B8TS01-06 at B008*, MWH, April 4, 2001.
[8] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. Q-3.
[9] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. Q-3.

showing elevated gamma activity in the walkabout survey were followed up with an ambient gamma survey. Walkabout data was not reported in the characterization survey report. However, the walkabout survey results were reported to be consistent with ambient gamma survey measurements. The average gamma exposure rate for the developed areas of the Santa Susana Field Laboratory Area IV was 13.6 microroentgens per hour (μR/hr) with a maximum rate of 19.4 μR/hr. The average exposure rate for all of Area IV was 14.6 μR/hr with a maximum rate of 21.4 μR/hr. The local background exposure rate outside of Area IV was 15.6 μR/hr with a maximum value of 20.5 μR/hr. According to the survey report, the gamma radiation distribution of Area IV was statistically indistinguishable from the local background gamma radiation distribution. The U.S. Nuclear Regulatory Commission and the State of California specify a limit of 5 μR/hr above the average background of the data set for release of land for radiologically unrestricted use. Ambient gamma regulatory limits were below these acceptable limits.[1]

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Locations: None found.

Aerial Photographs: Building 4008 is first identified on a 1959 aerial photograph. In 1959, two stains are located south of Building 4008. In 1967, a pipeline is noted along G Street, south of Building 4008. A 1978 aerial photograph shows a pipeline to the north of Building 4008 along F Street. The pipeline extends from Building 4008 to 17th Street. This pipeline is not noted in any other aerial photographs. In 1980 and 1983, an open storage area is noted south of Building 4008. By 1995, this open storage area is designated OS-20 and contains a stain and probable refuse containers. Building 4008 is not present on a 2005 aerial photograph.[2]

Radionuclides of Concern: The research team did not find evidence of radioactive material use in Building 4008. Radionuclides associated with potential migration from Building 4011 include: americium-241 (Am-241), cesium-137 (Cs-137), cobalt-60 (Co-60), europium isotopes (Eu-152, Eu-154), iridium-192 (Ir-192), lead-210 (Pb-210), plutonium isotopes (Pu-238, Pu-239, Pu-240, Pu-241), potassium-40 (K-40), radium-226 (Ra-226), strontium-90 (Sr-90), tantalum-182 (Ta-182), technetium-99 (Tc-99), thorium isotopes (Th-230, Th-232), tritium (H-3), and uranium isotopes (U-234, U-235, U-238).[3,4] All radionuclides of concern listed, with the exception of Ir-192, Mn-54, and Ta-182, are included for analysis in the August 2009 *Final Field Sampling Plan, Radiological Background Study, Santa Susana Field Laboratory*. Ir-192, Mn-54, and Ta-182 have half-lives of less than one year and thus do not meet the criteria for analysis. Table 3.3 presents a summary of radiological contaminants of concern.

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[1] Rockwell International/Rocketdyne Division, *Area IV Radiological Characterization Survey, A4CM-ZR-0011, Rev. A*, August 15, 1996.

[2] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.

[3] Rockwell International, Rocketdyne Division, *Application for Renewal, State of California Broad Scope "A" Radioactive Materials License #0015-70, RI/RD-93-160, Exhibit 10: Inventory of Radioactive Sources*, Revised August 7, 1995, p. 6.

[4] Internal Correspondence from Bresson, J.F. to Heine, W.F., North American Rockwell Corporation, *Reference: Inspection of Santa Susana Radiographic Installation*, April 18, 1969.

Drainage Pathways: A leach field associated with Building 4008 was identified as an area of concern in a 1993 Current Conditions Report and Draft RFI Work Plan and exploratory trench logs previously indicated disturbed soil in the area of Building 4008, but no information has been found to further describe the potential leach field and field investigation has failed to locate a leach field.[1,2] A lined drainage channel following G Street is located south of Building 4008.[3] Aerial photographs from 1957 to 2005 indicate that drainage followed 17th Street to the south and continued to impoundments in Areas III and IV. The Area IV impoundment is identified as IM-5 on aerial photograph analysis and as the 17th Street Drainage in this technical memorandum.[4] The 17th Street Drainage is discussed later in this section. The general slope of Area IV is in a southerly direction. Water runoff is directed to the retention reservoirs which are part of the SSFL industrial effluent control system. Liquid effluent discharge from the final retention pond into the Bell Canyon drainage occurs only after controlled effluent holdup and sampling.[5,6]

Radiological Contamination Potential: Class 2 due to potential radioactive material migration via surface water flow or airborne release from Building 4011, and lack of site investigation.

Recommended Locations for Sediment/Soil Sampling:

Plate 1 and Figure 2.7 provide a convenient reference for the following recommendations.

Due to lack of site investigation and potential radioactive material migration via surface water flow or airborne release from Building 4011, there is a possibility that radionuclide concentrations in soil will exceed the standard required by the December 2010 Administrative Order on Consent. Therefore, additional characterization is recommended for the Building 4008 area. This includes the following Building 4008 areas:

- Stains identified in aerial photographs south of the Building 4008 footprint. Unknown stained areas could contain residual contamination.

- Lined drainage channel south of the Building 4008 footprint along G Street. The G Street storm drain collects storm water from 17th Street, which in turn collects storm water from buildings using radioactive material; consequently, residual contamination may exist in the G Street drainage.

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[1] ICF Kaiser Engineers, *Current Conditions Report and Draft RCRA Facility Investigation Work Plan, Area IV Santa Susana Field Laboratory, Ventura County, California, Part 1-Current Conditions Report, Volume 1*, October 1993, pgs. 4-82, 4-85, 4-88.
[2] Stewart, B., *Trench Logs B8TS01-06 at B008*, MWH, April 4, 2001.
[3] Map located at: http://www.dtsc-ssfl.com/files/maps/SSFL%20-%20Western%20Half.pdf.
[4] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.
[5] Chapman, J. A., *Radiological Survey of Buildings T019 and T013; An Area Northwest of T059, T019, T013, and T012; And a Storage Yard West of Buildings T626 and T038, GEN-ZR-0010*, Rockwell International, Rocketdyne Division, August 26, 1988, p. 17.
[6] Map located at: http://www.dtsc-ssfl.com/files/maps/SSFL%20-%20Western%20Half.pdf.

- Possible leach field associated with Building 4008 using previous exploratory trench locations as a guide. If radioactive materials were released into a septic system, residual contamination may exist in the materials surrounding the former leach field.

- Drainage pathways associated with the Building 4008 area and outside Area IV as proposed by the field sampling plan. Residual contamination may exist in drainages outside of Area IV.

2.7.3 Building 4011 Area

Site Description: The Building 4011 area comprises Building 4011, Traffic Dispatch Building 4403, Electrical Substation 4711, and the land surrounding these sites located between F and G Streets. Building 4011 was constructed in 1958 as an administration and services building, but later became the Radiation Instrument Calibration Laboratory.[1,2] Figures 2.7.3a through 2.7.3f provide a current photograph and the best available building-specific drawing(s) that the research team could find. Building 4011 is located west of Flammable Material Storage Building 4008 and east of X-Ray Buildings 4171 and 4172. These buildings are discussed elsewhere in this section. Plate 1 presents a summary of all identified features for this site.

Building Features: Building 4011 is a 15,120-square-foot steel structure.[3] Figure 2.7.3b provides a floor plan. Two aboveground tanks were associated with Building 4011, a 200-gallon propane tank and an 87,000-gallon empty tank.[4] The Building 4011 leach field (identified as AI-Z9) was 200 linear feet and received waste from a septic tank with a 2,340-gallon capacity. It consisted of 8-inch diameter clay piping surrounded by gravel and buried at depths ranging from 2 to 7 feet below ground surface. The leach field was located approximately 100 feet south of Building 4011, across G Street. It was removed in 2000.[5,6] Trench logs from 2001 indicate that the Building 4011 leach field was filled with non-native material and showed an area of staining.[7] A gas shutoff was located at the northwest corner of Building 4011 and the domestic water shutoff was at the south side of the building.[8] A sanitary sewer line is identified at the west side of Building 4011.[9] Photographs of the Building 4011 septic tank area and leach field are included as Figures 2.7.3c and 2.7.3d. Figure 2.7.3e is a 1957 as-built drawing showing the

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[1] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. R-1.
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[3] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. R-1.
[4] *Technical Site Information, Energy Technology Engineering Center (ETEC), GEN-AT-0027, Revision B*, Rockwell International Corporation, August 1993, pgs. b-41, b-45.
[5] *Group 5 – Central Portion of Areas III and IV RCRA Facility Investigation Report, Santa Susana Field Laboratory, Ventura County, California, Volume IV – RFI Site Reports, Appendix D, Boeing Area IV Leach Field*, CH2M Hill, Draft in Progress November 2008, p. Table D.2-4.
[6] ICF Kaiser Engineers, *Current Conditions Report and Draft RCRA Facility Investigation Work Plan, Area IV Santa Susana Field Laboratory, Ventura County, California, Part 1-Current Conditions Report, Volume 1*, October 1993, pgs. 4-84, 4-87.
[7] Stewart, B., *Trench Logs L2TS02 and L2TS03*, MWH, May 4, 2001.
[8] *Fire Preplan Area IV, Building 011 and Surrounding Area (Including Bldg. 171 and 172)*, Unknown Author, Unknown Date.
[9] *Santa Susana Field Laboratory Site Development Plan, Existing Development, Sanitary Sewage System*, Rockwell International Corporation, Unknown date, HDMSE00688360.

plumbing plan for Building 4011. Figure 2.7.3f is a 1969 as-built drawing that illustrates the Building 4011 machining/milling area, cage room, tool crib, material storage area, weld area, rotary table, and Room 120 where radiological contaminated sludge was found in a sink trap (see Radiological Incident Reports below).

Former Use(s): Building 4011 was used to support various non-nuclear programs until 1984. From 1984 to 1996, the north section of Building 4011 was used for calibration and repair of radiation detection instruments. Calibration and repair could have involved instruments containing radioactive contaminants from any of the Area IV nuclear facilities. Service work used only sealed radioactive sources and electroplated calibration sources. After 1996, laboratory activities were transferred to Building 4100. The Property Inventory and Control Department used the south section of the building. The south side of Building 4011 was used as a materials warehouse for non-radiological materials.[1,2,3] Industrial planning maps indicate that Building 4011 was an administration and services building in the late 1960s and early 1970s, a development support shop in the mid-1970s, a manufacturing support shop in the late 1970s and early 1980s, a machine shop in the mid to late 1980s, and a storage facility in the early 1990s.[4]

Information from Interviewees: None to date.

Radiological Incident Reports: There have been several incidents associated with Building 4011. The following table provides information presented in an incidents database provided by Boeing. Summaries of only the incident reports that resulted or may have resulted in releases to the environment are provided following the table, when available. Summaries of all available incident reports are provided in Attachment A.

[1] U.S. Department of Energy, *Instrument Calibration Lab*, Energy Technology Engineering Center (ETEC) Website, http://www.etec.energy.gov/History/Major-Operations/Support-Ops/Instrument-Calibration.html, accessed November 25, 2009, p.1.

[2] Rash, M., *Final Oversight Verification and Confirmation Radiological Survey Report for Buildings T-011, T-019, T-055, and T-100*, Tetra Tech EM, Inc., December 20, 2002, p. 9.

[3] Correspondence from Tuttle, R.J., Rockwell International, to Vaille, R., U.S. Environmental Protection Agency, *Reference: Identification and Description of Areas Involved with Radioactive Materials at SSFL Area IV*, dated October 2, 1989.

[4] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.

Building 4011 Incident Report Summary

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A0531	4/26/1960	WEST OF BLDG 11	MFP	LEAK TEST OF OMRE SHIPPING CASK SPILLED R/A LIQUID ON GROUND.
A0519	7/14/1964	SS 19TH & F ST		EMPTY BUT LABELED R/A SHIPPING CONTAINERS FOUND IN PRIVATE CAR.
A0083	7/2/1980	RIHL, 011	Ta-182	UNEXPLAINED EXPOSURE OVER GUIDELINES.
A0318	4/13/1985	CALIBRATOR	Cs-137	CALIBRATION SOURCE CAME LOSE FROM ACUTATOR ROD.
A0651	1/6/1994	INST. CALB. LAB		INTERNALLY CONTAMINATED AIR SAMPLING PUMPS NOT LABLED.
A0658	12/6/1994	T011 CALIB. LAB	Cs-137	28 Ci Cs-137 CALIBRATION SOURCE DISLOCATED FROM RELEASE PULL ROD.

- On April 28, 1960, during the final leak test of the Organic Moderated Reactor Experiment trailer cask cooling system, a union between the two circulating lines was not tightened. When the pump was turned on, water ran out from the system onto the trailer bed and blacktop through bolt holes where the cask was secured. The water was soaked up immediately and confined to an area of about 1 square foot. Approximately 1 pint of radioactive liquid containing mixed fission products was spilled on the ground to the west of Building 4011. All loose dirt was cleaned up and a sample of the blacktop was taken. Results showed 216 disintegrations per minute beta gamma. The incident report notes that this type of operation should have been done in an area that had the proper facilities for handling contaminated equipment (A531).[1]

In addition to the incidents noted in Boeing's incident database, two other incidents pertaining to Building 4011 were identified by the research team.

- Sludge in a sink trap in Room 120 was found to contain 27.2 pCi/g of U-234. The sink and trap and a portion of the drain line were removed and disposed of as radioactive waste.[2,3,4] It is not clear from Figure 2.7.3e if the drain line was connected to the former septic tank or the sewer line, but this is a possibility.

- On January 15, 1976, a radioactive spill in the Rocketdyne conservation yard was discovered. In the search for the origin and extent of contamination, numerous radioactively contaminated barrels and pallets were recovered from a wide area of the

[1] Klostermann, J.P., *Radiological Safety Incident Report, Bldg. #11 (West Side)*, Atomics International, April 28, 1960.
[2] Barnes, J., *Final Radiological Survey Data Package for Building 011, Santa Susana Field Laboratory*, The Boeing Company, July 28, 1998.
[3] Rash, M., *Final Oversight Verification and Confirmation Radiological Survey Report for Buildings T-011, T-019, T-055, and T-100*, Tetra Tech EM, Inc., December 20, 2002, p. 9.
[4] Rash, M., *Final Rocketdyne Technical Support and Field Oversight Document Review for Buildings T009, T011, T019, T055, and T100, Tetra Tech EM, Inc.*, December 20, 2002, pgs 8-9.

Santa Susana complex. A pallet in the Building 4011 receiving yard with two acetone barrels on it was discovered to be radiologically contaminated at approximately 800 millirad per hour (mrad/hr) beta. According to the incident report, all contaminated items that had been detected were transferred to the Radioactive Materials Handling Facility for disposal with the exception of three large concrete structures and a 1 mrad/hr spot on the asphalt in the Building 4011 yard. The incident report does not describe how these items were handled. Externally contaminated barrels appeared to have resulted from a double stacked barrel of radioactive liquid that corroded and leaked.[1]

Current Use: Building 4011 is still standing as of 2010 and is currently used to house communication equipment.[2]

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): A chronology of radiological investigations at this building is as follows:

- **1988 Rocketdyne Field Survey**. In 1988, Rocketdyne surveyed a field south of Building 4011 and G Street because it had been used as a temporary storage or staging area for materials/equipment and was often used as a dumpsite for dirt. The field was surveyed for mixed fission products by measuring ambient gamma exposure rates. Ambient gamma exposure rates were measured at 39 locations and compared against the U.S. Nuclear Regulatory Commission (NRC) Regulatory Guide 1.86 limit of 5 microroentgens per hour (μR/hr) above background. Natural background at the Santa Susana Field Laboratory was noted as having large variability, and for this reason, the gamma measurements were compared against three independent natural background distributions. Then the average background exposure rate of the three natural background distributions was subtracted from each data set and results were compared against the 5 μR/hr background criteria. Average background was 15.30 μR/hr. The maximum gamma exposure rate for the Building 4011 field was 13.8 μR/hr while the average for all 39 locations was 13.0 μR/hr. Survey results were below the NRC acceptable limits in 1988.[3]

- **1996 Rocketdyne Area IV Radiological Characterization**. During the 1996 Area IV Radiological Characterization Survey conducted by Rocketdyne, a randomly selected soil sample collected at the northwest corner of Building 4011 found elevated cesium-137 (Cs-137) at 0.53 picocuries per gram (pCi/g). This is above the survey's local background average of 0.09 pCi/g and Area IV background average of 0.15 pCi/g, but within the average U.S. background range of 0.8 pCi/g and the U.S. Department of Energy, U.S. Environmental Protection Agency (EPA), and U.S. Nuclear Regulatory Commission cleanup standards of 9.2 pCi/g, 9.0 pCi/g and 9.0 pCi/g, respectively. The

[1] Harris, J. and F. Badger, *Internal Letter, Conservation Yard Spill*, Rockwell International, February 6, 1976,
[2] U.S. Department of Energy, *Instrument Calibration Lab*, Energy Technology Engineering Center (ETEC) Website, http://www.etec.energy.gov/History/Major-Operations/Support-Ops/Instrument-Calibration.html, accessed November 25, 2009, p.1.
[3] Chapman, J.A., *Radiological Survey f the T056 Landfill; Area from 23rd Street to Building T100; And An Area Across From Building T011, GEN-ZR-0011*, Rockwell International, Rocketdyne Division, August 26, 1988, pgs. 3, 9-11, 13, 20, 62, 76, 79, 81, Appendix C.

cleanup standards were based on uniform contamination and an annual dose limit of 15 millirem per year.[1]

- **1998 Rocketdyne Radiological Survey**. In 1998, Rocketdyne performed a final comprehensive radiological survey to measure total or removable surface activity on the walls, floors, ceilings, structural surfaces, concrete pads, sink traps, and the roof. The Rocketdyne acceptable release limit for fixed alpha and beta contamination was less than 5,000 disintegrations per minute per 100 square centimeters (dpm/100cm^2). The acceptable limit for removable alpha contamination was less than 20 dpm/100cm^2 and for beta it was less than 100 dpm/100cm^2. The ambient gamma release limit was less than 5.0 μR/hr above ambient background. Survey results were below the acceptable limits in 1998. Samples were collected from sludge in a sink trap for gamma spectroscopy analysis. The sludge was contaminated with low levels of uranium-234 (U-234). Results found U-234 at 27.2 pCi/g. Both the sink and trap were removed and disposed. An additional sludge sample was taken from a location several feet into the line and the sample met release criteria in 1998.[2,3]
- **1998 California DHS Verification Survey**. In 1998, the California Department of Health Services (DHS) performed verification surveys and concurred that the facility met release criteria in 1998.[4]

- **1998 Release for Unrestricted Use**. On December 16, 1998, the California DHS released Building 4011 for unrestricted use.[5]

- **2001 EPA Verification Survey**. In October 2001, the EPA conducted an oversight verification survey for alpha, beta, beta-gamma (total and removable) and gamma radiation. Survey results were below acceptable limits in 2001 and EPA field measurements confirmed the conclusions reached by Rocketdyne.[6]

Radiological Use Authorizations: Both sealed and unsealed radioactive material sources were likely handled in Building 4011.[7]

Former Radiological Burial or Disposal Locations: None found.

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[1] Rutherford, P., Area IV Radiological Characterization Survey Final Report, A4CM-ZR-0011, Revision A, Energy Technology Engineering Center, August 15, 1996.
[2] Barnes, J., *Final Radiological Survey Data Package for Building 011, Santa Susana Field Laboratory*, The Boeing Company, July 28, 1998.
[3] Oliver, B.M., *Building T011 Final Survey Procedure, N001SRR140128*, Rockwell International, Rocketdyne Division, April 19, 1994.
[4] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. R-2.
[5] Correspondence from Wesley, D., Department of Health Services, Radiologic Health Branch, to Barnes, J., Boeing North American/Rocketdyne Division, *Reference: Building 11 Release for Unrestricted Use*, dated December 16, 1998.
[6] Rash, M., *Final Oversight Verification and Confirmation Radiological Survey Report for Buildings T-011, T-019, T-055, and T-100*, Tetra Tech EM, Inc., December 20, 2002.
[7] Rash, M., *Final Oversight Verification and Confirmation Radiological Survey Report for Buildings T-011, T-019, T-055, and T-100*, Tetra Tech EM, Inc., December 20, 2002, p. 9.

Aerial Photographs: Building 4011 was first identified in a 1959 aerial photograph. In 1959, an open storage (OS) area was identified at the southwest end of Building 4011 and portions of a pipeline were visible along G Street southwest of Building 4011. In 1962/63, the open storage area is identified as OS-15 and contains a stain. A probable stain is noticed in OS-15 in 1965 and a possible stain is noticed in OS-15 in 1967. In 1980 and 1983, two fill areas (FA) containing vegetated, mounded material are identified south of Building 4011 and G Street. By 1988, these two areas become part of a larger fill area identified as FA-11.[1]

Radionuclides of Concern: Both sealed and unsealed radioactive material sources were likely handled in Building 4011.[2] Radionuclides of concern include: americium-241 (Am-241), Cs-137, cobalt-60 (Co-60), europium isotopes (Eu-152, Eu-154), iridium-192 (Ir-192), lead-210 (Pb-210), plutonium isotopes (Pu-238, Pu-239, Pu-240, Pu-241), potassium-40 (K-40), radium-226 (Ra-226), strontium-90 (Sr-90), Ta-182, technetium-99 (Tc-99), thorium isotopes (Th-230, Th-232), tritium (H-3), and uranium isotopes (U-234, U-235, U-238).[3,4] All radionuclides of concern listed, with the exception of Ir-192 and Ta-182, are included for analysis in the August 2009 *Final Field Sampling Plan, Radiological Background Study, Santa Susana Field Laboratory*. Ir-192 and Ta-182 have half-lives of less than one year and thus do not meet the criteria for analysis. Table 3.3 presents a summary of radiological contaminants of concern.

Drainage Pathways: The southeast side of Building 4011 parallels a lined drainage channel running along G Street.[5] The Building 4011 leach field (identified as AI-Z9) was 200 linear feet and had a septic tank capacity of 2,340 gallons. The leach field was located approximately 100 feet south of Building 4011, across G Street.[6] It was removed in 2000. Aerial photographs from 1965 to 2005 identify a drainage pathway that flows south from 20th Street to impoundments in Area III.[7] The general slope of Area IV is in a southerly direction. Water runoff is directed to the retention reservoirs which are part of the SSFL industrial effluent control system. Liquid effluent discharge from the final retention pond into the Bell Canyon drainage occurs only after controlled effluent holdup and sampling.[8,9]

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[1] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.

[2] Rash, M., *Final Oversight Verification and Confirmation Radiological Survey Report for Buildings T-011, T-019, T-055, and T-100*, Tetra Tech EM, Inc., December 20, 2002, p. 9.

[3] Rockwell International, Rocketdyne Division, *Application for Renewal, State of California Broad Scope "A" Radioactive Materials License #0015-70, RI/RD-93-160, Exhibit 10: Inventory of Radioactive Sources*, Revised August 7, 1995, p. 6.

[4] Internal Correspondence from Bresson, J.F. to Heine, W.F., North American Rockwell Corporation, *Reference: Inspection of Santa Susana Radiographic Installation*, April 18, 1969.

[5] Map located at: http://www.dtsc-ssfl.com/files/maps/SSFL%20-%20Western%20Half.pdf.

[6] ICF Kaiser Engineers, *Current Conditions Report and Draft RCRA Facility Investigation Work Plan, Area IV Santa Susana Field Laboratory, Ventura County, California, Part 1-Current Conditions Report, Volume 1*, October 1993, pgs. 4-84, 4-87.

[7] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.

[8] Chapman, J. A., *Radiological Survey of Buildings T019 and T013; An Area Northwest of T059, T019, T013, and T012; And a Storage Yard West of Buildings T626 and T038, GEN-ZR-0010*, Rockwell International, Rocketdyne Division, August 26, 1988, p. 17.

[9] Map located at: http://www.dtsc-ssfl.com/files/maps/SSFL%20-%20Western%20Half.pdf.

Radiological Contamination Potential: Class 1 because of sealed and unsealed radioactive material sources used in Building 4011, reported incidents, and previous investigations.

Recommended Locations for Sediment/Soil Sampling:

Plate 1 and Figure 2.7 provide a convenient reference for the following recommendations.

Extensive soil sampling is recommended in the Building 4011 area. As discussed above, an incident resulted in a radioactive liquid spill to the ground and previous investigation found radiological contamination in the Building 4011 area. In addition, previous characterization studies for the Building 4011 area were focused on delineating the extent of contamination to standards that were applicable at the time and not to the standard required by the December 2010 Administrative Order on Consent. Therefore, additional characterization is recommended for the Building 4011 area. This includes the following Building 4011 areas and appurtenances:

- Former septic tank located on the southwest side of Building 4011. If radioactive materials were released into the septic system, residual contamination may exist in the materials surrounding the former septic tank.

- Former leach field located south of Building 4011, across G Street. If radioactive materials were released into the septic system, residual contamination may exist in the materials surrounding the former leach field.

- Sink trap locations in Building 4011 where previous radiological contamination was found. Radioactive sludge was previously found in a sink trap in the building. Residual contamination may still exist in sink traps locations or soils surrounding the sink trap locations.

- Sanitary sewer line located west of Building 4011. If radioactive materials were released into the sewer system, residual contamination may exist in the materials inside and surrounding the sewer lines.

- Former OS-15 identified on aerial photographs west of Building 4011 where staining was noted. If radioactive materials were stored in OS-15, contamination could migrate into the Building 4011 area and residual contamination may exist west of the building.

- Northwest corner of Building 4011 where elevated Cs-137 was found in past investigations. Past cleanup efforts were not conducted to the standard of the December 2010 Administrative Order on Consent; consequently, residual contamination may exist near this corner of the building.

- Lined drainage channel south of Building 4011, along G Street. The G Street storm drain collects storm water from 17th Street, which in turn collects storm water from buildings using radioactive material; consequently, residual contamination may exist in the G Street drainage.

- Drainage pathways associated with the Building 4011 area and outside Area IV as proposed by the field sampling plan. Residual contamination may exist in drainages outside of Area IV.

2.7.4 Building 4171 Area

Site Description: The Building 4171 area comprises Building 4171 and the land surrounding it on 19th Street between F and G Streets. Building 4171 was first identified as an X-Ray Building on a July 1964 industrial planning map. Building 4171 was built directly adjacent to Building 4612, which is discussed elsewhere in this section. Figure 2.7.4a provides a current photograph. The research team was unable to find building-specific drawing(s). Building 4171 was located west of the Building 4011 Radiation Instrument Calibration Laboratory and Electrical Substation 4711.[1,2] These buildings are discussed elsewhere in this section. No as-built drawings were located for Building 4171. Plate 1 presents a summary of all identified features for this site.

Building Features: Building 4171 was a steel-framed building with a concrete floor and measured 850 square feet.[3] A 200-gallon propane tank was located west of Building 4171, and east of 20th Street, for fueling maintenance vehicles.[4] A sanitary sewer map shows a sewer line south of Building 4171.[5] However, it is not clear if Building 4171, itself, is actually connected to this sewer line.

Former Use(s): Building 4171 was identified as an X-Ray Building on industrial planning maps.[6] It was also used for storage of radiographic sources and miscellaneous electronic equipment.[7] A 1993 Rockwell International internal letter notes that Building 4171 was a radiography room, but is currently vacant. The letter requests the use of the building to install and use a new dosimeter calibrator that contains a radioactive source. The letter states that because of relatively high levels of radioactivity, the calibrator should be placed in a separate structure away from the calibration lab in Building 4011. The dosimeter calibrator will not release radioactive materials, and thus Building 4171 will not become radioactively contaminated and will not require decontamination when use of the facility is no longer required.[8]

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[1] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.

[2] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. R-5.

[3] *Fire Preplan Area IV, Building 011 and Surrounding Area (Including Bldg. 171 and 172)*, Unknown Author, Unknown Date.

[4] *Group 5 – Central Portion of Areas III and IV RCRA Facility Investigation Report, Santa Susana Field Laboratory, Ventura County, California, Volume VIII – RFI Site Reports, Appendix D, Boeing Area IV Leach Field*, CH2M Hill, Draft in Progress November 2008, p. Table D.2-2.

[5] *Technical Site Information, Energy Technology Engineering Center (ETEC), GEN-AT-0027, Revision B*, Rockwell International Corporation, August 1993, p. b-23.

[6] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.

[7] Correspondence from Tuttle, R.J., Rockwell International, to Vaille, R., U.S. Environmental Protection Agency, *Reference: Identification and Description of Areas Involved with Radioactive Materials at SSFL Area IV*, dated October 2, 1989.

[8] Internal correspondence from Barnes, J., to Sitlington, S., Rockwell International Corporation, *Reference: Request of Use of SSFL Building 171*, January 6, 1993.

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: Demolished in 2000.[1] Based on available information, the dimensions of the excavation made during building demolition are unknown.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): Radiological surveys specific to Building 4171 were not conducted. The Building 4171 area was covered as part of the Rockwell/Rocketdyne 1994-1995 Area IV Radiological Characterization Survey. A walkabout gamma survey was conducted in the area of Building 4171. Only areas showing elevated gamma activity in the walkabout survey were followed up with an ambient gamma survey. Walkabout data was not reported in the characterization survey report. However, the walkabout survey results were reported to be consistent with ambient gamma survey measurements. The average gamma exposure rate for the developed areas of the Santa Susana Field Laboratory Area IV was 13.6 microroentgens per hour (μR/hr) with a maximum rate of 19.4 μR/hr. The average exposure rate for all of Area IV was 14.6 μR/hr with a maximum rate of 21.4 μR/hr. The local background exposure rate outside of Area IV was 15.6 μR/hr with a maximum value of 20.5 μR/hr. According to the survey report, the gamma radiation distribution of Area IV was statistically indistinguishable from the local background gamma radiation distribution. The U.S. Nuclear Regulatory Commission and the State of California specify a limit of 5 μR/hr above the average background of the data set for release of land for radiologically unrestricted use. Ambient gamma regulatory limits were below these acceptable limits.[2]

Radiological Use Authorizations: A safety committee annual review for 1987 notes two authorizations relating to Building 4171. Authorization 18 required leak test tags on the source safe. Authorization 42 required the door leading to the x-ray booth control room to be locked when unattended, the emergency shutdown button in the booth to be clearly posted, and leak tag tests to be updated properly.[3] No other Radiological Use Authorizations have been located.

Former Radiological Burial or Disposal Location: None found.

Aerial Photographs: Building 4171 was first identified on a 1965 aerial photograph. A 1965 aerial photograph identifies a large open storage (OS) area, denoted OS-15, to the east, west, and south of Building 4171. A probable stain was noted in OS-15. In 1967, a possible stain is located south of Building 4171. In 1980 and 1983, a fill area containing vegetated, mounded material is identified south of Building 4171 and G Street. By 1988, this area is part of a larger fill area (FA) identified as FA-11. A 1995 aerial photograph identifies a probable horizontal tank west of Building 4171. By 2005, Building 4171 is no longer present.[4]

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[1] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 - Area IV Site Summaries*, May 2005, p. R-5.
[2] Rockwell International/Rocketdyne Division, *Area IV Radiological Characterization Survey, A4CM-ZR-0011, Rev. A*, August 15, 1996.
[3] Dix, T.E., *Radiation Safety Committee Annual Review for 1987, N001SRR140105*, Rockwell International Corporation, June 15, 1988, pgs. 9, 29.
[4] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.

Radionuclides of Concern: Radiographic source containers usually consisted of depleted uranium.[1] Radionuclides associated with potential migration from Building 4011 include: americium-241 (Am-241), cesium-137 (Cs-137), cobalt-60 (Co-60), europium isotopes (Eu-152, Eu-154), iridium-192 (Ir-192), lead-210 (Pb-210), plutonium isotopes (Pu-238, Pu-239, Pu-240, Pu-241), potassium-40 (K-40), radium-226 (Ra-226), strontium-90 (Sr-90), tantalum-182 (Ta-182), technetium-99 (Tc-99), thorium isotopes (Th-230, Th-232), tritium (H-3), and uranium isotopes (U-234, U-235, U-238).[2,3] All radionuclides of concern listed, with the exception of Ir-192 and Ta-182, are included for analysis in the August 2009 *Final Field Sampling Plan, Radiological Background Study, Santa Susana Field Laboratory*. Ir-192 and Ta-182 have half-lives of less than one year and thus do not meet the criteria for analysis. Table 3.3 presents a summary of radiological contaminants of concern.

Drainage Pathways: Storm drainage for Building 4171 follows a culvert around the north and west of the building. The drainage flows southwest to 20th Street.[4] Aerial photographs from 1965 to 2005 identify a drainage pathway that flows south from 20th Street to impoundments in Area III.[5] Building 4171 was located north of a lined drainage channel running southwest along G Street. Two other surface drainage channels, one lined and one unlined, were located just south of G Street, between 19th and 20th Streets. These channels run south into Area III.[6] The general slope of Area IV is in a southerly direction. Water runoff is directed to the retention reservoirs which are part of the SSFL industrial effluent control system. Liquid effluent discharge from the final retention pond into the Bell Canyon drainage occurs only after controlled effluent holdup and sampling.[7,8] Building 4171 was located west of Building 4011 Radiation Instrument Calibration Laboratory, which handled radioactive materials. This presents a possibility of radiological contamination in the area of Building 4171.

Radiological Contamination Potential: Class 1 because storage of radiographic sources, potential radioactive material migration via surface waste flow or airborne release from Building 4011, and lack of site investigation.

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[1] Correspondence from Tuttle, R.J., Rockwell International, to Vaille, R., U.S. Environmental Protection Agency, *Reference: Identification and Description of Areas Involved with Radioactive Materials at SSFL Area IV*, dated October 2, 1989.

[2] Rockwell International, Rocketdyne Division, *Application for Renewal, State of California Broad Scope "A" Radioactive Materials License #0015-70, RI/RD-93-160, Exhibit 10: Inventory of Radioactive Sources*, Revised August 7, 1995, p. 6.

[3] Internal Correspondence from Bresson, J.F. to Heine, W.F., North American Rockwell Corporation, *Reference: Inspection of Santa Susana Radiographic Installation*, April 18, 1969.

[4] *Technical Site Information, Energy Technology Engineering Center (ETEC), GEN-AT-0027, Revision B*, Rockwell International Corporation, August 1993, p. b-25.

[5] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.

[6] Map located at: http://www.dtsc-ssfl.com/files/maps/SSFL%20-%20Western%20Half.pdf.

[7] Chapman, J. A., *Radiological Survey of Buildings T019 and T013; An Area Northwest of T059, T019, T013, and T012; And a Storage Yard West of Buildings T626 and T038, GEN-ZR-0010*, Rockwell International, Rocketdyne Division, August 26, 1988, p. 17.

[8] Map located at: http://www.dtsc-ssfl.com/files/maps/SSFL%20-%20Western%20Half.pdf.

Recommended Locations for Sediment/Soil Sampling:

Plate 1 and Figure 2.7 provide a convenient reference for the following recommendations.

Due to lack of site investigation, storage of radioactive source material, and potential radioactive material migration via surface waste flow or airborne release from Building 4011, there is a possibility that radionuclide concentrations in soil will exceed the standard required by the December 2010 Administrative Order on Consent. Therefore, additional characterization is recommended for the Building 4171 area. This includes the following Building 4171 areas:

- Former sealed source use and storage areas of Building 4171 footprint if locations can be determined. Due to lack of site investigation, areas of known radioactive material use and storage may have residual contamination.

- Sanitary sewer located south of Building 4171 footprint. If radioactive materials were released into the sewer system, residual contamination may exist in the materials inside and surrounding the sewer lines.

- Former OS-15 identified on aerial photographs south and west of Building 4171 footprint where staining was noted. If radioactive materials were stored in OS-15, contamination could migrate into the Building 4171 area and residual contamination may exist west of the building.

- Storm drainage area along north and west of the Building 4171 footprint. The 20th Street storm drain collects storm water from Systems for Nuclear Auxiliary Power Building 4019; consequently, residual contamination may exist along the 20th Street drainage.

- Drainage pathways associated with the Building 4171 area and outside Area IV as proposed by the field sampling plan. Residual contamination may exist in drainages outside of Area IV.

2.7.5 Building 4172 Area

Site Description: The Building 4172 area comprises Building 4172 and the land surrounding it. Building 4172 was first identified as an X-Ray Building on a March 1973 industrial planning map. The building was located adjacent to Building 4011, between 18th and 19th Streets.[1,2] Figure 2.7.5a provides a current photograph. The research team was unable to find building-specific drawing(s). Building 4011, the Radiation Instrument Calibration Laboratory, is discussed elsewhere in this section. No as-built drawings were located for Building 4172. Plate 1 presents a summary of all identified features for this site.

[1] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[2] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. R-7.

Building Features: Building 4172 was a single-story building with lead/concrete block walls and a metal roof. The building measured 630 square feet.[1,2] A tank of unknown contents was associated with Building 4172 in a Resource Conservation and Recovery Act Facility Investigation (RFI) report, but no other information has been identified on this tank.[3] A sanitary sewer map shows a sewer line under Building 4172.[4]

Former Use(s): Building 4172 was identified as an X-Ray Building on industrial planning maps. It was designed for shielded room radiography of pipe welds, valves, components, and subassemblies. It was also used for storage of sealed sources that were checked every six months to ensure no leakage occurred.[5,6] Sealed plutonium fuel elements were x-ray inspected in Building 4172.[7] Reportedly, Building 4172 was mistakenly listed on a Nuclear Regulatory Commission license. The building was deleted from that license in December of 1982.[8]

Information from Interviewees: None to date.

Radiological Incident Reports: There has been one incident associated with Building 4172. The following table provides information presented in an incidents database provided by Boeing. Summaries of only the incident reports that resulted or may have resulted in releases to the environment are provided following the table, when available. Summaries of all available incident reports are provided in Attachment A.

Building 4172 Incident Report Summary

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A0057	4/13/1977	X RAY ROOM		MISDIRECTED X-RAY BEAM CAUSED EXPOSURE TO THE OPERATOR IN THE CONTROL ROOM.

[1] *Fire Preplan Area IV, Building 011 and Surrounding Area (Including Bldg. 171 and 172)*, Unknown Author, Unknown Date.
[2] Pritchett, D., *Radiation Survey, SSFL, Building 172*, Unknown Organization, February 4, 1994, HDMSp01703040.
[3] *Group 5 – Central Portion of Areas III and IV RCRA Facility Investigation Report, Santa Susana Field Laboratory, Ventura County, California, Volume VIII RFI Site Reports, Appendix D, Boeing Area IV Leach Field*, CH2M Hill, Draft in Progress November 2008, p. Table D.2-2.
[4] *Technical Site Information, Energy Technology Engineering Center (ETEC), GEN-AT-0027, Revision B*, Rockwell International Corporation, August 1993, pgs. b-23.
[5] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[6] Internal correspondence from Donnelly, C.W. to Heine, W.F., Rockwell International, *Reference: Application Authorization to Perform X-Radiography in Building 172, Nuclear Development (NDFL) Field Laboratory, Santa Susana*, dated February 25, 1974. [This supercedes similar letters dated June 4, 1973 and August 8, 1973.]
[7] Correspondence from Tuttle, R.J., Rockwell International, to Vaille, R., U.S. Environmental Protection Agency, *Reference: Identification and Description of Areas Involved with Radioactive Materials at SSFL Area IV*, dated October 2, 1989.
[8] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. R-7.

Current Use: Demolished in 2000.[1] Based on available information, the dimensions of the excavation made during building demolition are unknown.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s):

- **Biannual Leak Check Program**. No leaking sealed sources reportedly were detected during the biannual leak check program. An entry in The Boeing Company's Radiation Safety Records Management System suggests that release data following decommissioning and demolition efforts at Building 4172 was collected; however, documentation of such survey has not be located to date.[2]

- **1973 Rockwell Radiation Survey**. On February 28, 1973, radiation surveys were performed at Building 4172 to determine if equipment operating limitations would be required. Four surveys were performed. Survey results ranged from less than 0.1 to 44 milliroentgens per hour (mR/hr) across all four surveys. The highest readings were recorded on the high roof of Building 4011.[3]

- **1994 Radiation Survey**. On or around February 4, 1994, a radiation survey of Building 4172 was conducted. The x-ray tube was positioned at areas to be surveyed. Survey results ranged from 0.2 to 1.5 mR/hr, but were 20 to 1,000 mR/hr when the lead shield near the cable cutout was removed. The highest readings, 1.5 mR/hr with lead shielding or 1,000 mR/hr without lead shielding, were recorded on the high roof of Building 4011.[4]

Radiological Use Authorizations: The following Use Authorizations have been located for Building 4172.

- Use Authorization Series 68, originally dated January 30, 1975, first permitted x-radiography in this building. Operations were subsequently permitted under Use Authorization Series 93, edition C, June 30, 1978. Both of these authorizations permitted the use of sealed sources for radiography.[5]

- Use Authorization 42 noted that a "Caution Radiation Area" sign was required if appropriate based on use of the building, the door leading to the x-ray booth must be locked when unattended, the emergency shutdown button in the booth must be clearly posted, and leak test tags must be properly updated.[6]

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[1] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. R-7.
[2] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. R-7.
[3] Internal correspondence from Moore, J.D., to Heine, W.F., North American Rockwell, *Reference: Radiation Survey at X-Ray Building T172*, February 28, 1973.
[4] Pritchett, D., *Radiation Survey, SSFL, Building 172*, Unknown Organization, February 4, 1994, HDMSp01703040.
[5] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. R-7.
[6] Dix, T.E., *Radiation Safety Committee Annual Review for 1987, N001SRR140105*, Rockwell International Corporation, June 15, 1988, pgs. 9, 29.

- Use Authorization 18 pertained to radiographic safety procedures.[1]

Former Radiological Burial or Disposal Location: None found.

Aerial Photographs: Building 4172 is first identified in a 1967 aerial photograph. In 1980 and 1983, a fill area containing vegetated, mounded material is identified south of Building 4172 and G Street. By 1988, this area is part of a larger fill area (FA) identified as FA-11. The footprint of the building is still visible in 2005.[2]

Radionuclides of Concern: Sealed sources were stored in Building 4172, but the research team did not find evidence identifying the specific sources.[3] Radionuclides associated with potential migration from Building 4011 include: americium-241 (Am-241), cesium-137 (Cs-137), cobalt-60 (Co-60), europium isotopes (Eu-152, Eu-154), iridium-192 (Ir-192), lead-210 (Pb-210), plutonium isotopes (Pu-238, Pu-239, Pu-240, Pu-241), potassium-40 (K-40), radium-226 (Ra-226), strontium-90 (Sr-90), tantalum-182 (Ta-182), technetium-99 (Tc-99), thorium isotopes (Th-230, Th-232), tritium (H-3), and uranium isotopes (U-234, U-235, U-238).[4,5] All radionuclides of concern listed, with the exception of Ir-192 and Ta-182, are included for analysis in the August 2009 *Final Field Sampling Plan, Radiological Background Study, Santa Susana Field Laboratory*. Ir-192 and Ta-182 have half-lives of less than one year and thus do not meet the criteria for analysis. Table 3.3 presents a summary of radiological contaminants of concern.

Drainage Pathways: Aerial photographs from 1965 to 2005 identify a drainage pathway that flows south from 20th Street to impoundments in Area III.[6] Building 4172 was located north of a lined drainage channel running southwest along G Street. Two other surface drainage channels, one lined and one unlined, were located just south of G Street, between 19th and 20th Streets. These channels run south into Area III.[7] The general slope of Area IV is in a southerly direction. Water runoff is directed to the retention reservoirs which are part of the SSFL industrial effluent control system. Liquid effluent discharge from the final retention pond into the Bell Canyon drainage occurs only after controlled effluent holdup and sampling.[8,9] Building 4172 was located

[1] Dix, T.E., *Radiation Safety Committee Annual Review for 1987, N001SRR140105*, Rockwell International Corporation, June 15, 1988, pgs. 9, 29.
[2] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.
[3] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. R-7.
[4] Rockwell International, Rocketdyne Division, *Application for Renewal, State of California Broad Scope "A" Radioactive Materials License #0015-70, RI/RD-93-160, Exhibit 10: Inventory of Radioactive Sources*, Revised August 7, 1995, p. 6.
[5] Internal Correspondence from Bresson, J.F. to Heine, W.F., North American Rockwell Corporation, *Reference: Inspection of Santa Susana Radiographic Installation*, April 18, 1969.
[6] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.
[7] Map located at: http://www.dtsc-ssfl.com/files/maps/SSFL%20-%20Western%20Half.pdf.
[8] Chapman, J. A., *Radiological Survey of Buildings T019 and T013; An Area Northwest of T059, T019, T013, and T012; And a Storage Yard West of Buildings T626 and T038, GEN-ZR-0010*, Rockwell International, Rocketdyne Division, August 26, 1988, p. 17.
[9] Map located at: http://www.dtsc-ssfl.com/files/maps/SSFL%20-%20Western%20Half.pdf.

just west of Radiation Instrument Calibration Building 4011, which handled radioactive materials. This presents a possibility of radiological contamination in the area of Building 4172.

Radiological Contamination Potential: Class 2 because of storage of sealed sources, inspection of plutonium fuel elements, and potential radioactive material migration via surface water flow or airborne release from Building 4011.

Recommended Locations for Sediment/Soil Sampling:

Plate 1 and Figure 2.7 provide a convenient reference for the following recommendations.

Due to storage of sealed sources, inspection of plutonium fuel elements, and potential radioactive material migration via surface water flow or airborne release from Building 4011, there is a possibility that radionuclide concentrations in soil will exceed the standard required by the December 2010 Administrative Order on Consent. Therefore, additional characterization is recommended for the Building 4172 area. This includes the following Building 4172 areas:

- Former sealed source use and storage areas of Building 4172 footprint if locations can be determined. Due to lack of site investigation, areas of known radioactive material use and storage may have residual contamination.

- Sanitary sewer located under Building 4172 footprint. If radioactive materials were released into the sewer system, residual contamination may exist in the materials inside and surrounding the sewer lines.

- Drainage pathways associated with the Building 4172 area and outside Area IV as proposed by the field sampling plan. Residual contamination may exist in drainages outside of Area IV.

2.7.6 Building 4500 Area

Site Description: The Building 4500 area comprises Building 4500 and the land surrounding it on G Street between 17th and 20th Streets. Building 4500 is identified on a March 1962 industrial planning map as a Gas Bottle Dock. The building does not appear on a 1962/63 aerial photograph, but does appear on the next available aerial photograph in 1965. Building 4500 was a small shed built on a concrete pad located south of Flammable Material Storage Building 4008 and east of Radiation Instrument Calibration Laboratory Building 4011.[1,2,3] These buildings are discussed elsewhere in this section. Figure 2.7.6a provides a current photograph. The research team was unable to find building-specific drawing(s). No as-built drawings were located for Building 4500. Plate 1 presents a summary of all identified features for this site.

[1] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. R-11.
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[3] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.

Building Features: No information was located.

Former Use(s): Building 4500 was used as a storage area for portable gas containers, including argon, nitrogen, helium, and various calibration gasses. It was also a drop-off and pick-up point for suppliers. The high-pressure gas cylinders stored in Building 4500 were used throughout Area IV. In 1998, the building was identified as "foundation only" and left unused.[1]

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: The walls and foundation of Building 4500 were in place as of 2005, but have since been demolished. Based on available information, the dimensions of the excavation made during building demolition are unknown.[2]

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): Radiological surveys specific to Building 4500 were not conducted. The Building 4500 location was covered as part of the Rockwell/Rocketdyne 1994-1995 Area IV Radiological Characterization Survey. An ambient gamma and walkabout survey was conducted in the area of Building 4310. The average gamma exposure rate for the developed areas of the Santa Susana Field Laboratory Area IV was 13.6 microroentgens per hour (μR/hr) with a maximum rate of 19.4 μR/hr. The average exposure rate for all of Area IV was 14.6 μR/hr with a maximum rate of 21.4 μR/hr. The local background exposure rate outside of Area IV was 15.6 μR/hr with a maximum value of 20.5 μR/hr. According to the survey report, the gamma radiation distribution of Area IV was statistically indistinguishable from the local background gamma radiation distribution. The U.S. Nuclear Regulatory Commission and the State of California specify a limit of 5 μR/hr above the average background of the data set for release of land for radiologically unrestricted use. Ambient gamma regulatory limits were below these acceptable limits.[3]

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Location: None found.

Aerial Photographs: Building 4500 is first identified on a 1965 aerial photograph. In 1967, a pipeline is identified running southeast along 17th Street then turning southwest along G Street and ending just south of Building 4500. In 1972, a ground scar is located south of Building 4500 and G Street. The pipeline and ground scar are both identified in 1978 and 1980 aerial photographs. In 1980, an open storage area is also noted northwest of Building 4500. A 1983 aerial photograph identifies the pipeline, ground scar, and open storage (OS) area. In 1995, the pipeline and open storage area, now identified as OS-20, are still present. A stain and probable

[1] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. R-11.
[2] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. R-11.
[3] Rockwell International/Rocketdyne Division, *Area IV Radiological Characterization Survey, A4CM-ZR-0011, Rev. A*, August 15, 1996.

refuse container are identified in the open storage area northwest of Building 4500. The building appears to be demolished in a 2005 aerial photograph.[1]

Radionuclides of Concern: The research team did not find evidence of radioactive material use in Building 4500. Radionuclides associated with potential migration from Building 4011 include: americium-241 (Am-241), cesium-137 (Cs-137), cobalt-60 (Co-60), europium isotopes (Eu-152, Eu-154), iridium-192 (Ir-192), lead-210 (Pb-210), plutonium isotopes (Pu-238, Pu-239, Pu-240, Pu-241), potassium-40 (K-40), radium-226 (Ra-226), strontium-90 (Sr-90), tantalum-182 (Ta-182), technetium-99 (Tc-99), thorium isotopes (Th-230, Th-232), tritium (H-3), and uranium isotopes (U-234, U-235, U-238).[2,3] All radionuclides of concern listed, with the exception of Ir-192 and Ta-182, are included for analysis in the August 2009 *Final Field Sampling Plan, Radiological Background Study, Santa Susana Field Laboratory*. Ir-192 and Ta-182 have half-lives of less than one year and thus do not meet the criteria for analysis. Table 3.3 presents a summary of radiological contaminants of concern.

Drainage Pathways: The southeast side of Building 4500 parallels a lined drainage channel running southwest along G Street.[4] Aerial photographs from 1957 to 2005 indicate that drainage followed 17th Street to the south and continued to impoundments in Areas III and IV. The Area IV impoundment is identified as IM-5 on aerial photograph analysis and as the 17th Street Drainage in this technical memorandum. The 17th Street Drainage is discussed later in this section. Aerial photographs from 1965 to 2005 also identify a drainage pathway that flows south from 20th Street to impoundments in Area III.[5] The general slope of Area IV is in a southerly direction. Water runoff is directed to the retention reservoirs which are part of the SSFL industrial effluent control system. Liquid effluent discharge from the final retention pond into the Bell Canyon drainage occurs only after controlled effluent holdup and sampling.[6,7] Building 4500 may have received drainage from 17th Street that was redirected along G Street to 20th Street. Drainage from 17th Street could have included runoff from Buildings 4005, 4006, 4010, 4012, and 4024, all of which handled radioactive materials. This presents a possibility of radiological contamination in the area of Building 4500.

Radiological Contamination Potential: Class 2 because of potential radioactive material migration via surface water flow or airborne release from Building 4011, stains and OS-20 identified on aerial photographs, potential radioactive drainage along G Street, and lack of site investigation.

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[1] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.

[2] Rockwell International, Rocketdyne Division, *Application for Renewal, State of California Broad Scope "A" Radioactive Materials License #0015-70, RI/RD-93-160, Exhibit 10: Inventory of Radioactive Sources*, Revised August 7, 1995, p. 6.

[3] Internal Correspondence from Bresson, J.F. to Heine, W.F., North American Rockwell Corporation, *Reference: Inspection of Santa Susana Radiographic Installation*, April 18, 1969.

[4] Map located at: http://www.dtsc-ssfl.com/files/maps/SSFL%20-%20Western%20Half.pdf

[5] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.

[6] Chapman, J. A., *Radiological Survey of Buildings T019 and T013; An Area Northwest of T059, T019, T013, and T012; And a Storage Yard West of Buildings T626 and T038, GEN-ZR-0010*, Rockwell International, Rocketdyne Division, August 26, 1988, p. 17.

[7] Map located at: http://www.dtsc-ssfl.com/files/maps/SSFL%20-%20Western%20Half.pdf.

Recommended Locations for Sediment/Soil Sampling:

Plate 1 and Figure 2.7 provide a convenient reference for the following recommendations.

Due to lack of site investigation, potential radioactive material migration via surface water flow or airborne release from Building 4011, stains and OS-20 identified in aerial photographs, and potential radioactive drainage along G Street, there is a possibility that radionuclide concentrations in soil will exceed the standard required by the December 2010 Administrative Order on Consent. Therefore, additional characterization is recommended for the Building 4500 area. This includes the following Building 4500 areas:

- Stains and OS-20 identified in aerial photographs north of the Building 4500 footprint. Unknown stained areas and open storage areas could be a potential source of residual contamination.

- Ground scar identified in aerial photographs located south of Building 4500 footprint and G Street. Unknown scar should be further investigated to determine if there is any residual contamination present.

- Southeast edge of the Building 4500 footprint, near the G Street drainage channel. The G Street storm drain collects storm water from 17th Street, which in turn collects storm water from buildings using radioactive material; consequently, residual contamination may exist along the G Street drainage.

- Drainage pathways associated with the Building 4171 area and outside Area IV as proposed by the field sampling plan. Residual contamination may exist in drainages outside of Area IV.

2.7.7 Parking Lot 4521

Site Description: The Parking Lot 4521 area comprises Parking Lot 4521 and the land surrounding it. Parking Lot 4521 is identified on a March 1962 industrial planning map as a parking lot serving Building 4011, but it is not identified on any subsequent planning maps.[1] A 2005 historical site assessment places the parking lot on the northeast and southwest sides of Building 4011, between F and G Streets and 18th and 20th Streets.[2] Aerial photographs from 1959 to 2005 indicate paved areas on either side of Building 4011, but it is not clear if the paved areas were ever used as parking lots.[3] Figure 2.7.7a provides a current photograph. The research team was unable to find building-specific drawing(s). Building 4011 is discussed elsewhere in

[1] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.

[2] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, pgs. R-13 and Site Summary Group R Figure.

[3] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.

this section. No as-built drawings were located for Parking Lot 4521. Plate 1 presents a summary of all identified features for this site.

Building Features: A sanitary sewer line is identified originating from the west side of Building 4011 and running west across Parking Lot 4521 to 20th Street.[1]

Former Use(s): Parking Lot 4521 served as a parking lot for Building 4011 and the surrounding area.[2]

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: Demolished in the mid-1960s.[3] Based on available information, the dimensions of the excavation made during building demolition are unknown.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): Radiological surveys specific to Parking Lot 4521 were not conducted. The Parking Lot 4521 area was covered as part of the Rockwell/Rocketdyne 1994-1995 Area IV Radiological Characterization Survey. An ambient gamma and walkabout survey was conducted in the area of Building 4310. The average gamma exposure rate for the developed areas of the Santa Susana Field Laboratory Area IV was 13.6 microroentgens per hour (μR/hr) with a maximum rate of 19.4 μR/hr. The average exposure rate for all of Area IV was 14.6 μR/hr with a maximum rate of 21.4 μR/hr. The local background exposure rate outside of Area IV was 15.6 μR/hr with a maximum value of 20.5 μR/hr. According to the survey report, the gamma radiation distribution of Area IV was statistically indistinguishable from the local background gamma radiation distribution. The U.S. Nuclear Regulatory Commission and the State of California specify a limit of 5 μR/hr above the average background of the data set for release of land for radiologically unrestricted use. Ambient gamma regulatory limits were below these acceptable limits.[4]

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Location: None found.

Aerial Photographs: Aerial photographs from 1959 to 2005 indicate paved areas on the northeast and southwest sides of Building 4011, but it is not clear if the paved areas were ever used as parking lots. In 1959, the southwest paved area is identified as an open storage (OS) area. In 1962/63, the open storage area is identified as OS-15 and contains a stain. A probable stain is noticed in OS-15 in 1965 and a possible stain is noticed in OS-15 in 1967. In 1980 and

[1] *Technical Site Information, Energy Technology Engineering Center (ETEC), GEN-AT-0027, Revision B*, Rockwell International Corporation, August 1993, p. b-23.
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[3] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. R-13.
[4] Rockwell International/Rocketdyne Division, *Area IV Radiological Characterization Survey, A4CM-ZR-0011, Rev. A*, August 15, 1996.

1983, an open storage area is noted in the paved area on the northeast side of Building 4011. Additionally, two fill areas containing vegetated, mounded material are identified south of the Building 4011 paved areas and G Street. By 1988, the two areas of mounded material are identified as one large vegetated fill area (FA), FA-11. A 1995 aerial photograph notes an open storage area identified as OS-20 with a stain and probable refuse container in the paved area on the northeast side of Building 4011. In 2005, the paved areas northeast and southwest of Building 4011 are still present as is OS-20 and FA-11.[1]

Radionuclides of Concern: The research team did not find evidence of radioactive material use in Parking Lot 4521. Radionuclides associated with potential migration from Building 4011 include: americium-241 (Am-241), cesium-137 (Cs-137), cobalt-60 (Co-60), europium isotopes (Eu-152, Eu-154), iridium-192 (Ir-192), lead-210 (Pb-210), plutonium isotopes (Pu-238, Pu-239, Pu-240, Pu-241), potassium-40 (K-40), radium-226 (Ra-226), strontium-90 (Sr-90), tantalum-182 (Ta-182), technetium-99 (Tc-99), thorium isotopes (Th-230, Th-232), tritium (H-3), and uranium isotopes (U-234, U-235, U-238).[2,3] All radionuclides of concern listed, with the exception of Ir-192 and Ta-182, are included for analysis in the August 2009 *Final Field Sampling Plan, Radiological Background Study, Santa Susana Field Laboratory*. Ir-192 and Ta-182 have half-lives of less than one year and thus do not meet the criteria for analysis. Table 3.3 presents a summary of radiological contaminants of concern.

Drainage Pathways: A lined drainage channel parallels the southeast side of Parking Lot 4521 and runs southwest along G Street.[4] Aerial photographs from 1965 to 2005 identify a drainage pathway that flows south from 20th Street to impoundments in Area III.[5] The general slope of Area IV is in a southerly direction. Water runoff is directed to the retention reservoirs which are part of the SSFL industrial effluent control system. Liquid effluent discharge from the final retention pond into the Bell Canyon drainage occurs only after controlled effluent holdup and sampling.[6,7] Parking Lot 4521 was located on the east and west sides of Radiation Instrument Calibration Building 4011, which handled radioactive materials. This presents a possibility of radiological contamination in the Parking Lot 4521 area.

Radiological Contamination Potential: Class 2 because of stained areas and open storage areas noted in aerial photographs, potential radioactive material migration via surface water flow or airborne release from Building 4011, potential radioactive drainage along G Street, and lack of site investigation.

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[1] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.

[2] Rockwell International, Rocketdyne Division, *Application for Renewal, State of California Broad Scope "A" Radioactive Materials License #0015-70, RI/RD-93-160, Exhibit 10: Inventory of Radioactive Sources*, Revised August 7, 1995, p. 6.

[3] Internal Correspondence from Bresson, J.F. to Heine, W.F., North American Rockwell Corporation, *Reference: Inspection of Santa Susana Radiographic Installation*, April 18, 1969.

[4] Map located at: http://www.dtsc-ssfl.com/files/maps/SSFL%20-%20Western%20Half.pdf.

[5] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.

[6] Chapman, J. A., *Radiological Survey of Buildings T019 and T013; An Area Northwest of T059, T019, T013, and T012; And a Storage Yard West of Buildings T626 and T038, GEN-ZR-0010*, Rockwell International, Rocketdyne Division, August 26, 1988, p. 17.

[7] Map located at: http://www.dtsc-ssfl.com/files/maps/SSFL%20-%20Western%20Half.pdf.

Recommended Locations for Sediment/Soil Sampling:

Plate 1 and Figure 2.7 provide a convenient reference for the following recommendations.

Due to lack of site investigation, potential radioactive material migration via surface water flow or airborne radiation from Building 4011, stains and open storage areas identified in aerial photographs, and potential radioactive drainage along G Street, there is a possibility that radionuclide concentrations in soil will exceed the standard required by the December 2010 Administrative Order on Consent. Therefore, additional characterization is recommended for the Parking Lot 4521 area. This includes the following Parking Lot 4521 areas:

- Stains, OS-15, and OS-20 identified in aerial photographs in and around Parking Lot 4521 footprint. Unknown stained areas and open storage areas could be a potential source of residual contamination.

- Sanitary sewer that runs west from Building 4011 through Parking Lot 4521 footprint. If radioactive materials were released into the sewer system, residual contamination may exist in the materials inside and surrounding the sewer lines.

- Lined drainage channel along G Street, south of Parking Lot 4521 footprint. The G Street storm drain collects storm water from 17th Street, which in turn collects storm water from buildings using radioactive material; consequently, residual contamination may exist along the G Street drainage.
- Drainage pathways associated with the Parking Lot 4521 area and outside Area IV as proposed by the field sampling plan. Residual contamination may exist in drainages outside of Area IV.

2.7.8 Building 4611 Area

Site Description: The Building 4611 area comprises Building 4611 and the land surrounding it near the intersection of 19th and G Streets. Building 4611 is first identified on a 1959 aerial photograph. Industrial planning maps note Building 4611 was a paint spray booth canopy. It is assumed that the building was an open structure for spray painting. The structure was located at the southwest corner of Radiation Instrument Calibration Laboratory Building 4011.[1,2] Figure 2.7.8a provides a current photograph. The research team was unable to find available building-specific drawing(s). Building 4011 is discussed elsewhere in this section. No as-built drawings were located for Building 4611. Plate 1 presents a summary of all identified features for this site.

Building Features: No information was located.

[1] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.

Former Use(s): Building 4611 was assumed to be an open structure for spray painting.[1]

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: The last legible industrial planning map that specifically identifies Building 4611 is a 1978 map.[2] Building 4611 does not appear on a May 1978 aerial photograph.[3] The building presumably was demolished in 1978. Based on available information, the dimensions of the excavation made during building demolition are unknown.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): Radiological surveys specific to Building 4611 were not conducted. The Building 4611 area was covered as part of the Rockwell/Rocketdyne 1994-1995 Area IV Radiological Characterization Survey. An ambient gamma and walkabout survey was conducted in the area of Building 4310. The average gamma exposure rate for the developed areas of the Santa Susana Field Laboratory Area IV was 13.6 microroentgens per hour (μR/hr) with a maximum rate of 19.4 μR/hr. The average exposure rate for all of Area IV was 14.6 μR/hr with a maximum rate of 21.4 μR/hr. The local background exposure rate outside of Area IV was 15.6 μR/hr with a maximum value of 20.5 μR/hr. According to the survey report, the gamma radiation distribution of Area IV was statistically indistinguishable from the local background gamma radiation distribution. The U.S. Nuclear Regulatory Commission and the State of California specify a limit of 5 μR/hr above the average background of the data set for release of land for radiologically unrestricted use. Ambient gamma regulatory limits were below these acceptable limits.[4]

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Location: None found.

Aerial Photographs: Building 4611 is identified in a 1959 aerial photograph. In 1959, an open storage area was identified along the southwest side of Building 4011, just north of Building 4611, and portions of a pipeline were visible along G Street southwest of Building 4611. In 1962/63, Building 4611 is included in the open storage area (OS), now identified as OS-15, and a stain is visible. In 1965, Building 4611 is no longer included in OS-15, but the storage area has grown to the north and west. By 1978, Building 4611 is no longer present on aerial photographs.[5]

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[1] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. R-15.
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[3] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.
[4] Rockwell International/Rocketdyne Division, *Area IV Radiological Characterization Survey, A4CM-ZR-0011, Rev. A*, August 15, 1996.
[5] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.

Radionuclides of Concern: The research team did not find evidence of radioactive material use in Building 4611. Radionuclides associated with potential migration from Building 4011 include: americium-241 (Am-241), cesium-137 (Cs-137), cobalt-60 (Co-60), europium isotopes (Eu-152, Eu-154), iridium-192 (Ir-192), lead-210 (Pb-210), plutonium isotopes (Pu-238, Pu-239, Pu-240, Pu-241), potassium-40 (K-40), radium-226 (Ra-226), strontium-90 (Sr-90), tantalum-182 (Ta-182), technetium-99 (Tc-99), thorium isotopes (Th-230, Th-232), tritium (H-3), and uranium isotopes (U-234, U-235, U-238).[1,2] All radionuclides of concern listed, with the exception of Ir-192 and Ta-182, are included for analysis in the August 2009 *Final Field Sampling Plan, Radiological Background Study, Santa Susana Field Laboratory*. Ir-192 and Ta-182 have half-lives of less than one year and thus do not meet the criteria for analysis. Table 3.3 presents a summary of radiological contaminants of concern.

Drainage Pathways: Aerial photographs from 1965 to 2005 identify a drainage pathway that flows south from 20th Street to impoundments in Area III.[3] A lined drainage channel parallels the southeast side of Building 4611 and runs southwest along G Street. Two other surface drainage channels, one lined and one unlined, were located just south of G Street, between 19th and 20th Streets. These channels run south into Area III.[4] The general slope of Area IV is in a southerly direction. Water runoff is directed to the retention reservoirs which are part of the SSFL industrial effluent control system. Liquid effluent discharge from the final retention pond into the Bell Canyon drainage occurs only after controlled effluent holdup and sampling.[5,6] Building 4611 was located at the southwest corner of Radiation Instrument Calibration Building 4011, which handled radioactive materials. This presents a possibility of radiological contamination in the area of Building 4611 from Building 4011 drainage.

Radiological Contamination Potential: Class 2 because of potential radioactive material migration via surface water flow or airborne release from Building 4011, potential radioactive drainage along G Street, stains and OS-15 identified in aerial photographs, and lack of site investigation.

Recommended Locations for Sediment/Soil Sampling:

Plate 1 and Figure 2.7 provide a convenient reference for the following recommendations.

Due to lack of site investigation, potential radioactive material migration via surface water flow or airborne release from Building 4011, potential radioactive drainage along G Street, and stains and OS-15 identified in aerial photographs, there is a possibility that radionuclide concentrations

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[1] Rockwell International, Rocketdyne Division, *Application for Renewal, State of California Broad Scope "A" Radioactive Materials License #0015-70, RI/RD-93-160, Exhibit 10: Inventory of Radioactive Sources*, Revised August 7, 1995, p. 6.

[2] Internal Correspondence from Bresson, J.F. to Heine, W.F., North American Rockwell Corporation, *Reference: Inspection of Santa Susana Radiographic Installation*, April 18, 1969.

[3] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.

[4] Map located at: http://www.dtsc-ssfl.com/files/maps/SSFL%20-%20Western%20Half.pdf.

[5] Chapman, J. A., *Radiological Survey of Buildings T019 and T013; An Area Northwest of T059, T019, T013, and T012; And a Storage Yard West of Buildings T626 and T038, GEN-ZR-0010*, Rockwell International, Rocketdyne Division, August 26, 1988, p. 17.

[6] Map located at: http://www.dtsc-ssfl.com/files/maps/SSFL%20-%20Western%20Half.pdf.

in soil will exceed the standard required by the December 2010 Administrative Order on Consent. Therefore, additional characterization is recommended for the Building 4611 area. This includes the following Building 4611 areas:

- North and west portions of Building 4611 footprint where OS-15 and stains are identified in aerial photographs. Unknown stained areas and open storage areas could be a potential source of residual contamination.

- Lined drainage channel along G Street, south of Building 4611 footprint. The G Street storm drain collects storm water from 17th Street, which in turn collects storm water from buildings using radioactive material; consequently, residual contamination may exist along the G Street drainage.

- Drainage pathways associated with the Building 4611 area and outside Area IV as proposed by the field sampling plan. Residual contamination may exist in drainages outside of Area IV.

2.7.9 Building 4612 Area

Site Description: The Building 4612 area comprises Building 4612 and the land surrounding it on 19th Street between F and G Streets. Building 4612 was constructed prior to March 1962 as a Maintenance Building. The building was located south of X-Ray Building 4171 and west of X-Ray Building 4172 and Radiation Instrument Calibration Laboratory of Building 4011.[1] These buildings are discussed elsewhere in this section. Figure 2.7.9a provides a current photograph. The research team was unable to find building-specific drawing(s). No as-built drawings were located for Building 4612. Plate 1 presents a summary of all identified features for this site.

Building Features: A sanitary sewer map shows a sewer line that appears to be located under the Building 4612 site footprint.[2]

Former Use(s): Building 4612 was initially identified as a Maintenance Building. In 1967, it was further identified as a Maintenance/Reclaimed Material Storage Building. By 1972, the building was listed as a Storage Building. The last legible industrial planning map that specifically identifies Building 4612 is a 1982 map.[3]

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

[1] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[2] *Technical Site Information, Energy Technology Engineering Center (ETEC), GEN-AT-0027, Revision B*, Rockwell International Corporation, August 1993, p. b-23.
[3] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.

Current Use: Building 4612 was likely demolished in 2000 when Building 4171, directly adjacent to Building 4612, was demolished.[1] Based on available information, the dimensions of the excavation made during building demolition are unknown.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): Radiological surveys specific to Building 4612 were not conducted. The Building 4612 area was covered as part of the Rockwell/Rocketdyne 1994-1995 Area IV Radiological Characterization Survey. An ambient gamma and walkabout survey was conducted in the area of Building 4310. The average gamma exposure rate for the developed areas of the Santa Susana Field Laboratory Area IV was 13.6 microroentgens per hour (μR/hr) with a maximum rate of 19.4 μR/hr. The average exposure rate for all of Area IV was 14.6 μR/hr with a maximum rate of 21.4 μR/hr. The local background exposure rate outside of Area IV was 15.6 μR/hr with a maximum value of 20.5 μR/hr. According to the survey report, the gamma radiation distribution of Area IV was statistically indistinguishable from the local background gamma radiation distribution. The U.S. Nuclear Regulatory Commission and the State of California specify a limit of 5 μR/hr above the average background of the data set for release of land for radiologically unrestricted use. Ambient gamma regulatory limits were below these acceptable limits.[2]

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Location: None found.

Aerial Photographs: Building 4612 is first identified on a 1965 aerial photograph. The 1965 aerial photograph identifies a large open storage (OS) area, OS-15, containing a probable stain to the west and south of Building 4612. In 1967, a possible stain is located southeast of Building 4612 in OS-15. In 1980 and 1983, two fill areas containing vegetated, mounded material are identified south of Building 4011 and G Street. By 1988, these two areas become part of a larger fill area (FA) identified as FA-11. A 1995 aerial photograph identified a horizontal tank west of Building 4612. Building 4612 is no longer present on a 2005 aerial photograph.[3]

Radionuclides of Concern: The research team did not find evidence of radioactive material use in Building 4612. Radionuclides associated with potential migration from Building 4011 include: americium-241 (Am-241), cesium-137 (Cs-137), cobalt-60 (Co-60), europium isotopes (Eu-152, Eu-154), iridium-192 (Ir-192), lead-210 (Pb-210), plutonium isotopes (Pu-238, Pu-239, Pu-240, Pu-241), potassium-40 (K-40), radium-226 (Ra-226), strontium-90 (Sr-90), tantalum-182 (Ta-182), technetium-99 (Tc-99), thorium isotopes (Th-230, Th-232), tritium (H-3), and uranium isotopes (U-234, U-235, U-238).[4,5] All radionuclides of concern listed, with the

[1] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. R-17.
[2] Rockwell International/Rocketdyne Division, *Area IV Radiological Characterization Survey, A4CM-ZR-0011, Rev. A*, August 15, 1996.
[3] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory – Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.
[4] Rockwell International, Rocketdyne Division, *Application for Renewal, State of California Broad Scope "A" Radioactive Materials License #0015-70, RI/RD-93-160, Exhibit 10: Inventory of Radioactive Sources*, Revised August 7, 1995, p. 6.
[5] Internal Correspondence from Bresson, J.F. to Heine, W.F., North American Rockwell Corporation, *Reference: Inspection of Santa Susana Radiographic Installation*, April 18, 1969.

exception of Ir-192 and Ta-182, are included for analysis in the August 2009 *Final Field Sampling Plan, Radiological Background Study, Santa Susana Field Laboratory*. Ir-192 and Ta-182 have half-lives of less than one year and thus do not meet the criteria for analysis. Table 3.3 presents a summary of radiological contaminants of concern.

Drainage Pathways: Aerial photographs from 1965 to 2005 identify a drainage pathway that flows south from 20th Street to impoundments in Area III.[1] Building 4612 is located north of a lined drainage channel that runs southwest along G Street. Two other surface drainage channels, one lined and one unlined, were located just south of G Street, between 19th and 20th Streets. These channels run south into Area III.[2] The general slope of Area IV is in a southerly direction. Water runoff is directed to the retention reservoirs which are part of the SSFL industrial effluent control system. Liquid effluent discharge from the final retention pond into the Bell Canyon drainage occurs only after controlled effluent holdup and sampling.[3,4] Building 4612 was located west of Radiation Instrument Calibration Building 4011, which handled radioactive materials. This presents a possibility of radiological contamination in the area of Building 4612 from Building 4011 drainage.

Radiological Contamination Potential: Class 2 because of stains noted in aerial photographs, potential radioactive material migration via surface water flow or airborne release from Building 4011, and lack of site investigation.

Recommended Locations for Sediment/Soil Sampling:

Plate 1 and Figure 2.7 provide a convenient reference for the following recommendations.

Due to lack of site investigation, stains noted in aerial photographs, and potential radioactive material migration via surface water flow or airborne release from Building 4011, there is a possibility that radionuclide concentrations in soil will exceed the standard required by the December 2010 Administrative Order on Consent. Therefore, additional characterization is recommended for the Building 4612 area. This includes the following Building 4612 areas:

- Sanitary sewer located under Building 4612 site footprint and east and west of building footprint. If radioactive materials were released into the sewer system, residual contamination may exist in the materials inside and surrounding the sewer lines.

- Former OS-15 identified on aerial photographs south and west of Building 4612 footprint where staining is noted. If radioactive materials were stored in OS-15, contamination could migrate into the Building 4612 area and residual contamination may exist west of the building.

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[1] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.
[2] Map located at: http://www.dtsc-ssfl.com/files/maps/SSFL%20-%20Western%20Half.pdf.
[3] Chapman, J. A., *Radiological Survey of Buildings T019 and T013; An Area Northwest of T059, T019, T013, and T012; And a Storage Yard West of Buildings T626 and T038, GEN-ZR-0010*, Rockwell International, Rocketdyne Division, August 26, 1988, p. 17.
[4] Map located at: http://www.dtsc-ssfl.com/files/maps/SSFL%20-%20Western%20Half.pdf.

- Storm drainage area along west side of Building 4612 footprint. The 20th Street storm drain collects storm water from Systems for Nuclear Auxiliary Power Building 4019: consequently, residual contamination may exist along the 20th Street drainage.

- Drainage pathways associated with the Building 4612 area and outside Area IV as proposed by the field sampling plan. Residual contamination may exist in drainages outside of Area IV.

2.8 Group 8

The Group 8 index map is presented in Figure 2.8. Following Figure 2.8, the site photograph and layout drawings for each building area within HSA-5B Group 8 are presented. HSA-5B Group 8 includes the 17th Street Drainage area. Group 8 also contains the Building 4011 leach field discussed above in Group 7.

2.8.1 17th Street Drainage Area

Site Description: The 17th Street Drainage is the site of a stormwater channel where a berm was constructed in 1962 permitting the area to serve as a holdup pond. Over time, the area became overgrown with shrubs and trees and filled with silt.[1] The 17th Street Drainage is located south of the intersection of G and 17th Streets, in the central portion of Area IV. The former holdup pond measured approximately 30 feet by 30 feet and is noted as an impoundment (IM-5) in aerial photographs. The entire impacted area measures 2,230 meters.[2,3] Figure 2.8.1a provides a current photograph. There are no as-built drawings associated with the 17th Street Drainage. Plate 1 presents a summary of all identified features for this site.

Building Features: No structures are present in this area.

Former Use(s): A berm was constructed in 1962 around the stormwater channel to provide a 30-foot by 30-foot holdup pond. The reason for construction of the bermed pond is presently not known. The pond cycled through periods of evaporative drying in summer and refilled during the rainy season, causing the low lying area to be marshy. Over time, the area became overgrown and filled with silt. In 1998, the entire drainage channel area was cleared of shrubs and trees.[4,5] In January 1999, the main storm drainage system was re-routed by blocking and plugging the old drainage system. A new route was created along the north side of G Street to keep the stormwater channel dry all year long, presumably for ease of future monitoring and surveying.[6]

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[1] Liddy, P., *17th Street Drainage, Final Status Survey, RS-00009*, The Boeing Company, September 12, 1999, p. 6.
[2] Morton, J.R., *Verification Survey of the 17th Street Drainage Area, Santa Susana Field Laboratory, The Boeing Company, Ventura County, California*, April 14, 2000, p. 3.
[3] Liddy, P., *17th Street Drainage, Final Status Survey, RS-00009*, The Boeing Company, September 12, 1999, pgs. 6, 8, 22, 57-60, 64.
[4] Liddy, P., *17th Street Drainage, Final Status Survey, RS-00009*, The Boeing Company, September 12, 1999, pgs. 6, 8, 22, 57-60, 64.
[5] U.S. Department of Energy, *17th Street Drainage Area*, Energy Technology Engineering Center (ETEC) Website, http://www.etec.energy.gov/History/17_Street.html, accessed October 12, 2010, p.1.
[6] Ortega, Christina, *Operations Report for 17th Street Decontamination*, The Boeing Company, August 21, 2000, p. 5.

Information from Interviewees: A number of former employees were interviewed about their experience at the SSFL. One recalled information regarding the 17th Street Drainage area. Excerpts from this interview are included below.

Interviewee 12 worked at the Santa Susana Field Laboratory from 1974 to 1995 as a construction inspector. The following excerpt was pulled from the interview.

> *"I can indicate on the aerial photograph you provided a general area that was used for the disposal of miscellaneous debris. It was this general area along the southeastern side of G Street. I don't know if any irradiated material was ever disposed in the area."*[1]

Radiological Incident Reports: None found.

Current Use: The 17th Street Drainage is dry and overgrown with grass and shrubs.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s):

- **1995 Rockwell Area IV Radiological Survey**. During the 1995 Rockwell/Rocketdyne Area IV Radiological Survey, the pond was overgrown and inaccessible making a complete survey of the drainage area impossible. Soil from drainage areas to the north and south of the pond was sampled and found at background or slightly above background radiological activity. No remediation was deemed necessary at the time.[2,3]

- **1997 Rockwell Soil Sampling**. In 1997, Rockwell/Rocketdyne was able to collect soil samples from the pond area. Seven locations were sampled. Two samples indicated cesium-137 (Cs-137) at levels of 13.5 and 14.9 picocuries per gram (pCi/g), the U.S. Department of Energy approved derived concentration guideline limits (DCGLs) of 9.2 pCi/g above background. A radiation survey was then conducted in the areas to identify any locations above.[4]

- **1998 Rockwell Radiological Survey**. In 1998, Rockwell/Rocketdyne mapped and surveyed the entire drainage area. Both walkabout and ambient gamma surveys were conducted. A total of 66 hotspots (areas where total gamma radiation is greater than 5 microroentgens per hour (μR/hr) over background) located in and around the berm and along the drainage pathway south of the berm were identified during the walkabout survey. However, the ambient gamma survey resulted in only one hotspot location. This hotspot and two others with net ambient gamma levels close to 5 μR/hr over background were excavated. To further characterize the hotspot areas, a total of 13 representative surface walkabout hotspot locations were sampled and analyzed. Soil samples were

[1] Interview No. 12 conducted by EPA in 2009.
[2] Liddy, P., *17th Street Drainage, Final Status Survey, RS-00009*, The Boeing Company, September 12, 1999, pgs. 6, 8, 22, 57-60, 64.
[3] Internal correspondence from Shao, J. to Rutherford, P., The Boeing Company, *Reference: 17th Street Drainage Area – Radiation Characterization Surveys and Excavation, SHEA-016779*, January 18, 1999. [Note this letter can also be found as Appendix D in RS-00009 above.]
[4] Liddy, P., *17th Street Drainage, Final Status Survey, RS-00009*, The Boeing Company, September 12, 1999, pgs. 6, 8, 22, 57-60, 64.

collected at varying depths from the hotspot areas. Several areas immediately to the north and south of the berm showed levels of radionuclides (Cs-137 and thorium-228 (Th-228)) above local background. Four hotspots were found to have background Cs-137 levels as high as 2.11 pCi/g. This is below the DCGL of 9.2 pCi/g. Two hotspots also contained high Th-228 at 6.24 and 4.01 pCi/g, which was above the DCGL of 5 pCi/g. These hotspot areas immediately to the north and south of the berm were excavated and then re-sampled. Post-excavation sampling found the highest Cs-137 activity to be 0.72 pCi.g and the highest Th-228 activity to be 1.4 pCi/g, both below their respective DCGLs.[1,2]

- **1999 Rockwell Final Status Survey**. On June 1, 1999, Rockwell/Rocketdyne performed a final status survey at the 17th Street Drainage. Surface radiation and soil sample measurements indicated that the area met release limits approved by the U.S. Department of Energy (DOE) in 1999, and thus is suitable for release for unrestricted use.[3]

- **1999 ORISE Verification Survey**. On October 27, 1999, the Oak Ridge Institute for Science and Education (ORISE) performed a verification survey of the 17th Street Drainage that included document review, surface scans, exposure rate measurements and soil sampling. Cs-137 ranged from non-detect to 1.6 pCi/g and exposure rates ranged from 14 to 19 μR/hr.[4]

- **1999 California DHS Confirmation Survey**. In 1999, the California Department of Health Services (DHS) performed a confirmation survey of the 17th Street Drainage and recommended the site be released for unrestricted use.[5]

- **2004 Release for Unrestricted Use**. On August 14, 2004, the California DHS released the 17th Street Drainage for unrestricted use.[6]

- **2005 DOE Confirmation of Release**. On February 1, 2005, DOE declared that the Rockwell/Rocketdyne and ORISE surveys had confirmed that DOE and DHS soil cleanup limits had been met, and that the 17th Street Drainage was suitable for release for unrestricted use in 2005.[7]

Radiological Use Authorizations: None found.

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[1] Liddy, P., *17th Street Drainage, Final Status Survey, RS-00009*, The Boeing Company, September 12, 1999, pgs. 6, 8, 22, 57-60, 64.
[2] Internal correspondence from Shao, J. to Rutherford, P., The Boeing Company, *Reference: 17th Street Drainage Area – Radiation Characterization Surveys and Excavation, SHEA-016779*, January 18, 1999. [Note this letter can also be found as Appendix D in RS-00009 above.]
[3] Liddy, P., *17th Street Drainage, Final Status Survey, RS-00009*, The Boeing Company, September 12, 1999, pgs. 6, 8, 22, 57-60, 64.
[4] Liddy, P., *17th Street Drainage, Final Status Survey, RS-00009*, The Boeing Company, September 12, 1999, pgs. 6, 8, 22, 57-60, 64.
[5] Rupo, Roger K., *Confirmatory Survey, 17th Street Drainage Area, Santa Susana Field Laboratory, Boeing-Rocketdyne, Ventura County, California*, 1999, pgs. 1-2.
[6] Correspondence from Bailey, E., California Department of Health Services, Radiologic Health Branch, to Rutherford, P., The Boeing Company, *Reference: In reply to letter 2000RC-2627, Request for Release of the 17th Street Drainage Area for Unrestricted Use*, dated August 14, 2004.
[7] Lopez, M., *Release of 17th Street Drainage*, U.S. Department of Energy, February 1, 2005, p. 1.

Former Radiological Burial or Disposal Location: None found.

Aerial Photographs: The natural drainage pathway along 17th Street is identified in available aerial photographs as far back as 1957. A 1962/63 aerial photograph identifies light-toned mounded material in the drainage area and by 1965 an impoundment containing liquid is visible. Drainage continues to flow south from 17th Street to the impoundment, IM-5, and then further south into Area III during this time. By 1972, the impoundment area is densely vegetated and ground scarring is noted northwest of the impoundment. The vegetated impoundment area and ground scaring continues to be visible in 1978, 1980, and 1983. In 1980, possible fill areas (FA) are noted west of the former impoundment. In 1980 and 1983, one of two fill areas containing vegetated, mounded material is identified west of the vegetated impoundment. By 1988, the two fill areas become part of a larger fill area, identified as FA-11, west of the vegetated impoundment. Aerial photographs from 1988 through 2005 show a vegetated drainage pathway that runs south of 17th Street into Area III.[1]

Radionuclides of Concern: The principle contaminant of concern at the 17th Street Drainage is Cs-137. Uranium and thorium isotopes have been found in the soil, but always with the accompanying presence of Cs-137. Cesium has been used as a tracer for all potential contaminants. Soil sample analysis has been performed for all gamma emitting radionuclides, americium-241 (Am-241), strontium-90 (Sr-90), and isotopic plutonium (Pu-238, Pu-239, Pu-240), thorium (Th-228, Th-230, Th-232), and uranium (U-234, U-235, U-236, U-238).[2] All radionuclides of concern listed are included for analysis in the August 2009 *Final Field Sampling Plan, Radiological Background Study, Santa Susana Field Laboratory*. Table 3.3 presents a summary of radiological contaminants of concern.

Drainage Pathways: The 17th Street Drainage is the site of a stormwater channel where a berm was constructed in 1962 to permit the area to serve as a holdup pond.[3] The general slope of Area IV is in a southerly direction. Water runoff is directed to the retention reservoirs which are part of the SSFL industrial effluent control system. Liquid effluent discharge from the final retention pond into the Bell Canyon drainage occurs only after controlled effluent holdup and sampling.[4,5]

Radiological Contamination Potential: Class 1 due to past Cs-137 detection.

Recommended Locations for Sediment/Soil Sampling:

Plate 1 and Figure 2.8 provide a convenient reference for the following recommendations.

Extensive soil sampling is recommended in the 17th Street Drainage area. As discussed above, previous investigation found radiological contamination in 17th Street Drainage area and

[1] Kartman, A.S., *Aerial Photographic Analysis of Santa Susana Field Laboratory Area IV, Ventura County, California, Volume 1 & 2*, U.S. Environmental Protection Agency, Office of Research and Development, Environmental Sciences Division, March 2010.
[2] Liddy, P., *17th Street Drainage, Final Status Survey, RS-00009*, The Boeing Company, September 12, 1999, pgs. 6, 8, 22, 57-60, 64.
[3] Liddy, P., *17th Street Drainage, Final Status Survey, RS-00009*, The Boeing Company, September 12, 1999, p. 6.
[4] Chapman, J. A., *Radiological Survey of Buildings T019 and T013; An Area Northwest of T059, T019, T013, and T012; And a Storage Yard West of Buildings T626 and T038, GEN-ZR-0010*, Rockwell International, Rocketdyne Division, August 26, 1988, p. 17.
[5] Map located at: http://www.dtsc-ssfl.com/files/maps/SSFL%20-%20Western%20Half.pdf.

previous characterization studies were focused on delineating the extent of contamination to standards that were applicable at the time. Characterization was not conducted to delineate the extent of contamination above the standard required by the December 2010 Administrative Order on Consent. Therefore, additional characterization is recommended for the 17th Street Drainage area. This includes the following 17th Street Drainage areas:

- Hotspots identified in past surveys, including areas immediately north and south of the berm. Although hotspot areas were excavated in past surveys, residual contamination above the standards of the December 2010 Administrative Order on Consent may exist.

- Drainage pathways associated with the 17th Street Drainage area and outside Area IV as proposed by the field sampling plan. Residual contamination may exist in drainages outside of Area IV.

3.0 RADIONUCLIDE LIST

3.1 U.S. Atomic Energy Commission Special Nuclear Material License

The first license issued by the U.S. Atomic Energy Commission (AEC) for the SSFL site was Special Nuclear Material License No. SNM-21. It was initially issued on April 6, 1956, for use at the Canoga Park site. License No. SNM-21 authorized Atomics International (AI) to receive and possess 50 grams of uranium, enriched in uranium-235 (U-235), for use in fission counter tubes. License No. SNM-21 was amended 79 times in its 40-year history to increase the number and type of nuclear materials that could be handled at the Canoga Park and SSFL sites. This license was terminated on September 27, 1996. In February 1975, the AEC became known as the Nuclear Regulatory Agency (NRC) and License No. SNM-21 became an NRC license. License No. SNM-21 applies to company owned, not federally owned facilities. This license does not apply to the HSA-5B subarea.

3.2 U.S. Atomic Energy Commission Critical Experiments Facility License

On October 3, 1960, the AEC authorized Atomics International, under License No. CX-17, to possess and operate a separable-half type critical experiments facility at power levels not exceeding 200 watts (thermal) in Building 100 (now known as Building 4100). Atomics International conducted this research under contract to the Southwest Atomic Energy Associates of Shreveport, Louisiana. The license permitted the possession "and use of special nuclear materials as follows:

- 25 kilograms of U-233 and 110 kilograms of U-235 as fuel for the reactor;
- 135 grams of U-233, 1,135 grams of U-235, and 135 grams of Pu-239 in foils and capsules for use in connection with operation of the reactor;
- 0.5 gram each of U-233, U-235, and Pu-239 in fission counters for use in connection with operation of the reactor; and
- 32 grams of Pu in encapsulated neutron sources for use in connection with operation of the reactor."

License No. CX-17 also permitted the possession "and use of source materials as follows:

- 656 kilograms of Th-232 for use in the core and buffer regions of the reactor;
- 700 grams of natural uranium in foils and capsules for use in connection with operation of the reactor; and
- 0.5 gram each of U-234, U-236, and U-238 in fission counters for use in connection with operation of the reactor."

License No. CX-17 also permitted the possession "and use of 0.5 gram of Np-237 in fission counters for use in connection with operation of the reactor and to possess, but not to separate such byproduct materials as may be produced by operation of the reactor."

License No. CX-17 was amended 10 times before it was terminated on October 6, 1980. It does not apply to the HSA-5B subarea.

3.3 California Department of Public Health Radioactive Material License

On September 11, 1963, the State of California, Department of Public Health issued Radioactive Material License No. 0015-59 to Atomics International. This license authorized the possession and use of a wide range of radioactive materials at the De Soto Avenue, Canoga Park, and SSFL sites as listed in Table 3.1, below.

Table 3.1
Radioactive Materials Covered by License No. 0015-59

Radioactive Material (element and mass number)	Chemical and/or Physical Form	Maximum Quantity that Licensee may Possess
Any byproduct material between atomic number 3 and 83	Any	7 curies of each byproduct material between atomic number 3 and 83
Antimony-124	Any	50 curies
Iridium-192	Any	70 curies
Cobalt-60	Sealed sources	10 sources not to exceed 400 curies each
Hydrogen-3	Any	550 curies
Polonium-210	Any	150 curies
Any byproduct material	Separated from irradiated thorium and uranium samples	250 microcuries total
Hydrogen-3	Titanium tritide foil (U.S. Nuclear Corporation)	500 millicuries
Hydrogen-3	Titanium tritide foil (U.S. Radium Corporation)	1 curie
Strontium-90	Sealed source (U.S. Nuclear Corporation Model 312)	5 microcuries
Radium-226	Any	2,000 milligrams
Radium-226	Sealed neutron sources	500 milligrams
Cobalt-60	Sealed source (U.S. Nuclear Corporation Model 338)	1 source not to exceed 5 curies
Cobalt-60	Sealed source (Isotopes Specialties Company Model 338)	1 source not to exceed 5 curies
Cerium-144	Sealed source (Isotopes Specialties Company Model 160)	50 microcuries
Iridium-192	Sealed source (Technical Operations Model A424-1)	1 source not to exceed 20 curies
Radium-226	Sealed sources (NRC Equipment Corporation)	Seven sources not to exceed 0.4 milligram each
Strontium-90	Sealed sources	Two sources of 3 millicuries each
Americium-241	Any	2 millicuries
Natural or depleted uranium	Any	20,000 pounds
Natural thorium	Any	700 pounds

This license covered the use and possession of radioactive materials outside the former ETEC boundary. It does not apply to the HSA-5B subarea. Up until December 1969, there had been 39 amendments to this license. The radioactive materials covered in the 39th amendment are listed in Table 3.2, below.

Table 3.2
Radioactive Materials Covered by License No. 0015-59, Amendment No. 39

Radioactive Material (element and mass number)	Chemical and/or Physical Form	Maximum Quantity that Licensee may Possess
Any radionuclide with atomic number 3 through 83	Any	25 curies for any one radionuclide
Antimony-124	Any	100 curies
Iridium-192	Any	100 curies
Cobalt-60	Sealed sources	10 sources not to exceed 400 curies each
Hydrogen-3	Any	10,000 curies
Polonium-210	Any	150 curies
Krypton-85	Any	100 curies
Neptunium-237	Any	100 microcuries
Radium-226	Any except as neutron sources	5 grams
Radium-226	Sealed neutron sources	500 milligrams
Cobalt-60	Sealed source (U.S. Nuclear Corporation Model 338)	1 source not to exceed 5 curies
Cobalt-60	Sealed source (Isotopes Specialties Company Model 338)	1 source not to exceed 5 curies
Cobalt-60	Sealed source (Lockheed Nuclear Products Dwg 442-1001)	25,000 +/- 2,500 curies in 12 sources
Iridium-192	Sealed source (Technical Operations Model A424-1)	4 sources not to exceed 100 curies each
Radium-226	Sealed sources (NRC Equipment Corporation)	Seven sources not to exceed 0.4 milligram each
Califonium-252	Sealed source (Oak Ridge)	2 sources not to exceed 550 microcuries each
Any radionuclide with atomic number 3 through 83	Any	Not to exceed 100 curies for any one radionuclide
Promethium-147	Promethium oxide	150,000 curies
Americium-241	Any	10 curies
Natural or depleted uranium	Any	20,000 pounds
Natural thorium	Any	1,000 pounds
Tantalum-182	Metal	500 curies
Natural or depleted uranium	Any	50,000 pounds
Mixed fission products (Hot Lab)	Any	10,000,000 curies
Any radionuclide with atomic number 3 through 83 (Hot Lab)	Any	100,000 curies for any one radionuclide

This license was amended 64 times up until August 2, 1979, when the license number was changed to No. 0015-70. This license number was changed a second time to No. 0015-19 on December 5, 1996. As of August 27, 2010, there had been 110 amendments to this license. This license applies to buildings outside of the ETEC boundary. It does not apply to the HSA-5B subarea.

3.4 Radionuclide List to be Used in Soil and Groundwater Sampling

From a review of historical documents and radioactive material licenses issued for the SSFL, all of the radionuclides selected for radiochemical analysis of soil samples are likely to have been used or generated on the SSFL. In the table below, certain radionuclides mentioned in source documents will not be analyzed. These have undergone radioactive decay in excess of 10 half-

lives, such that they could no longer be present. These radionuclides include: Sb-125 and Cs-134. The September 23, 2010 Stakeholder Technical Meeting Action Items Memo describes the radionuclides contained in soil analytical suites, the sample analytical approach, and provides explanations for deleting certain radionuclides from analysis.

Table 3.3
Summary of Subarea HSA-5B Sites
Potential Radiological Contaminants of Concern

Site No.	Use(s)	Current Status	Potential Radiological Contaminants of Concern	Preliminary MARSSIM Class
4006	Sodium Laboratory	Standing	Potential radioactive contaminants include: Cs-137, H-3, U-234, U-235, U-238, and UO_2. Radionuclides associated with potential SNAP drainage include: Sb-125, Am-241, Cs-134, Cs-137, Co-60, Eu-152, Eu-154, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, H-3, U-234, U-235, and U-238.	2
4007	Sodium Storage Building	Demolished	Radionuclides associated with drainage from Buildings 4005, 4006, 4010, 4012, and 4024 include: Sb-125, Am-241, Cs-134, Cs-137, Co-60, Eu-152, Eu-154, Mn-54, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, H-3, U-234, U-235, U-238, and UO_2.	2
4008	Flammable Material Storage Building	Demolished	Radionuclides associated with nearby Building 4011 include: Am-241, Cs-137, Co-60, Eu-152, Eu-154, Ir-192, Pb-210, K-40, Pu-238, Pu-239, Pu-240, Pu-241, Ra-226, Sr-90, Tc-99, Th-230, Th-232, H-3, U-234, U-235, and U-238.	2
4010	Systems for Nuclear Auxiliary Power (SNAP) Experimental Reactor (SER), SNAP 8 Experimental Reactor (S8ER)	Demolished	Potential radioactive contaminants include: Sb-125, Am-241, Be-10, Ca-134, Cs-137, Co-60, Eu-152, Eu-154, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, H-3, U-234, U-235, and U-238.	1
4011	Administration and Services Building, Development Support Shop, Manufacturing Support Shop, Machine Shop, Radiation Instrument Calibration Laboratory	Standing	Potential radioactive contaminants include: Am-241, Cs-137, Co-60, Eu-152, Eu-154, Pb-210, K-40, Pu-238, Pu-239, Pu-240, Pu-241, Ra-226, Sr-90, Tc-99, Th-230, Th-232, H-3, U-234, U-235, and U-238.	1

Table 3.3 (continued)
Summary of Subarea HSA-5B Sites
Potential Radiological Contaminants of Concern

Site No.	Use(s)	Current Status	Potential Radiological Contaminants of Concern	Preliminary MARSSIM Class
4012	SNAP Critical Test Facility, Heavy Metal Reflected Fast Spectrum Reactor (HMRFSR), Energy Technology Engineering Center (ETEC) X-Ray Facility/Storage	Demolished	Potential radioactive contaminants include: Sb-125, Am-241, Cs-137, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, U-234, U-235, and U-238.	1
4013	SNAP Non-Nuclear Component Assembly and Performance Test Building, ETEC Thermal Transient Test Facility	Demolished	Radionuclides associated with nearby Buildings 4012 and 4019 include: Am-241, Cs-137, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, U-234, U-235, and U-238.	1
4019	SNAP Flight System Nuclear Qualification Test Building, ETEC Construction Staging and Computer Facility	Standing	Potential radioactive contaminants include: Am-241, Cs-137, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, U-234, U-235, and U-238.	1
4025	Remote Handling Mock-Up Building, ETEC Instrumentation and Inventory Building	Demolished	A potential radioactive contaminant is Co-60. Radionuclides associated with potential drainage from Building 4075 include: isotopes of thorium, plutonium, and uranium, and mixed fission products. Radionuclides associated with nearby Building 4024 include: Am-241, Cs-137, Co-60, Eu-152, Eu-154, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, H-3, U-234, U-235, and U-238.	1
4026	Large Component Test Loop (LCTL) Control Building, Small Component Test Loop (SCTL) Control Building	Demolished	Radionuclides associated with nearby Building 4006 include: Cs-137, H-3, U-234, U-235, and U-238. Radionuclides associated with potential drainage from Buildings 4010 and 4012 include: Sb-125, Am-241, Cs-134, Cs-137, Co-60, Eu-152, Eu-154, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, H-3, U-234, U-235, and U-238.	2
4171	X-Ray Building	Demolished	Radionuclides associated with nearby Building 4011 include: Am-241, Cs-137, Co-60, Eu-152, Eu-154, Pb-210, K-40, Pu-238, Pu-239, Pu-240, Pu-241, Ra-226, Sr-90, Tc-99, Th-230, Th-232, H-3, U-234, U-235, and U-238.	1

Table 3.3 (continued)
Summary of Subarea HSA-5B Sites
Potential Radiological Contaminants of Concern

Site No.	Use(s)	Current Status	Potential Radiological Contaminants of Concern	Preliminary MARSSIM Class
4172	X-Ray Building	Demolished	Radionuclides associated with nearby Building 4011 include: Am-241, Cs-137, Co-60, Eu-152, Eu-154, Pb-210, K-40, Pu-238, Pu-239, Pu-240, Pu-241, Ra-226, Sr-90, Tc-99, Th-230, Th-232, H-3, U-234, U-235, and U-238.	2
4226	SCTL Motor Generator Building	Demolished	Radionuclides associated with potential drainage from Buildings 4010 and 4012 include: Sb-125, Am-241, Cs-134, Cs-137, Co-60, Eu-152, Eu-154, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, H-3, U-234, U-235, and U-238.	2
4228	Sodium Component Test Installation (SCTI) Power Pak Building, SCTI Co-Generation Plant	Demolished	Radionuclides associated with Building 4012 include: Sb-125, Am-241, Cs-137, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, U-234, U-235, and U-238.	1
4293	Time Clock	Demolished	Radionuclides associated with potential drainage from Buildings 4010 and 4012 include: Sb-125, Am-241, Cs-134, Cs-137, Co-60, Eu-152, Eu-154, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, H-3, U-234, U-235, and U-238.	2
4310	Portable Change Room	Demolished	Radionuclides associated with potential drainage from Buildings 4010 and 4012 include: Sb-125, Am-241, Cs-134, Cs-137, Co-60, Eu-152, Eu-154, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, H-3, U-234, U-235, and U-238.	1 for original location near SNAP building / 2 for final location near SCTL building
4334	Kalina Cycle Demonstration Power Plant Control Room	Demolished	Radionuclides associated with potential drainage from Building 4019 include: Am-241, Cs-137, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, U-234, U-235, and U-238.	2
4335	Kalina Cycle Demonstration Power Plant Turbine Generator Room	Demolished	Radionuclides associated with potential drainage from Building 4019 include: Am-241, Cs-137, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, U-234, U-235, and U-238.	2

Table 3.3 (continued)
Summary of Subarea HSA-5B Sites
Potential Radiological Contaminants of Concern

Site No.	Use(s)	Current Status	Potential Radiological Contaminants of Concern	Preliminary MARSSIM Class
4354	SCTI Control Element Test Structure	Demolished	Radionuclides associated with nearby Building 4006 include: Cs-137, H-3, U-234, U-235, and U-238. Radionuclides associated with potential drainage from Buildings 4010 and 4012 include: Sb-125, Am-241, Cs-134, Cs-137, Co-60, Eu-152, Eu-154, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, H-3, U-234, U-235, and U-238.	2
4355	SCTI Control Center	Demolished	Potential radioactive contaminants include Co-60 and Cs-137. Radionuclides associated with potential drainage from Buildings 4010 and 4012 include: Sb-125, Am-241, Cs-134, Cs-137, Co-60, Eu-152, Eu-154, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, H-3, U-234, U-235, and U-238.	1
4356	SCTI High Bay	Demolished	A potential radioactive contaminant is Cs-137. Radionuclides associated with potential drainage from Buildings 4010 and 4012 include: Sb-125, Am-241, Cs-134, Cs-137, Co-60, Eu-152, Eu-154, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, H-3, U-234, U-235, and U-238.	1
4357	Heat Transfer Loop Control Building, Liquid Metal Engineering Center (LMEC) and ETEC Pump Bearing Test Facility Control Building	Demolished	Radionuclides associated with potential drainage from Buildings 4010 and 4012 include: Sb-125, Am-241, Cs-134, Cs-137, Co-60, Eu-152, Eu-154, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, H-3, U-234, U-235, and U-238.	2
4358	Chemical Storage Building Supporting SCTL, SCTI, and Kalina	Demolished	Radionuclides associated with potential drainage from Buildings 4010, 4012, and 4019 include: Sb-125, Am-241, Cs-134, Cs-137, Co-60, Eu-152, Eu-154, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, H-3, U-234, U-235, and U-238.	2

Table 3.3 (continued)
Summary of Subarea HSA-5B Sites
Potential Radiological Contaminants of Concern

Site No.	Use(s)	Current Status	Potential Radiological Contaminants of Concern	Preliminary MARSSIM Class
4359	SCTI Atomizing Air Building	Demolished	Radionuclides associated with potential drainage from Buildings 4010 and 4012 include: Sb-125, Am-241, Cs-134, Cs-137, Co-60, Eu-152, Eu-154, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, H-3, U-234, U-235, and U-238.	2
4360	SCTI Chemical Storage Building	Demolished	Radionuclides associated with potential drainage from Building 4019 include: Am-241, Cs-137, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, U-234, U-235, and U-238.	2
4361	SCTI Hazardous Material Storage Building	Demolished	Radionuclides associated with potential drainage from Building 4019 include: Am-241, Cs-137, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, U-234, U-235, and U-238.	2
4362	SCTI Water Sampling Building	Demolished	Radionuclides associated with potential drainage from Buildings 4010 and 4012 include: Sb-125, Am-241, Cs-134, Cs-137, Co-60, Eu-152, Eu-154, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, H-3, U-234, U-235, and U-238.	2
4392	SCTI Electrical Equipment Building	Demolished	Radionuclides associated with potential drainage from Buildings 4010 and 4012 include: Sb-125, Am-241, Cs-134, Cs-137, Co-60, Eu-152, Eu-154, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, H-3, U-234, U-235, and U-238.	2
4402	MHD Experiment Building	Demolished	Radionuclides associated with nearby Building 4006 include: Cs-137, H-3, U-234, U-235, and U-238. Radionuclides associated with potential drainage from Buildings 4010 and 4012 include: Sb-125, Am-241, Cs-134, Cs-137, Co-60, Eu-152, Eu-154, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, H-3, U-234, U-235, and U-238.	2
4457	SCTI Pump Bearing Test Structure	Demolished	Radionuclides associated with potential drainage from Buildings 4010 and 4012 include: Sb-125, Am-241, Cs-134, Cs-137, Co-60, Eu-152, Eu-154, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, H-3, U-234, U-235, and U-238.	2

Table 3.3 (continued)
Summary of Subarea HSA-5B Sites
Potential Radiological Contaminants of Concern

Site No.	Use(s)	Current Status	Potential Radiological Contaminants of Concern	Preliminary MARSSIM Class
4478	SCTI Support Trailer	Demolished	Radionuclides associated with potential drainage from Buildings 4010 and 4012 include: Sb-125, Am-241, Cs-134, Cs-137, Co-60, Eu-152, Eu-154, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, H-3, U-234, U-235, and U-238.	2
4500	Gas Bottle Dock	Demolished	Radionuclides associated with nearby Building 4011 include: Am-241, Cs-137, Co-60, Eu-152, Eu-154, Ir-192, Pb-210, K-40, Pu-238, Pu-239, Pu-240, Pu-241, Ra-226, Sr-90, Tc-99, Th-230, Th-232, H-3, U-234, U-235, and U-238.	2
4502	Parking Lot	Demolished	Radionuclides associated with potential drainage from Building 4019 include: Am-241, Cs-137, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, U-234, U-235, and U-238.	2
4506	Parking Lot	Demolished	Radionuclides associated with nearby Building 4006 include: Cs-137, H-3, U-234, U-235, and U-238. Radionuclides associated with potential drainage from Buildings 4010 and 4012 include: Sb-125, Am-241, Cs-134, Cs-137, Co-60, Eu-152, Eu-154, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, H-3, U-234, U-235, and U-238.	2
4521	Parking Lot	Demolished	Radionuclides associated with nearby Building 4011 include: Am-241, Cs-137, Co-60, Eu-152, Eu-154, Ir-192, Pb-210, K-40, Pu-238, Pu-239, Pu-240, Pu-241, Ra-226, Sr-90, Tc-99, Th-230, Th-232, H-3, U-234, U-235, and U-238.	2
4606	Sodium Lab Instrument Building A, MHD Support Building, Hydrogen Recombiner Test Building	Demolished	Radionuclides associated with nearby Building 4006 include: Cs-137, H-3, U-234, U-235, and U-238. Radionuclides associated with potential drainage from Buildings 4010 and 4012 include: Sb-125, Am-241, Cs-134, Cs-137, Co-60, Eu-152, Eu-154, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, H-3, U-234, U-235, and U-238.	2

Table 3.3 (continued)
Summary of Subarea HSA-5B Sites
Potential Radiological Contaminants of Concern

Site No.	Use(s)	Current Status	Potential Radiological Contaminants of Concern	Preliminary MARSSIM Class
4607	Sodium Lab Instrument Building B	Demolished	Radionuclides associated with nearby Building 4006 include: Cs-137, H-3, U-234, U-235, and U-238. Radionuclides associated with potential drainage from Buildings 4010 and 4012 include: Sb-125, Am-241, Cs-134, Cs-137, Co-60, Eu-152, Eu-154, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, H-3, U-234, U-235, and U-238.	2
4611	Paint Spray Booth Canopy	Demolished	Radionuclides associated with nearby Building 4011 include: Am-241, Cs-137, Co-60, Eu-152, Eu-154, Ir-192, Pb-210, K-40, Pu-238, Pu-239, Pu-240, Pu-241, Ra-226, Sr-90, Tc-99, Th-230, Th-232, H-3, U-234, U-235, and U-238.	2
4612	Maintenance Building	Demolished	Radionuclides associated with nearby Building 4011 include: Am-241, Cs-137, Co-60, Eu-152, Eu-154, Ir-192, Pb-210, K-40, Pu-238, Pu-239, Pu-240, Pu-241, Ra-226, Sr-90, Tc-99, Th-230, Th-232, H-3, U-234, U-235, and U-238.	2
4615	Combustion Test Facility	Demolished	Radionuclides associated with nearby Building 4006 include: Cs-137, H-3, U-234, U-235, and U-238. Radionuclides associated with potential drainage from Buildings 4010, 4012, and 4024 include: Sb-125, Am-241, Cs-134, Cs-137, Co-60, Eu-152, Eu-154, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, H-3, U-234, U-235, and U-238.	2
4639	Industrial Engineering Office Trailer Complex	Demolished/ May Not Have Been Built	Radionuclides associated with nearby Building 4011 include: Am-241, Cs-137, Co-60, Eu-152, Eu-154, Ir-192, Pb-210, K-40, Pu-238, Pu-239, Pu-240, Pu-241, Ra-226, Sr-90, Tc-99, Th-230, Th-232, H-3, U-234, U-235, and U-238.	2

Table 3.3 (continued)
Summary of Subarea HSA-5B Sites
Potential Radiological Contaminants of Concern

Site No.	Use(s)	Current Status	Potential Radiological Contaminants of Concern	Preliminary MARSSIM Class
4704	Electrical Substation	Standing	Radionuclides associated with drainage from Buildings 4005, 4006, 4010, 4012, and 4024 include: Sb-125, Am-241, Cs-134, Cs-137, Co-60, Eu-152, Eu-154, Mn-54, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, H-3, U-234, U-235, U-238, and UO_2.	2
4714	Power Pak Interconnecting Facility	Demolished	Radionuclides associated with nearby Building 4006 include: Cs-137, H-3, U-234, U-235, and U-238. Radionuclides associated with potential drainage from Buildings 4010 and 4012 include: Sb-125, Am-241, Cs-134, Cs-137, Co-60, Eu-152, Eu-154, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, H-3, U-234, U-235, and U-238.	2
4735	Fuel Tank	Demolished	Radionuclides associated with nearby Building 4011 include: Am-241, Cs-137, Co-60, Eu-152, Eu-154, Ir-192, Pb-210, K-40, Pu-238, Pu-239, Pu-240, Pu-241, Ra-226, Sr-90, Tc-99, Th-230, Th-232, H-3, U-234, U-235, and U-238.	2
4826	Large Component Test Loop Facility	Demolished	Radionuclides associated with nearby Building 4006 include: Cs-137, H-3, U-234, U-235, and U-238. Radionuclides associated with potential drainage from Buildings 4010 and 4012 include: Sb-125, Am-241, Cs-134, Cs-137, Co-60, Eu-152, Eu-154, Pu-238, Pu-239, Pu-240, Pu-241, Sr-90, H-3, U-234, U-235, and U-238.	2
17th Street Drainage	Natural Drainage Area Bermed to Create Holding Pond	Dry, Overgrown	Potential radioactive contaminants include: Am-241, Cs-137, Pu-238, Pu-239, Pu-240, Sr-90, Th-228, Th-230, Th-232, U-234, U-235, U-236, and U-238.	1

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4.0 REACTOR/CRITICALITY FACILITIES/SIGNIFICANT SITES WORKS CITED

4.1 BUILDING 4010

Facility Name	Building No.	Period of Operation	Notes
Systems for Nuclear Auxiliary Power (SNAP) Experimental Reactor Facility (SER) / SNAP 8 ER	4010	1959 - 1965	

Building 4010 Cited Documents

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Stelle, A.M., *S8ER Facilities Decommissioning Final Report, ESG-DOE-13237*, Rockwell International, Atomics International Division, Energy Systems Group, February 28, 1979.

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4.2 BUILDING 4012

Facility Name	Building No.	Period of Operation	Notes
Systems for Nuclear Auxiliary Power (SNAP) Critical Test Facility	4012	1961 - 1971	

Building 4012 Cited Documents

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4.3 BUILDING 4019

Facility Name	Building No.	Period of Operation	Notes
Systems for Nuclear Auxiliary Power (SNAP) Flight System Facility	4019	1963 - 1965	

Building 4019 Cited Documents

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Vitkus, T.J. and Bright, T.L., *Verification Survey of Buildings T019 and T024 Santa Susana Field Laboratory, Rockwell International, Ventura County, California*, Oak Ridge Institute for Science and Education, February 1996.

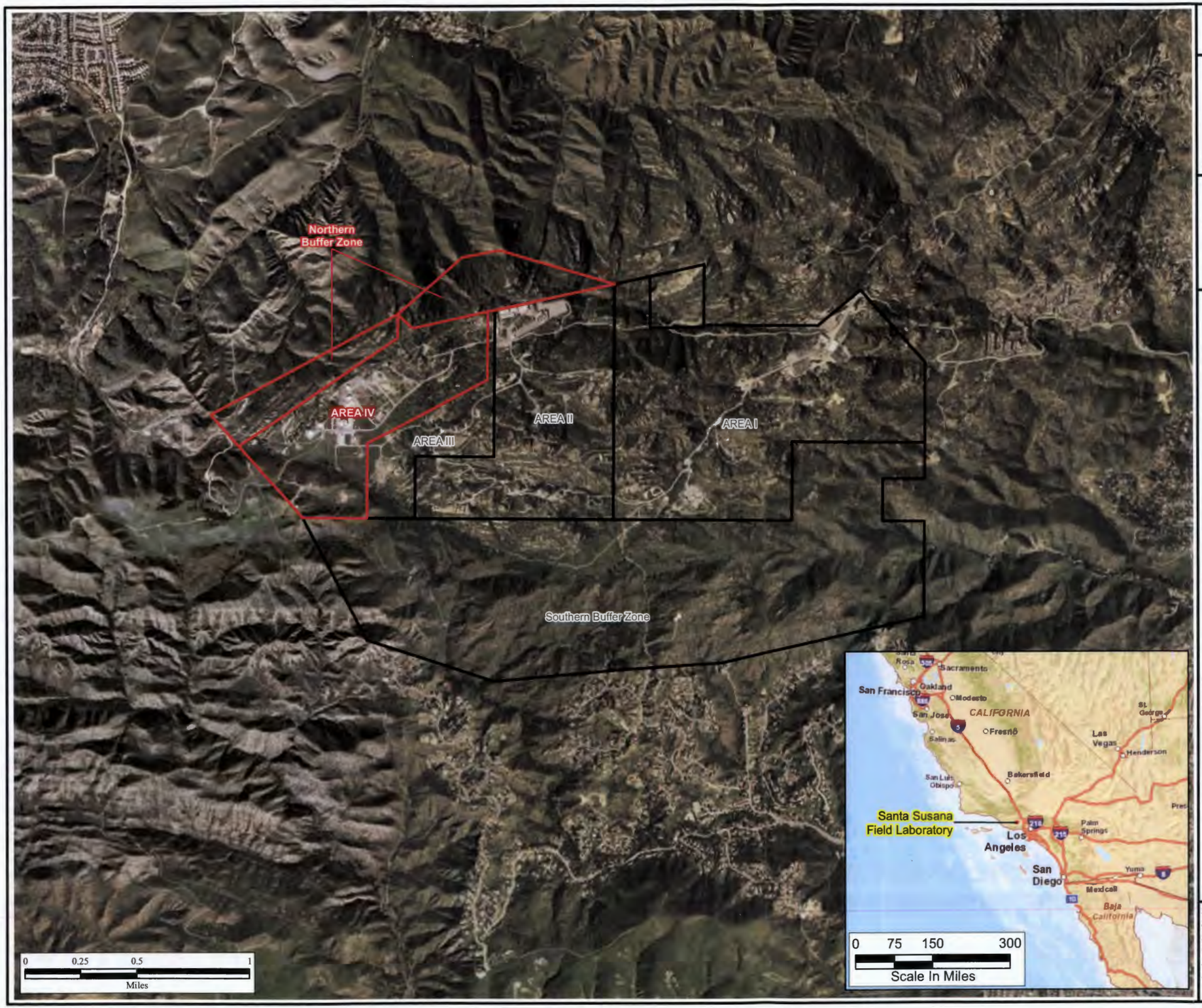
FIGURES

PARTIALLY SCANNED
OVERSIZE ITEM(S)

See document # 2266487
for partially scanned image(s).
PLATE 1
SUBAREA HSA - 5B
For complete hardcopy version of the oversize document
contact the Region IX Superfund Records Center

Figure 1.1
Site Location
Santa Susana Field Laboratory

U.S. EPA Region 9



Legend

- EPA Study Area Boundary; Area IV and Northern Buffer Zone
- Santa Susana Field Laboratory Property Boundary

N

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Revised: 09/03/2010 TJ
Sorce: CaSil, NAIP 2009; Boeing 2008

HGL HydroGeoLogic, Inc.

Redacted

Figure 1.2
General Site Layout for
Area IV/HSA Subareas
Santa Susana Field Laboratory

U.S. EPA Region 9

Legend

HSA Subarea

Buildings

Existing

Removed

N

0 250 500 1000

Scale In Feet

Filepath: Y:\Santa_Susana\EP9038\TM\HSA_5B\(1-02)site_layout.mxd
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Created: CLimoges
Revised: 09/03/2010 TJ
Sorce: Boeing Company, 2008
CIRGIS, 2007

HGL

Redacted

Figure 1.3
Subarea HSA-5B
Santa Susana Field Laboratory

U.S. EPA Region 9

Legend

Buildings

- Existing
- Removed

- Surface Water
- Lined Channel
- Intermittent Stream*
- Pipe (Unknown Type)

*Intermittent streams also represent unlined channels.

N

0 50 100 200
Scale In Feet

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HGL HydroGeoLogic, Inc.

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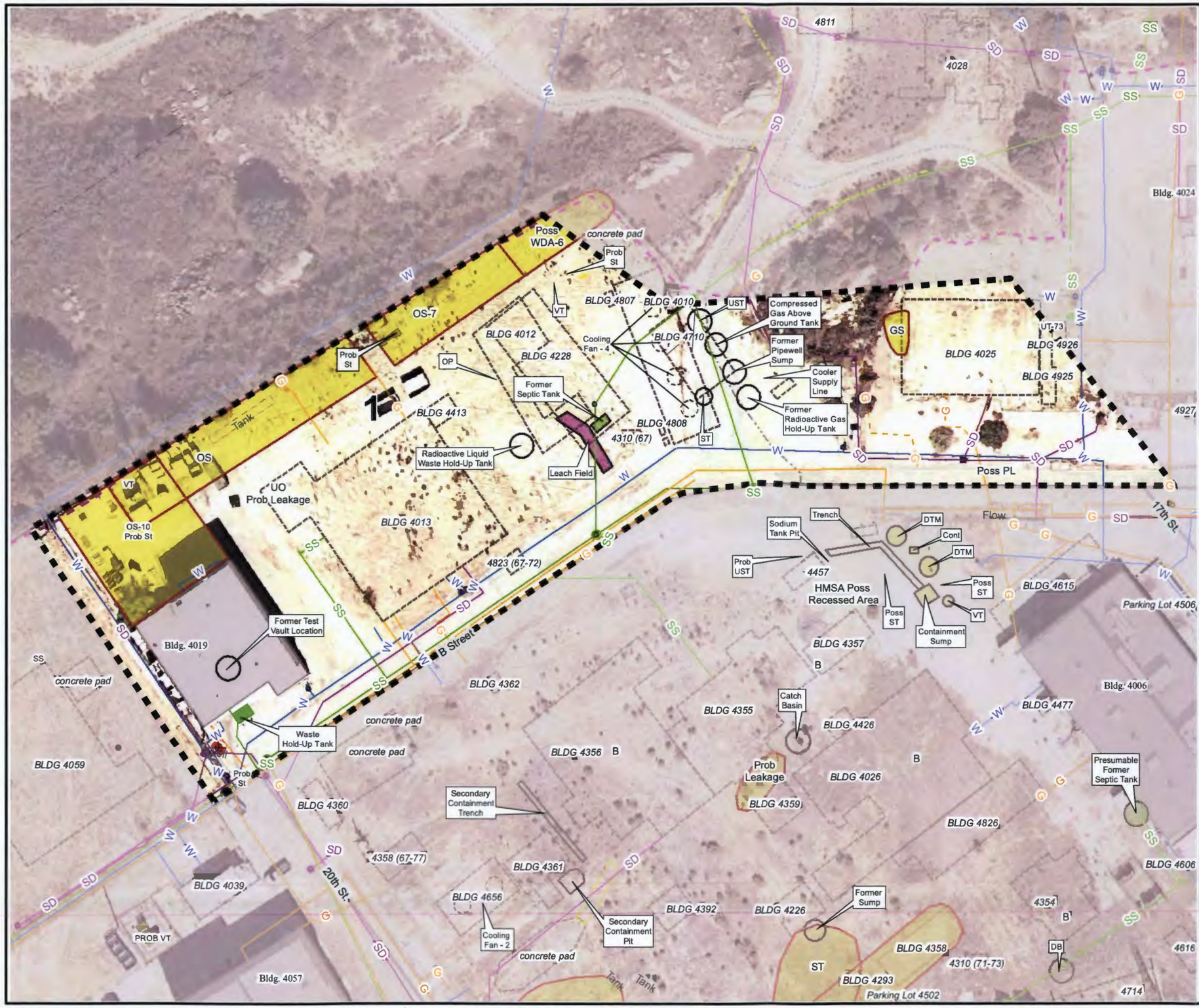

Historical Site Assessment
Final Technical Memorandum - HSA-5B

Figure 2.1
Area IV Subarea 5B-1
Santa Susana Field Laboratory

U.S. EPA Region 9

Legend

- Subarea 5B-1 Boundary
- Primary Roads
- Secondary Roads
- Underground Storage Tank
- Unknown Tank Type
- Sump
- Dry Well
- Tank Footprint
- Above ground Storage Tank
- Demolished Bldg.
- Existing Bldg.
- Parking Lots
- Drainage
- Drain
- Well

Aerial Photo Features

- Aerial Photography Features
- Leach Field
- Other

Surface Water

- Intermittent Stream
- Permanent Stream
- Surface Water
- Lined Channel
- French Drain
- Drainage
- Leach Field
- Septic System

Utilities

- Channel
- Drain
- Drain
- Drainage Divide
- Gutter
- Tank
- Tank
- Vault
- Well
- Gas
- Storm Drain
- Sanitary Sewer
- Water

B	Building
CONT	Container
CR	Crates
DB	Debris
DG	Disturbed Ground
DTM	Dark Tone Material
EX	Excavation
FA	Fill Area
GS	Ground Scar
HT	Horizontal Tank
IM	Impoundment
MTMM	Medium Toned Mounded Material
OS	Open Storage
PA	Processing Area
PL	Parking Lot
POSS	Possible
PROB	Probable
S-T	Storage Tank
SS	Smoke Stack
ST	Storage
UO	Unidentified Object
VT	Vertical Tank
WDA	Waste Disposal Area

N

0 25 50 100
Scale In Feet

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CIRGIS, 2007

HGL HydroGeoLogic, Inc.

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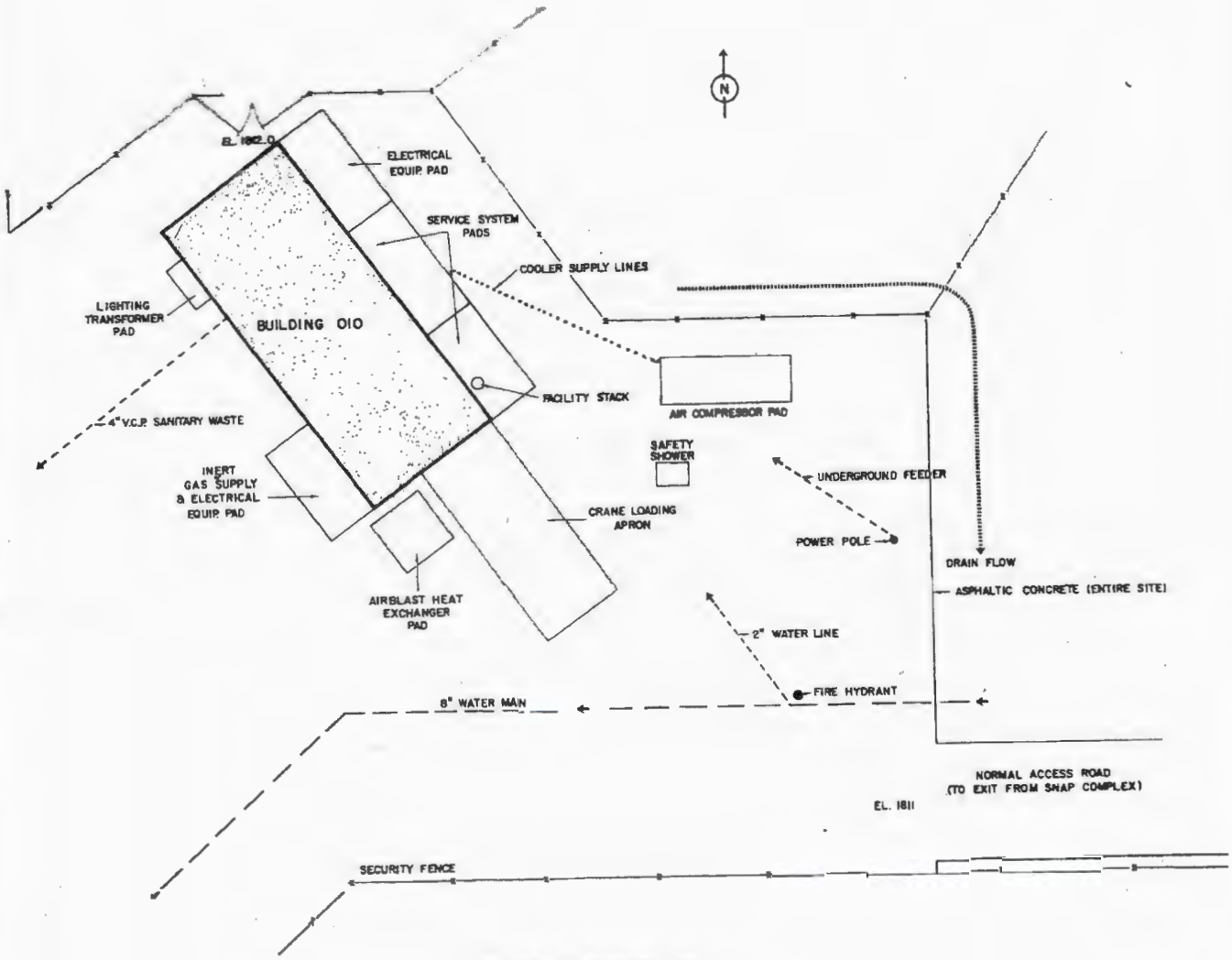
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.1a
Building 4010
Site Photograph



Building 4010 Plot Plan

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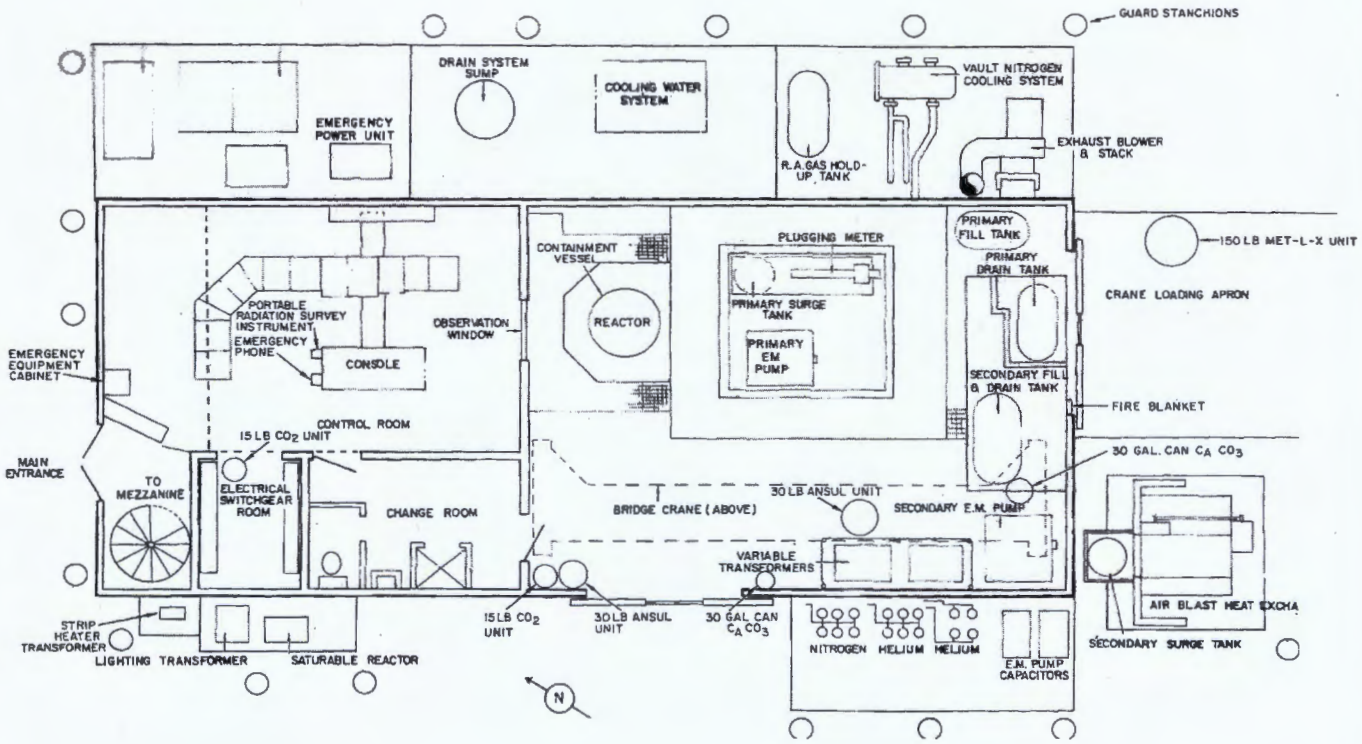
U.S. EPA Region 9

Figure 2.1.1b
Building 4010
Plot Plan



SNAP 8 Experimental Reactor Building 4010

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Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.1c
Building 4010
Floor Plan

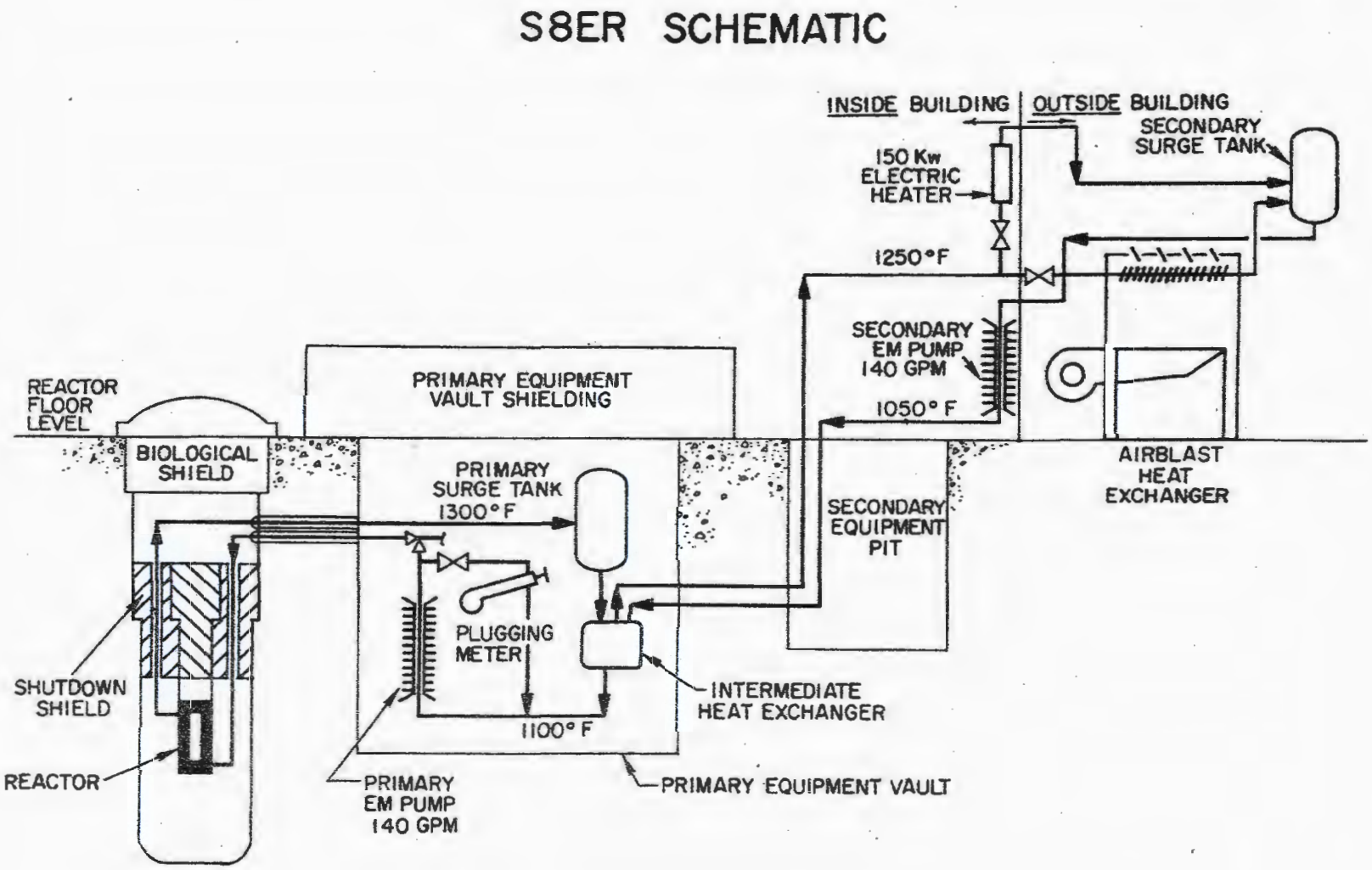

Figure Not to Scale

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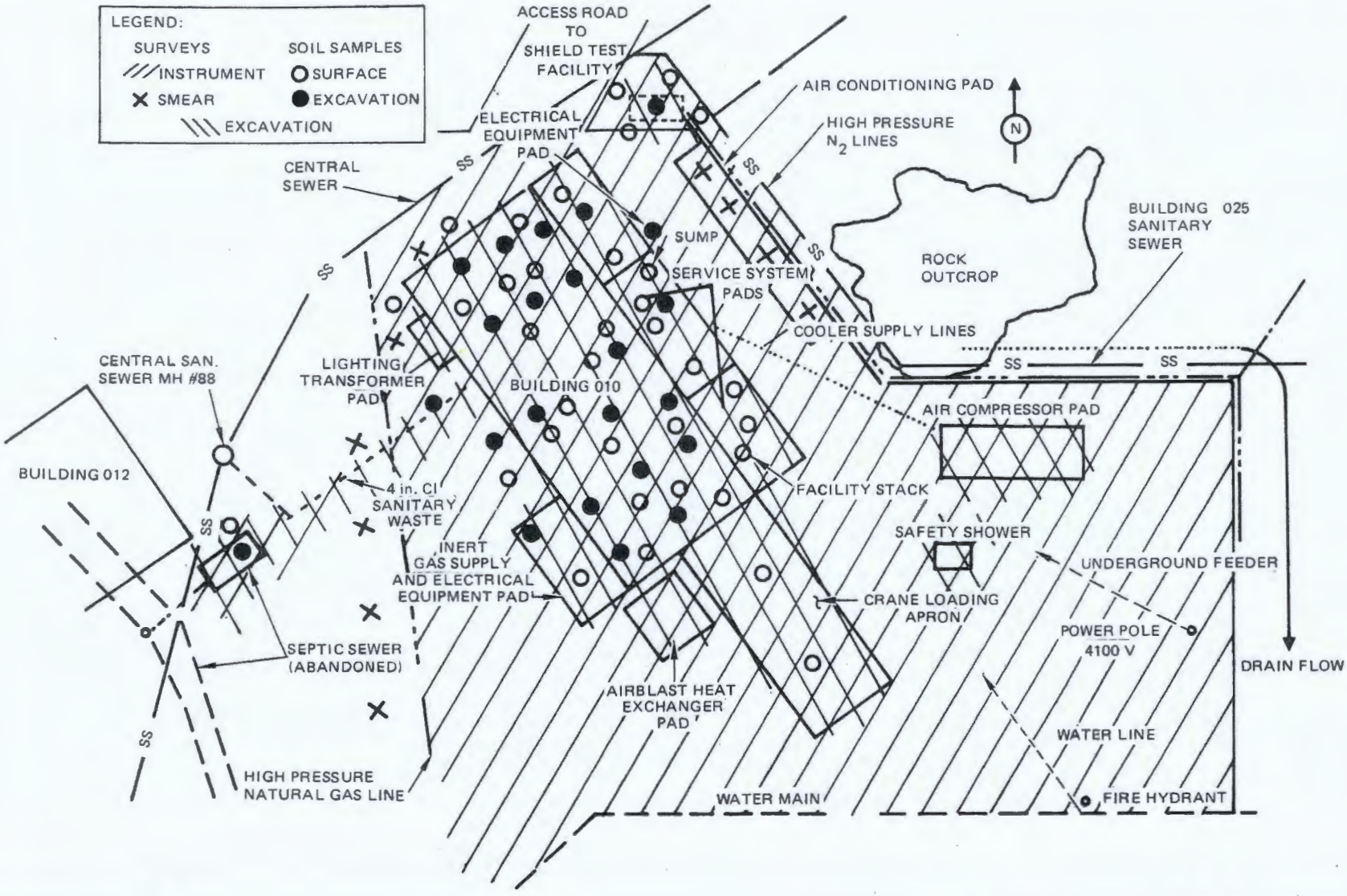
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.1d
SNAP 8 ER
Schematic Diagram



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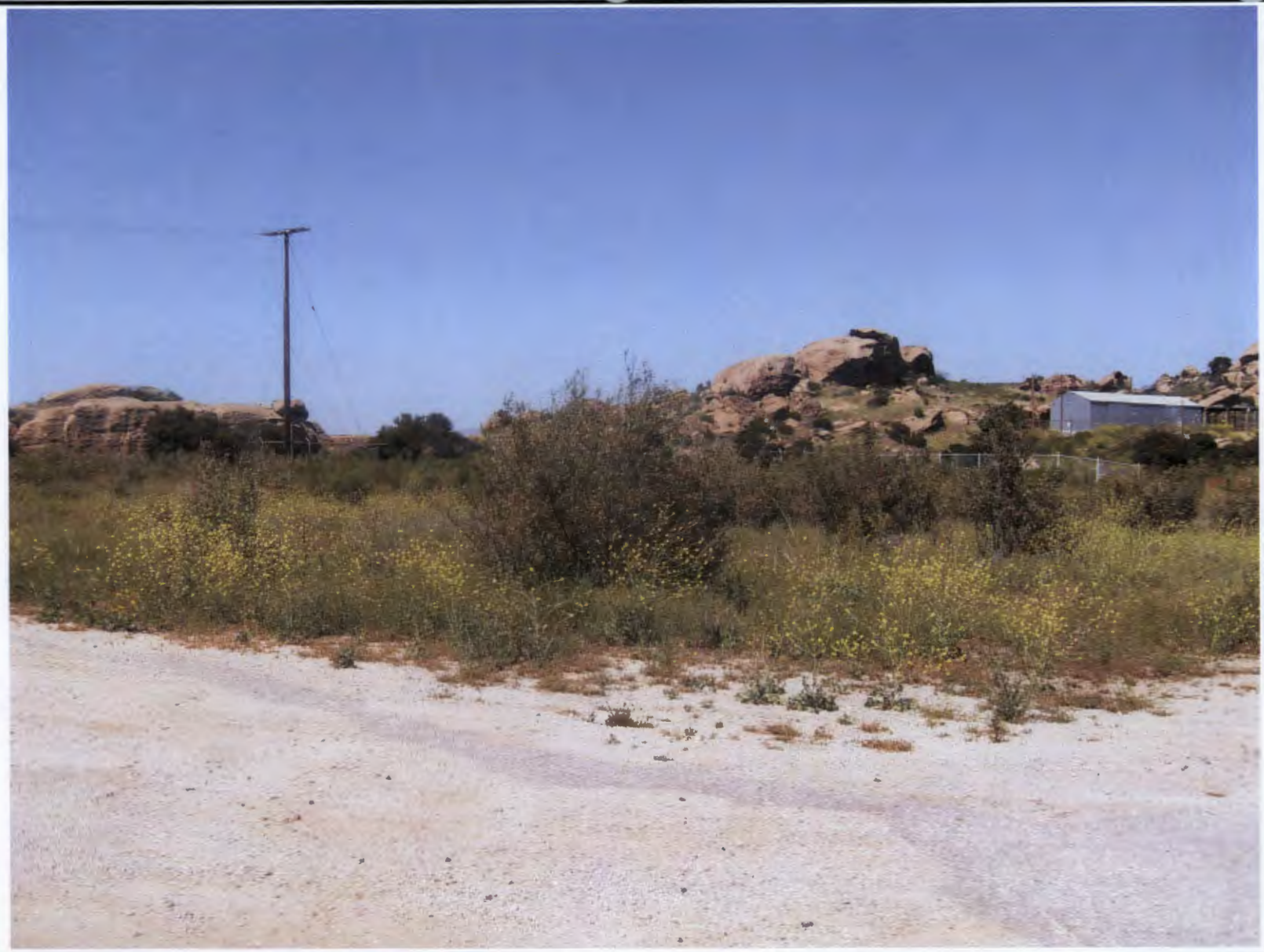
U.S. EPA Region 9

Figure 2.1.1.e
S8ER Faculty Survey Plot



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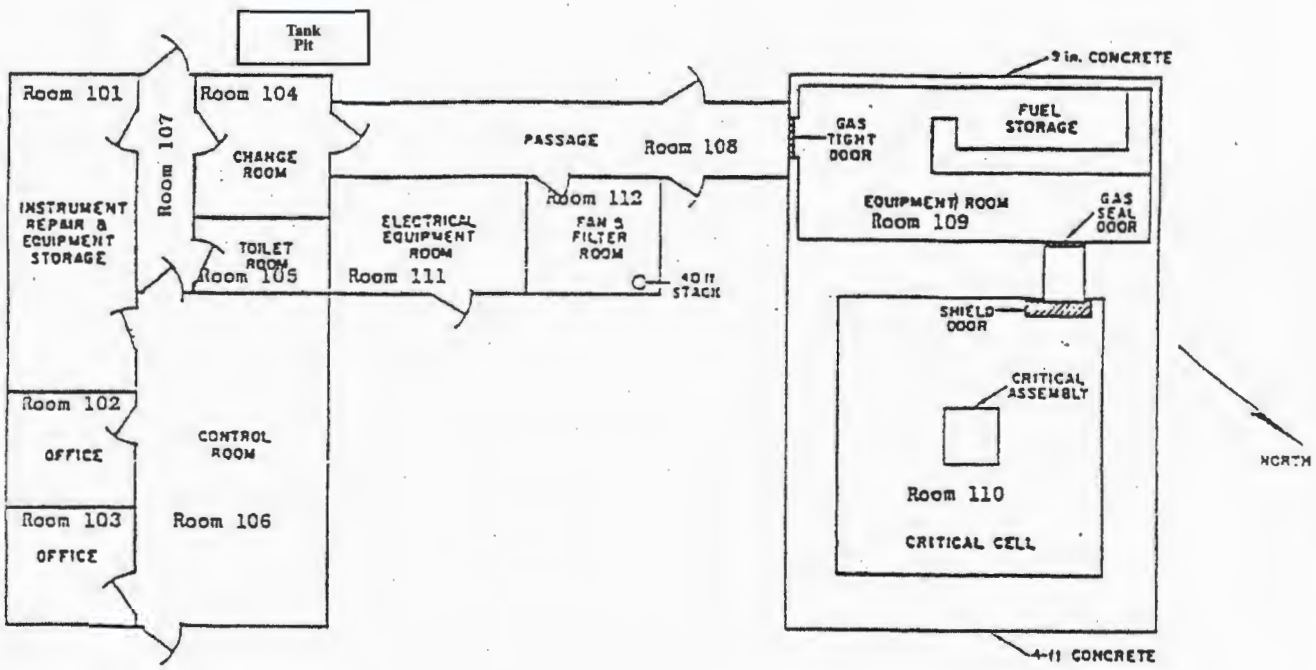
U.S. EPA Region 9

Figure 2.1.2a
Building 4012
Site Photograph



Original Building 4012 Floor Plan

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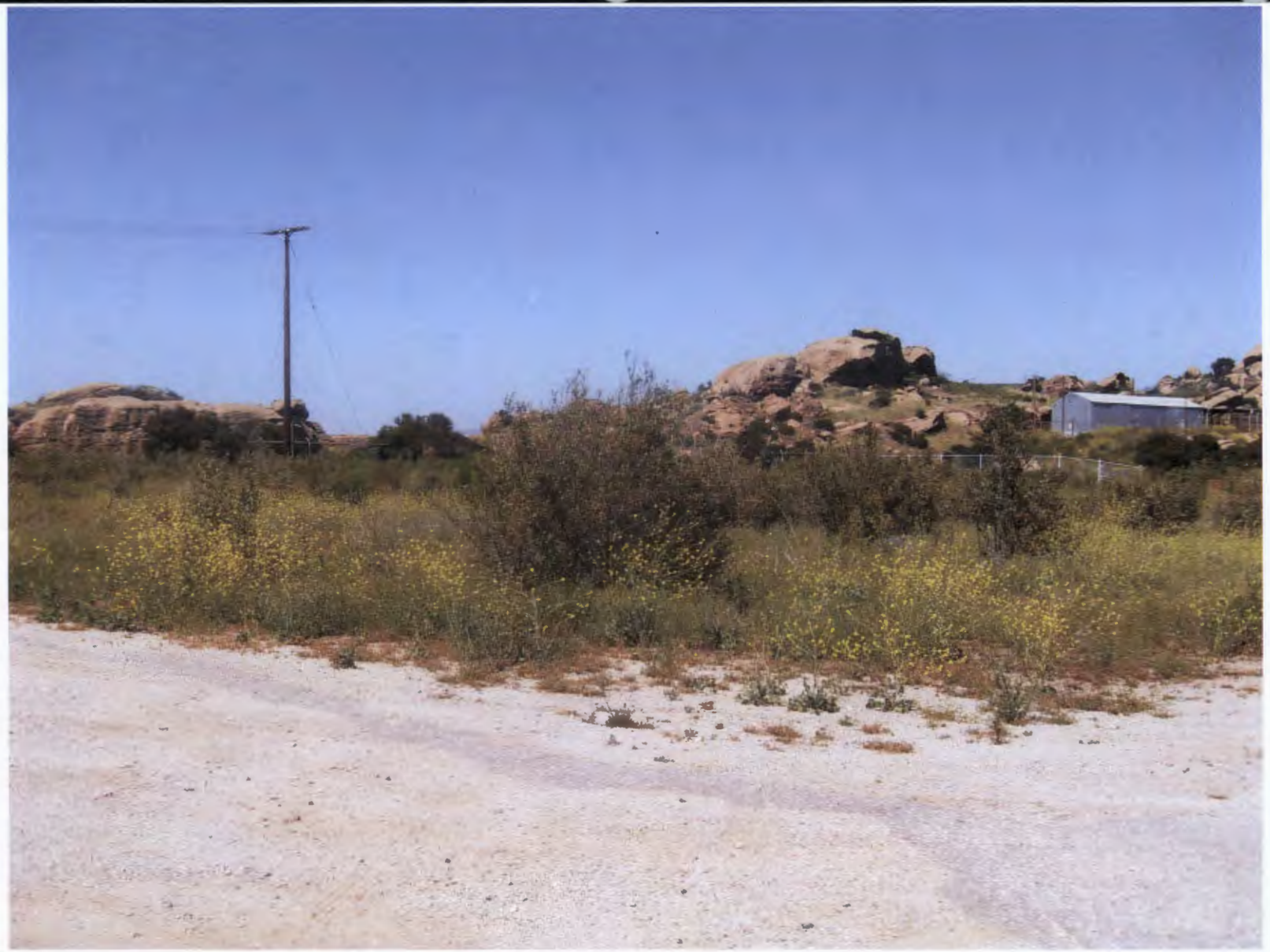
Revised: 09/07/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.2b Building 4012 Floor Plan



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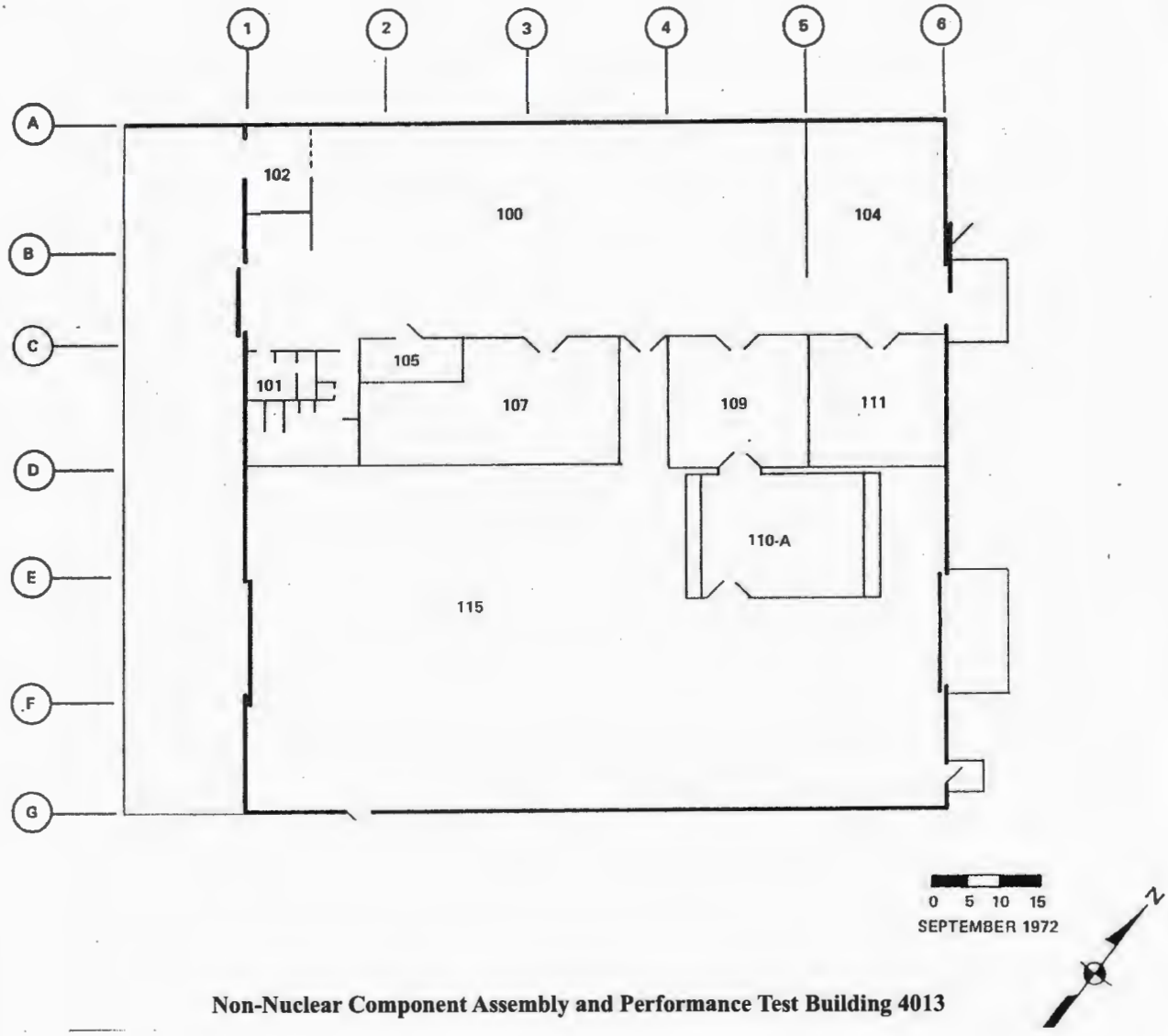
U.S. EPA Region 9

Figure 2.1.3a
Building 4013
Site Photograph



Non-Nuclear Component Assembly and Performance Test Building 4013

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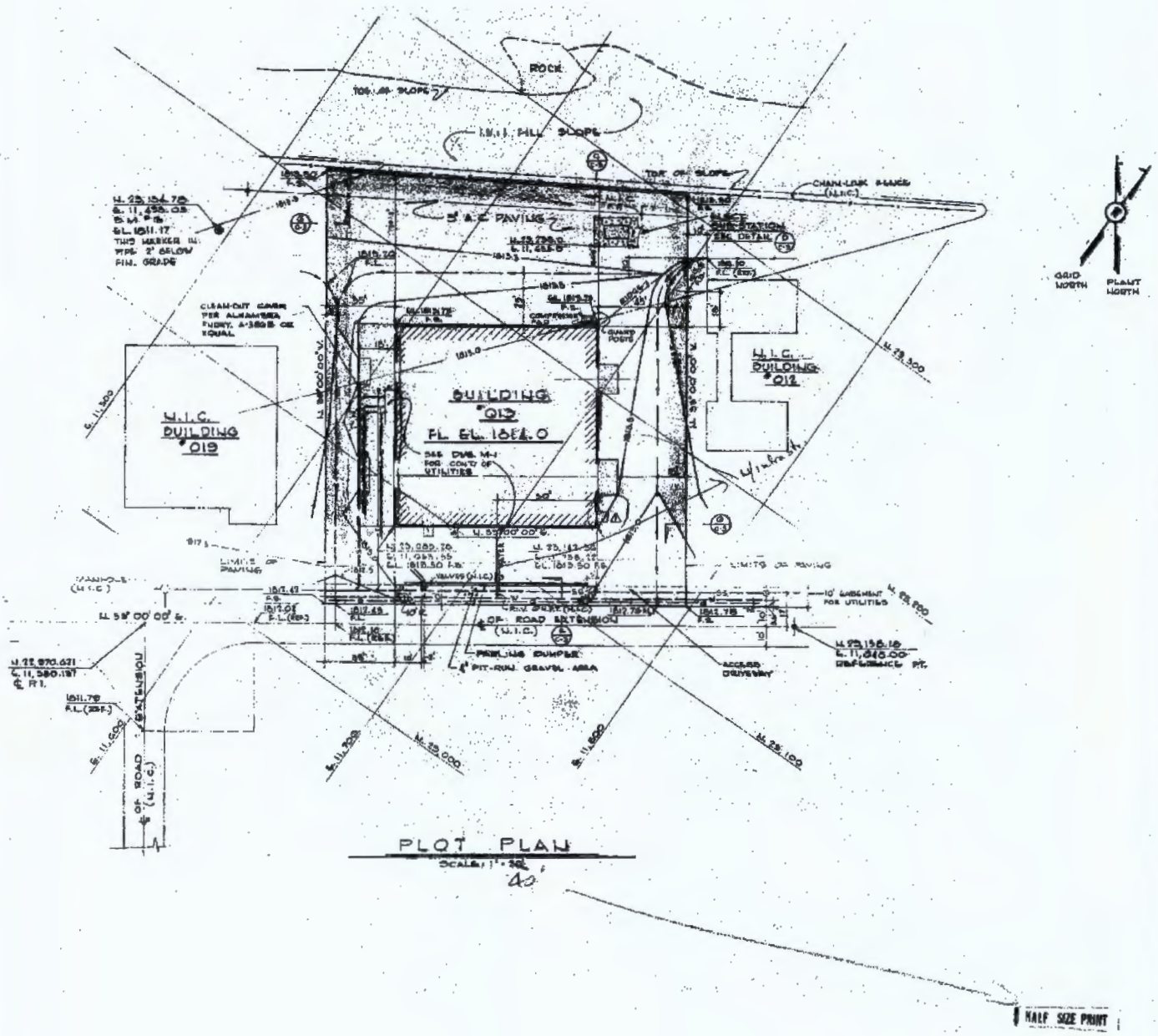
U.S. EPA Region 9

Figure 2.1.3b
Building 4013
Floor Plan



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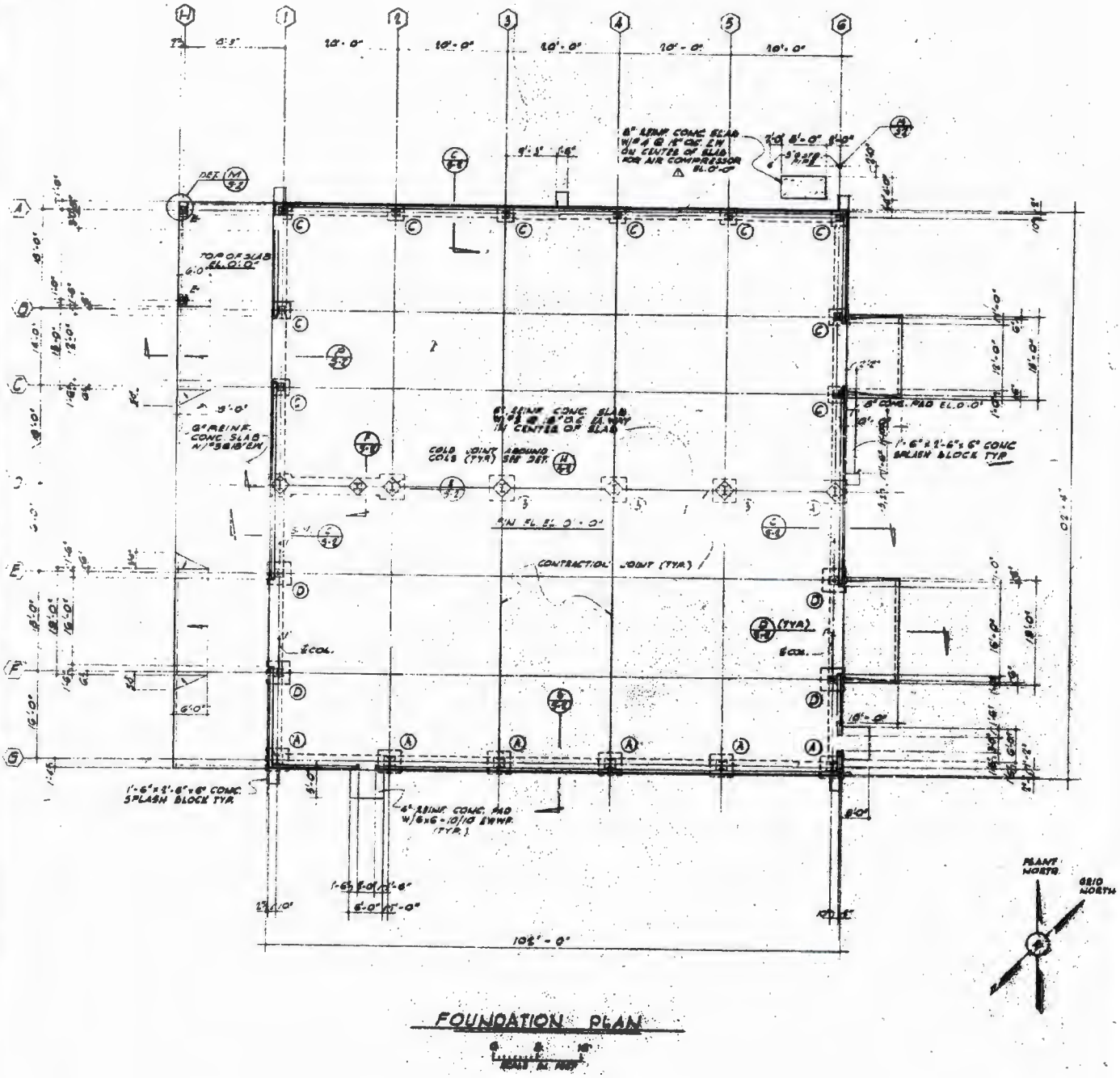
Revised: 05/03/2010 JP
Source: Boeing Company, 2008

U.S. EPA Region 9

LEGEND:

U.I.C. NOT IN CONTRACT
DIRECTION OF FLOW
P.M. POWER POLE
A.C. PAVING
SS — 8" V.C.P. SANITARY SEWER (U.I.C.)
F.S. FINISHED SURFACE
F.L. FLOW LINE
M.H. MANHOLE
1015 FINISHED SURFACE CONTOUR
1015 EXIST. GRADES
P.I.V. POST INDICATOR VALVE

Figure 2.1.3c
Building 4013
Plot Plan



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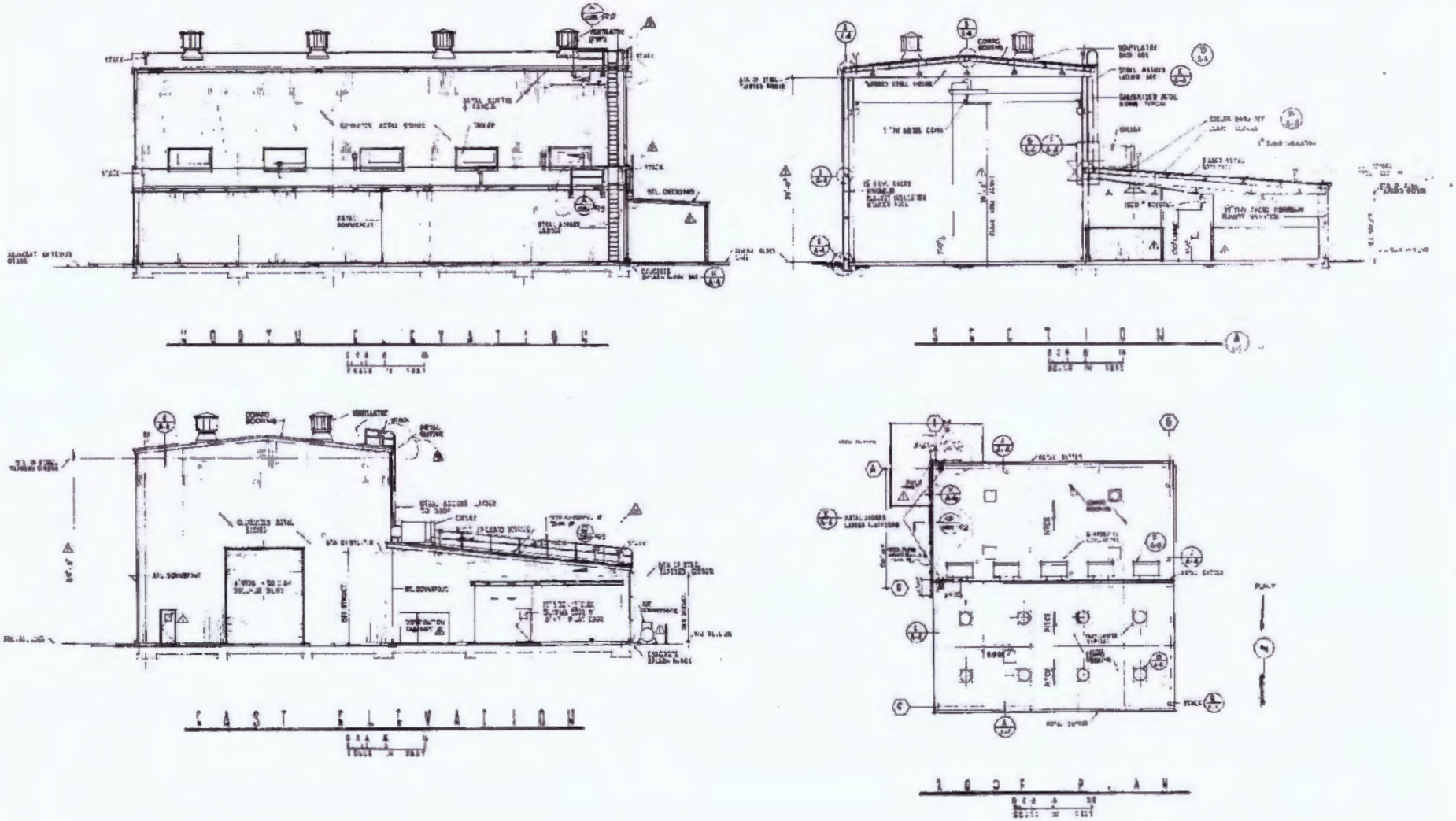
Revised: 05/03/2010 JP
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure2.1.3d
Building 4013
Foundation Plan



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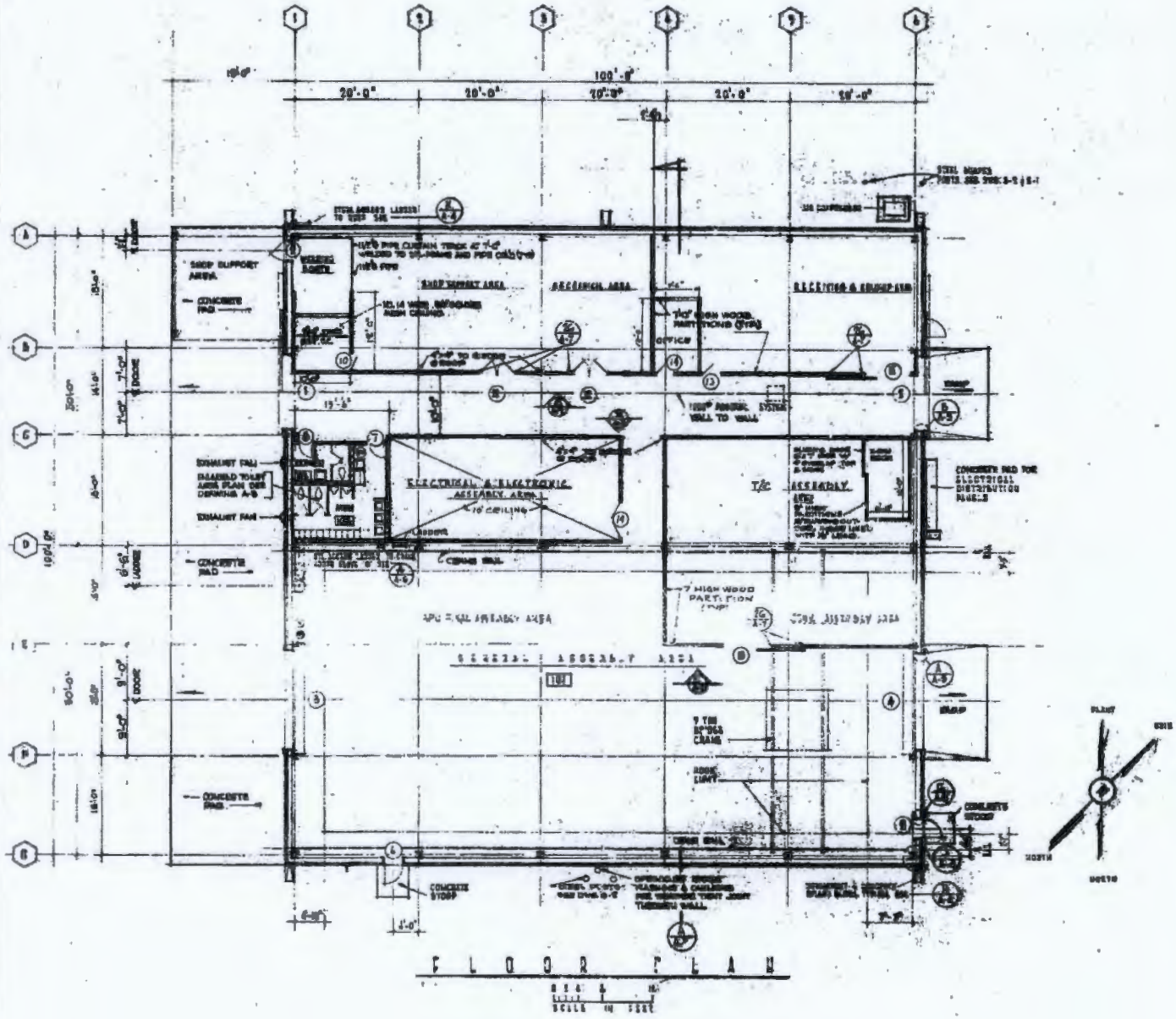
Revised: 09/07/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.3e
Building 4013
Elevations and Roof



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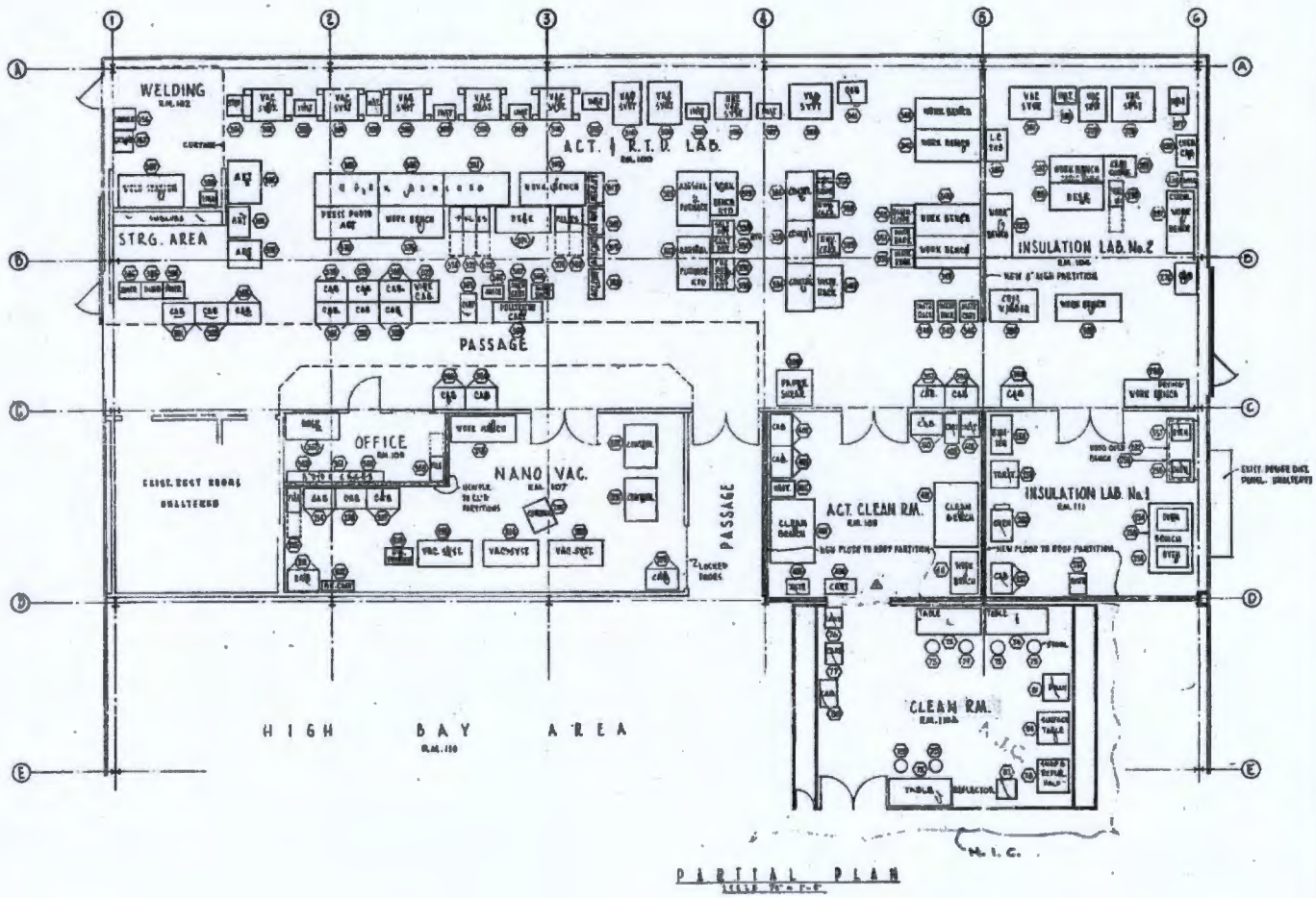
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.3f
Building 4013
Floor Plan



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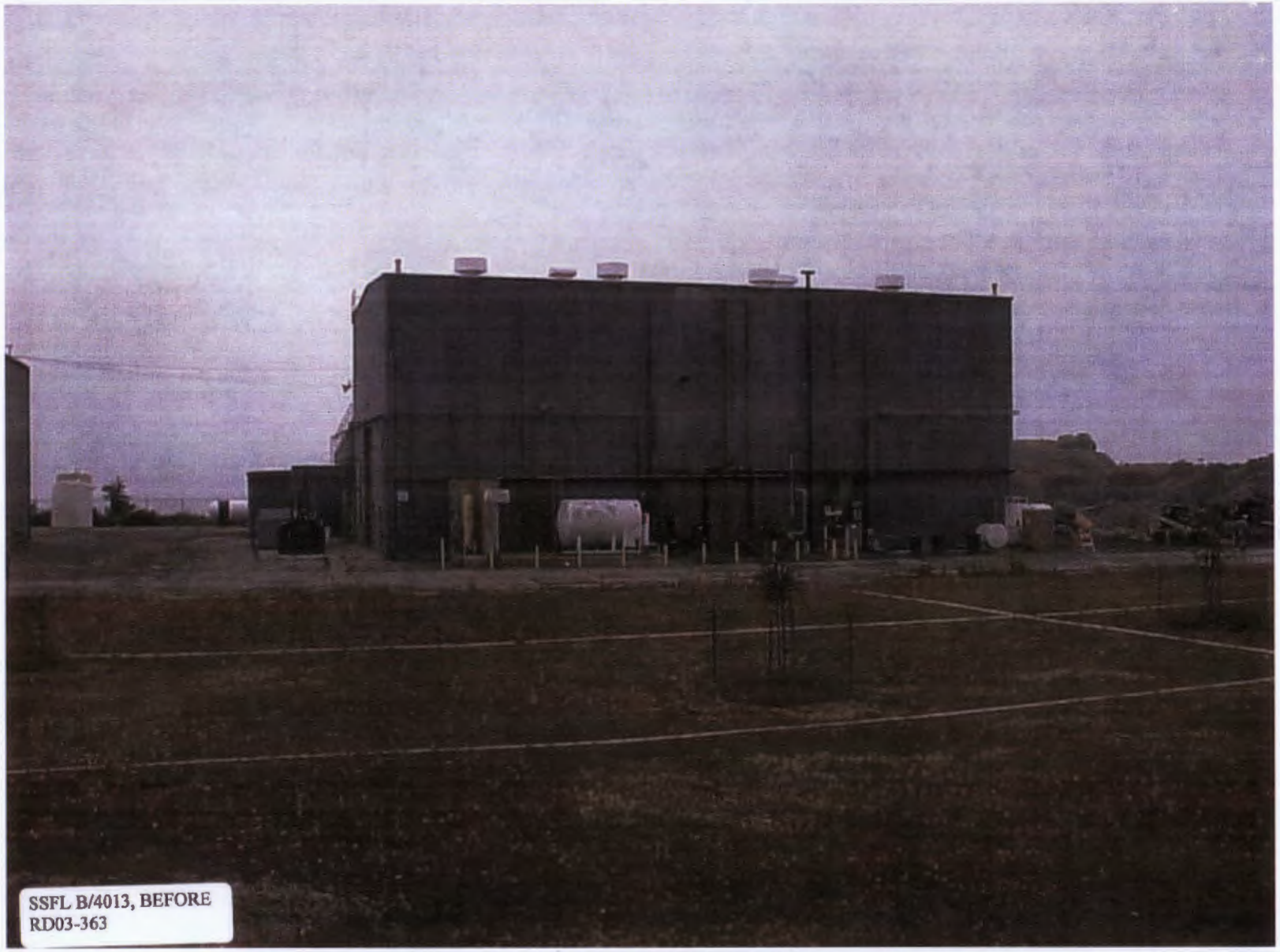
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.3g Building 4013 Reactor Development Plan



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Revised: 09/07/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.3h
Building 4013
Before Demolition
Photograph

Y:/Santa_Susana/EP9038/TM/HSA_5B
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Project:EP9038
Revised: 06/24/2010 RB
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.3i
Building 4013
After Demolition
Photograph

Y:/Santa_Susana/EP9038/TM/HSA_5B (2-1-4a)bldg4019.cdr
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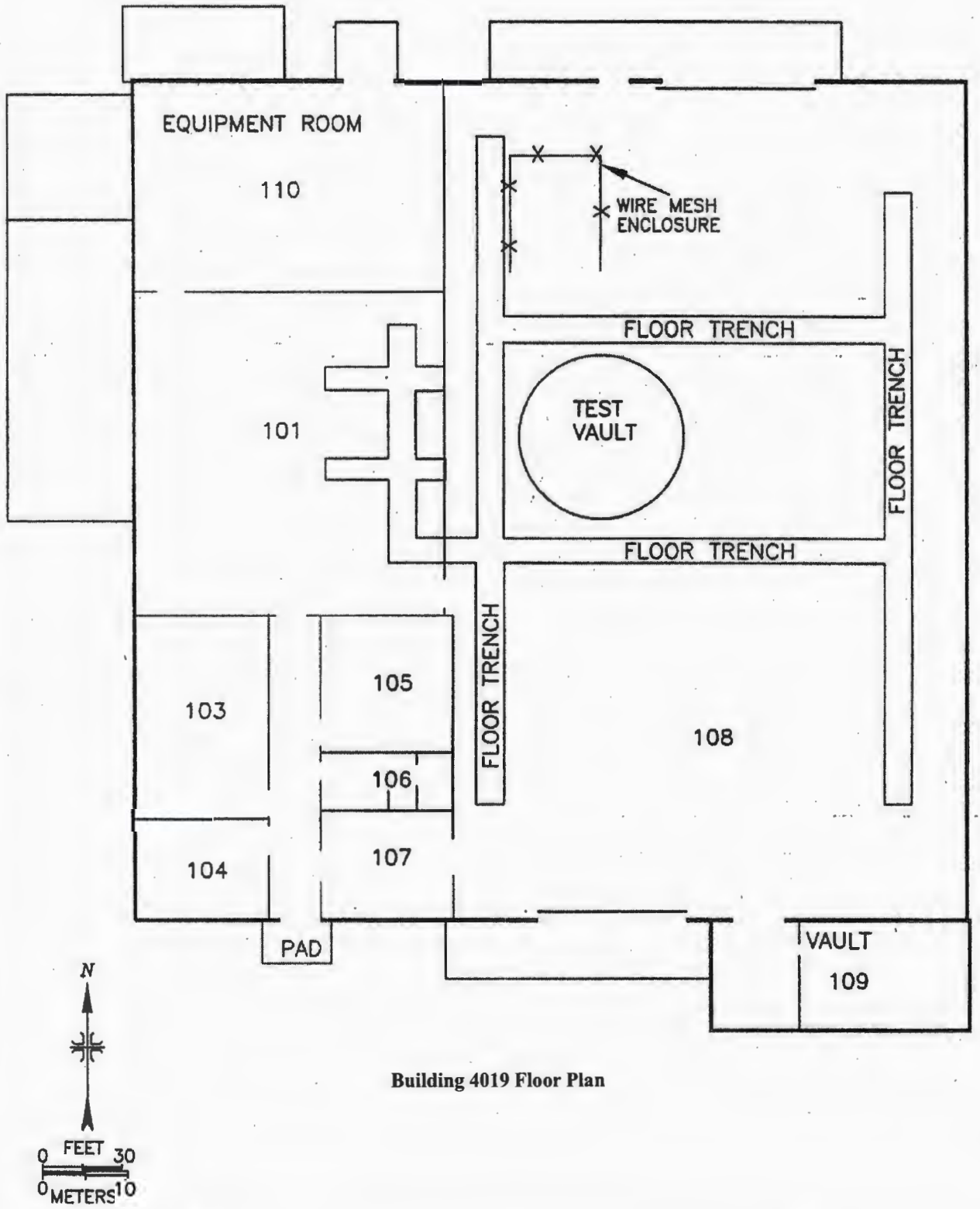
Revised: 09/07/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.4a
Building 4019
Site Photograph



Building 4019 Floor Plan

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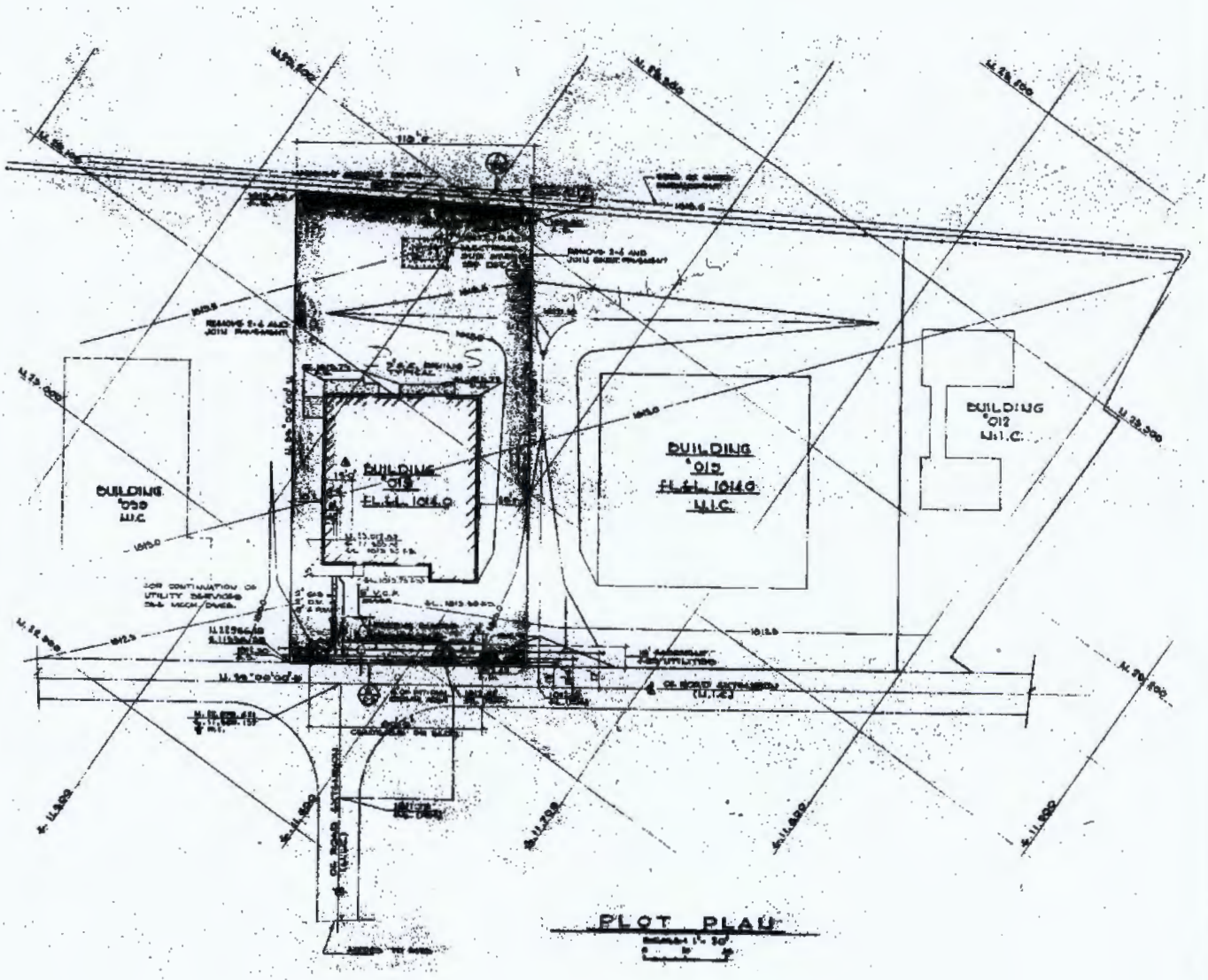
Source: Boeing Company, 2008

U.S. EPA Region 9

FENCE

Figure 2.1.4b
Building 4019
Floor Plan



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Project:EP9038
Revised: 09/07/2010 TJ
Source: Boeing Company, 2008

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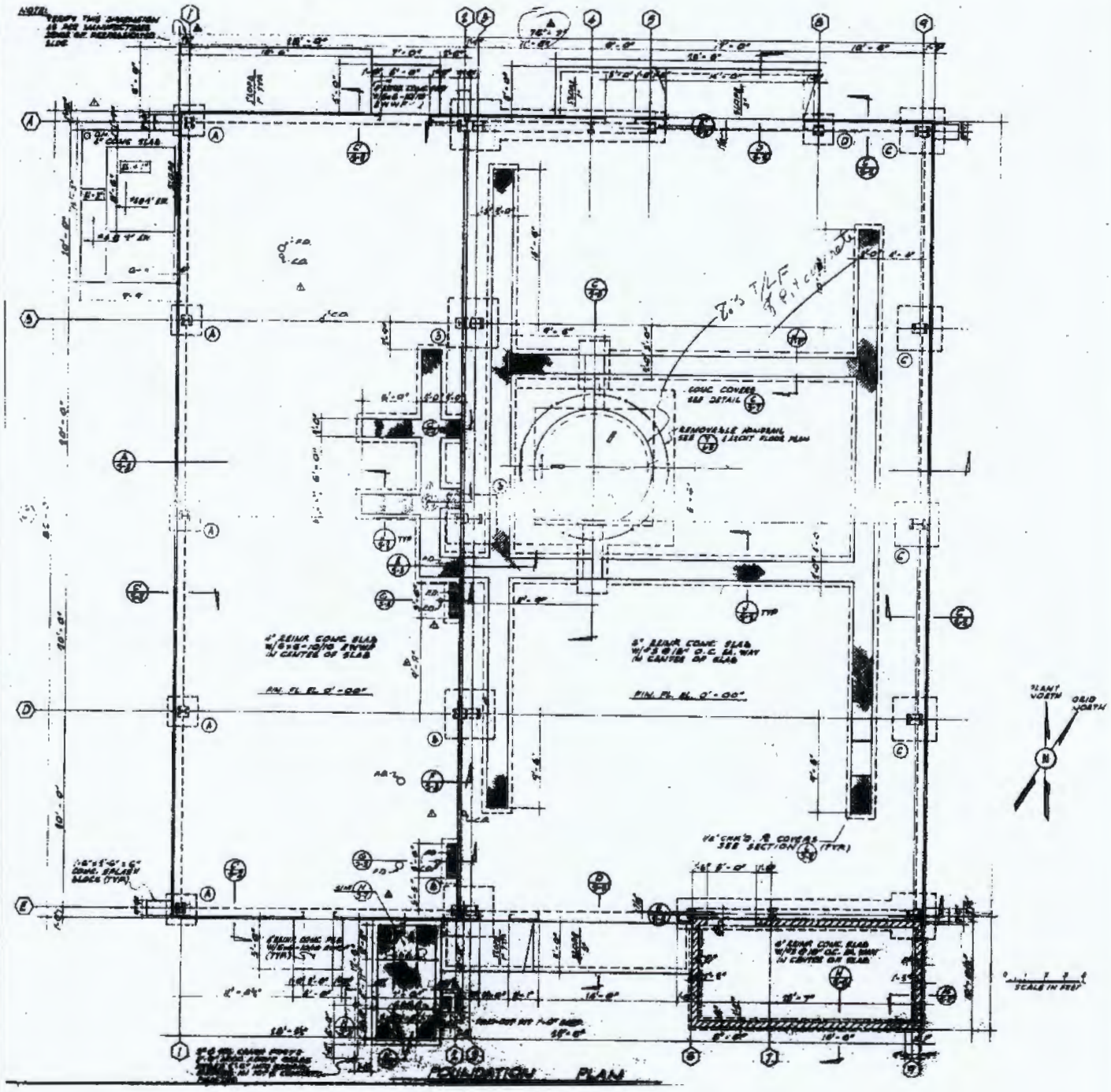
LEGEND:

- 6" V.C.P. SEWER
- 2" DOMESTIC WATER
- 2" GAS
- 6" V.C.P. SANITARY SEWER (N.I.C.)
- 6" WATER MAIN (N.I.C.)
- 6" GAS MAIN (N.I.C.)
- REFERENCE BENCH MARK
- HOV BUILDING
- N.I.C. WORK
- P.P. POWER POLE
- 5" A.C. PAVING
- F.S. FINISHED SURFACE
- F.L. FLOW LINE
- FINISHED SURFACE CONTOUR
- EXIST. GRADES
- 6" FIRE PROTECTION WATER
- CONCRETE

Figure 2.1.4c
Building 4019
Plot Plan



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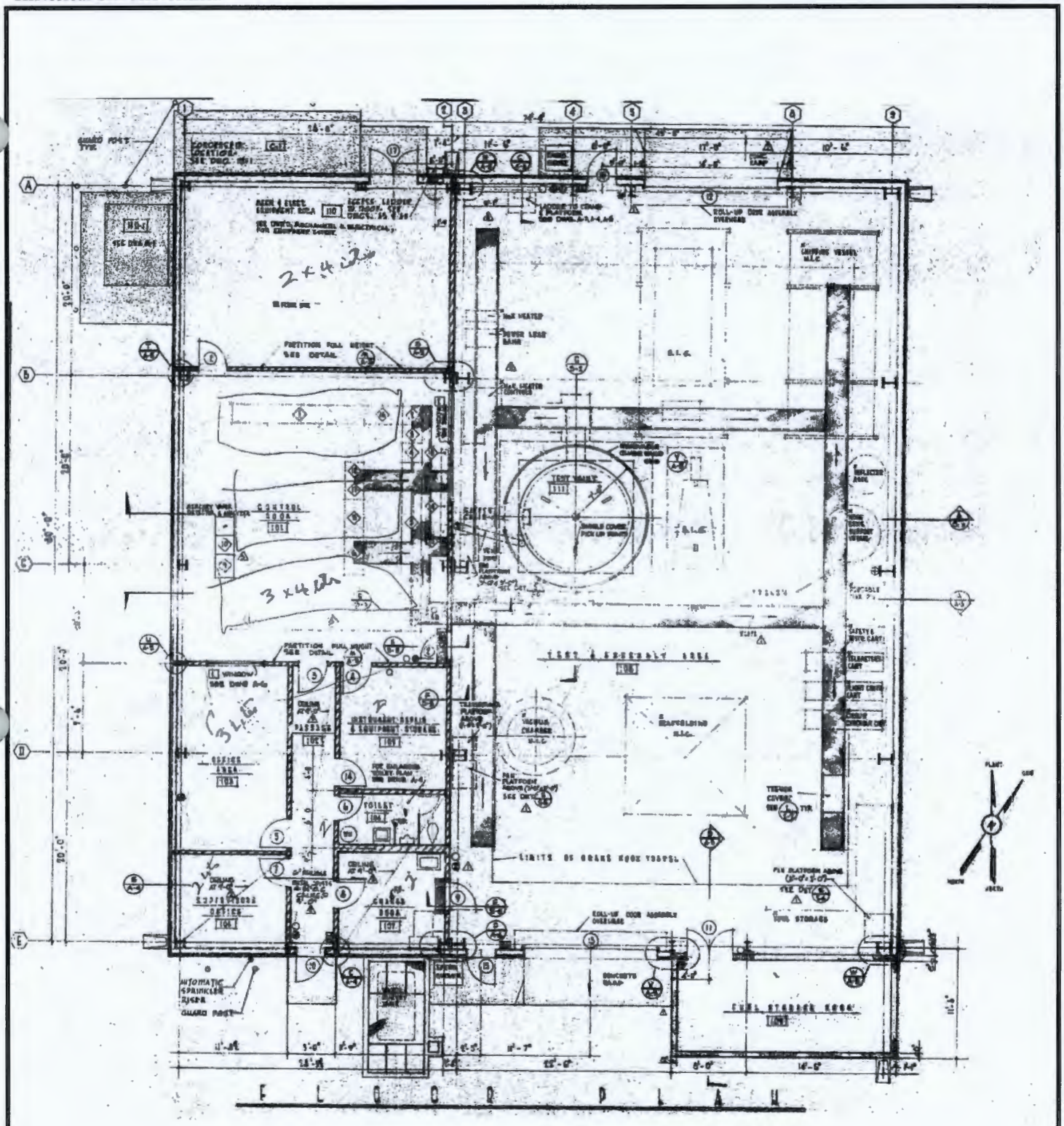
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.4d
Building 4019
Foundation Plan



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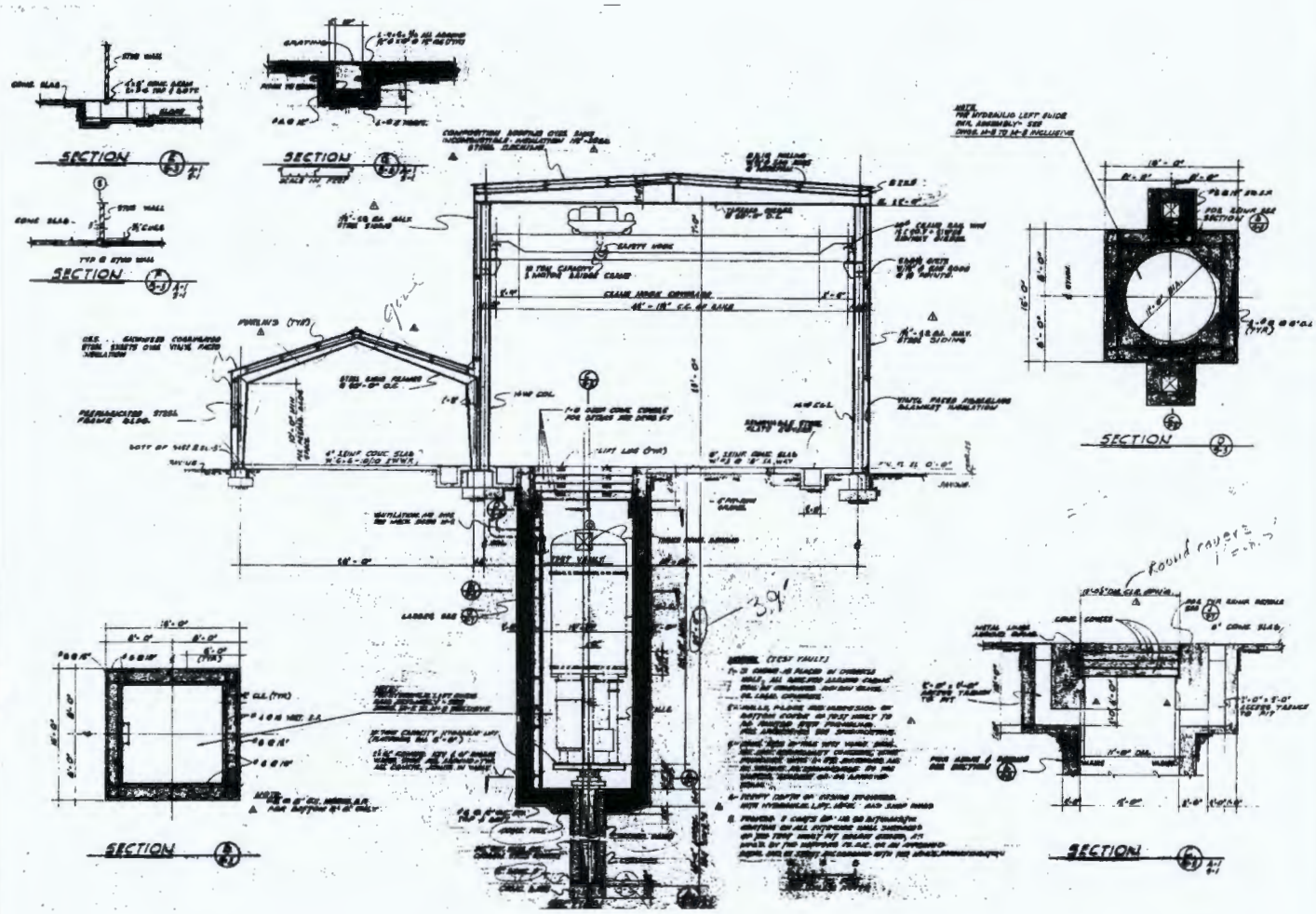
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.4e
Building 4019
Floor Plan



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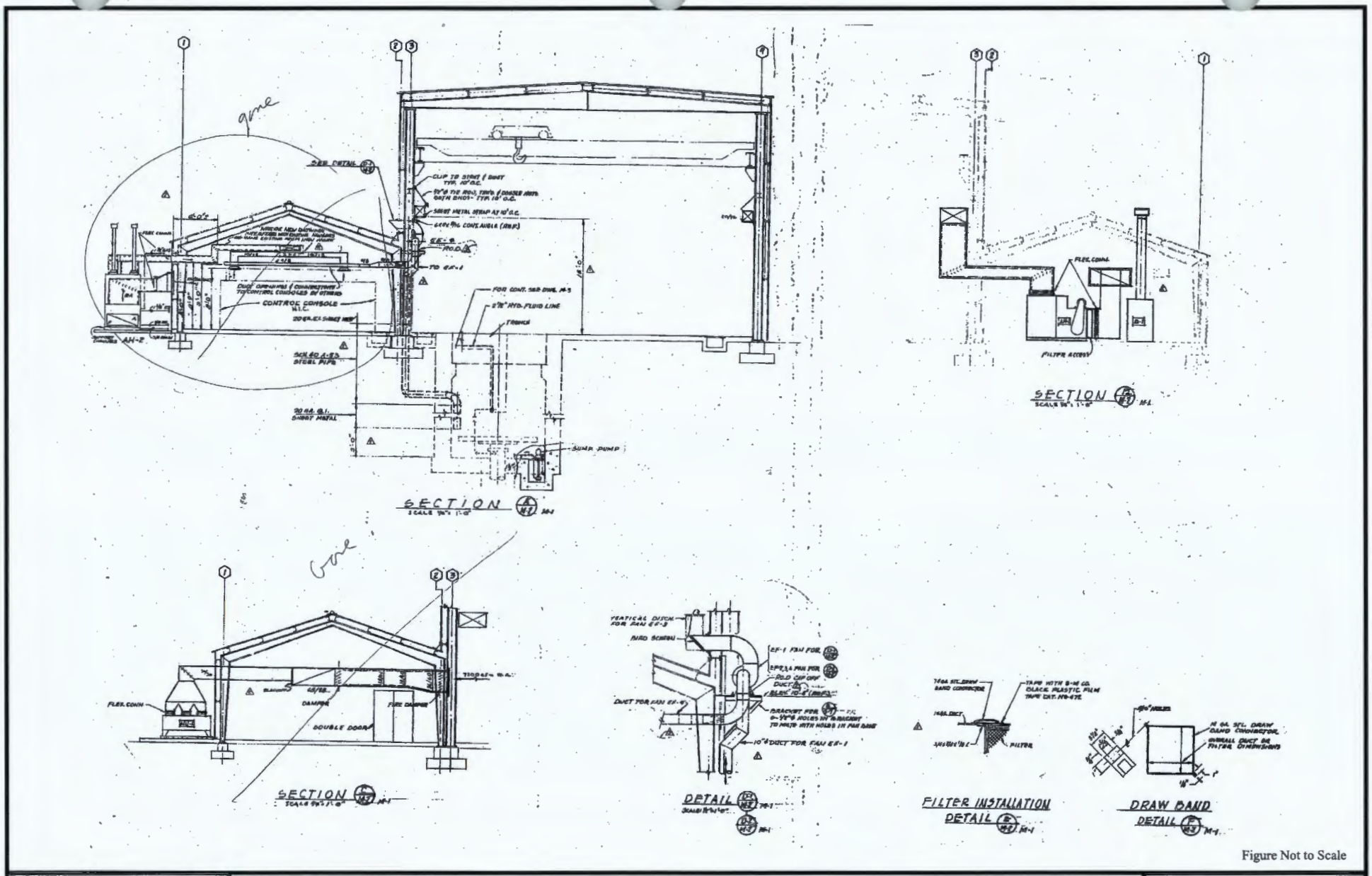
U.S. EPA Region 9

Figure 2.1.4f
Building 4019
Structural Section
Plan



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Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.4g
Building 4019
Heat, Ventilation, and Air Conditioning Plan

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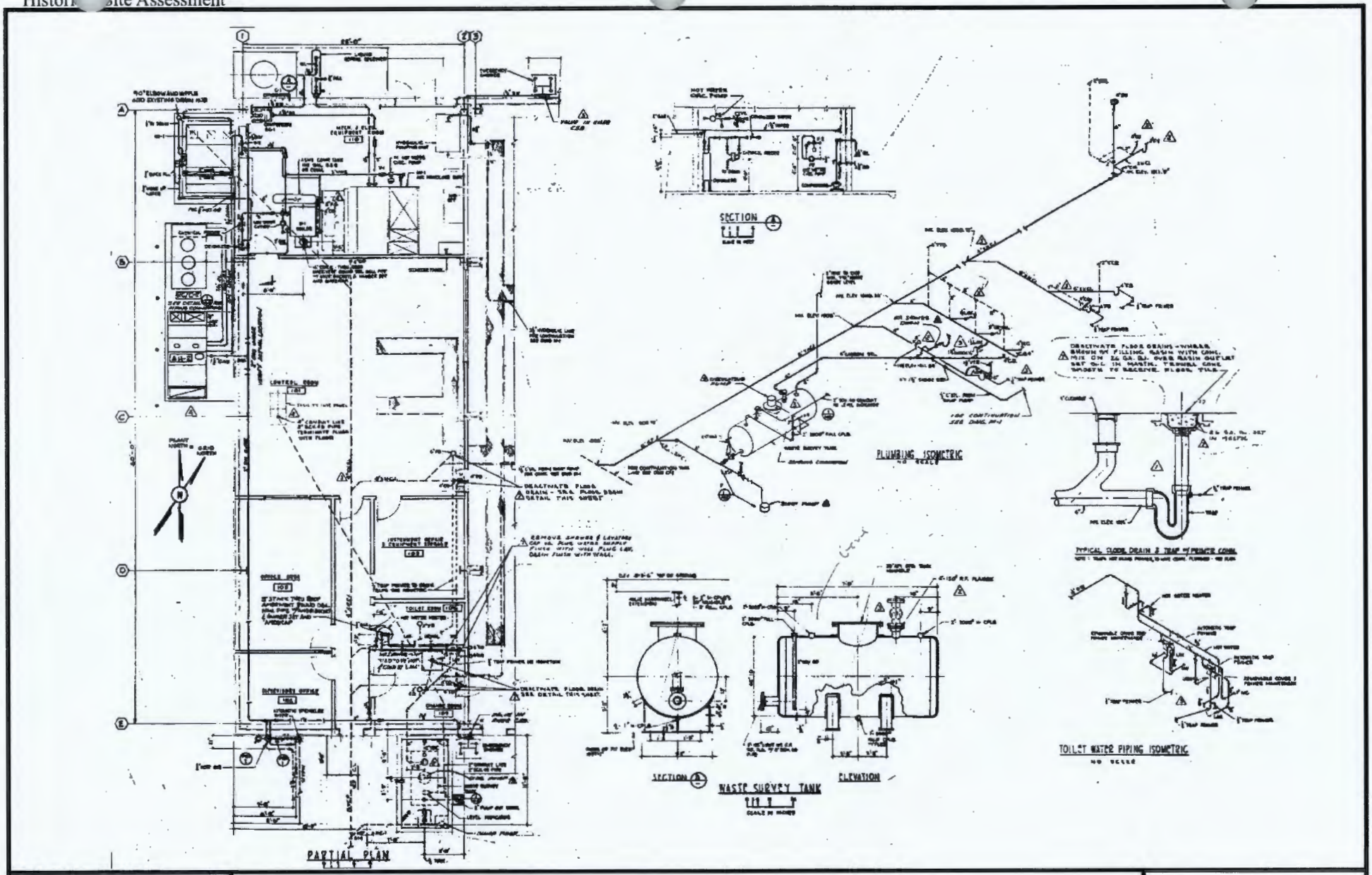

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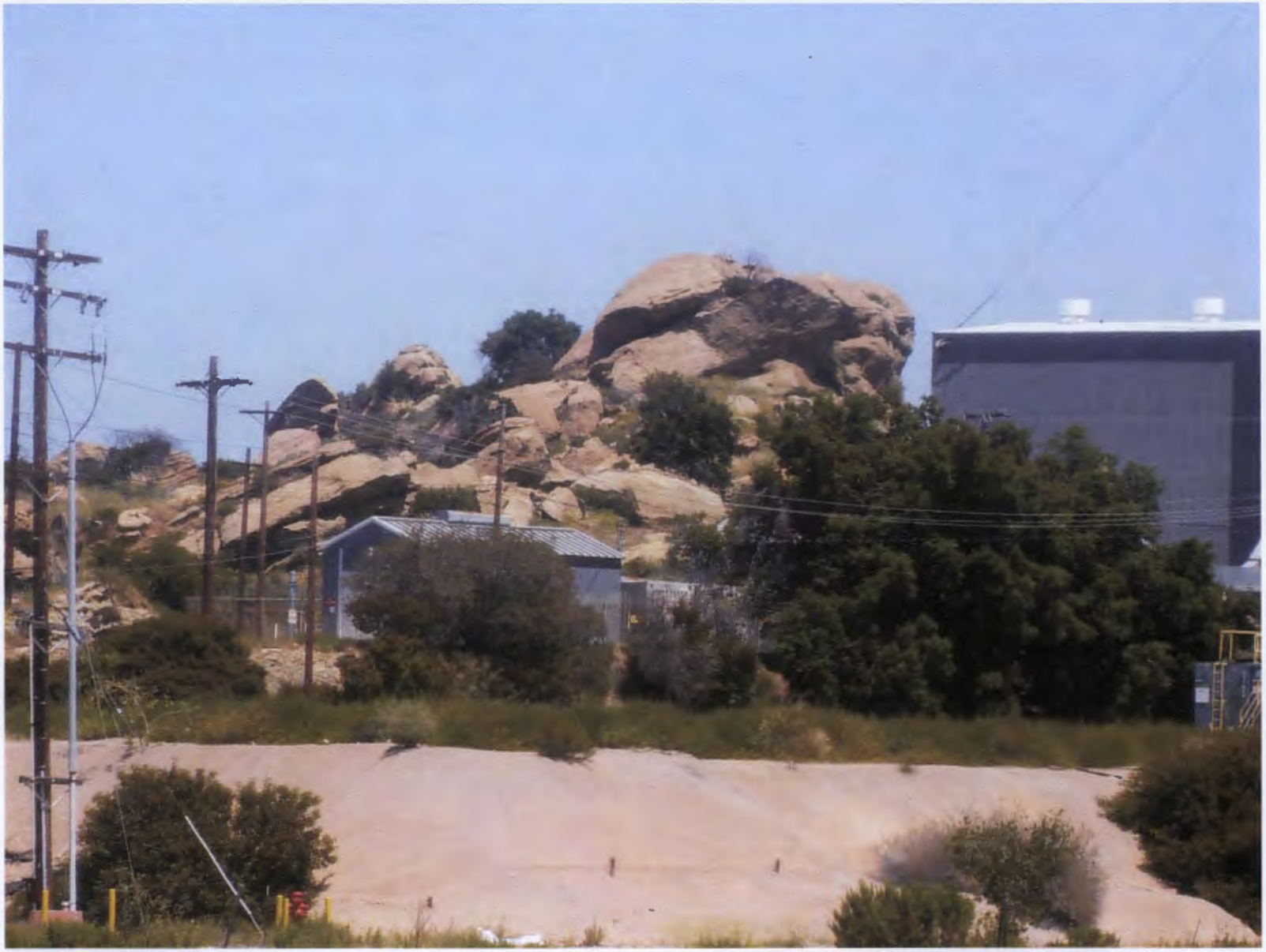
U.S. EPA Region 9

Figure 2.1.4h
Building 4019
Plumbing Plan



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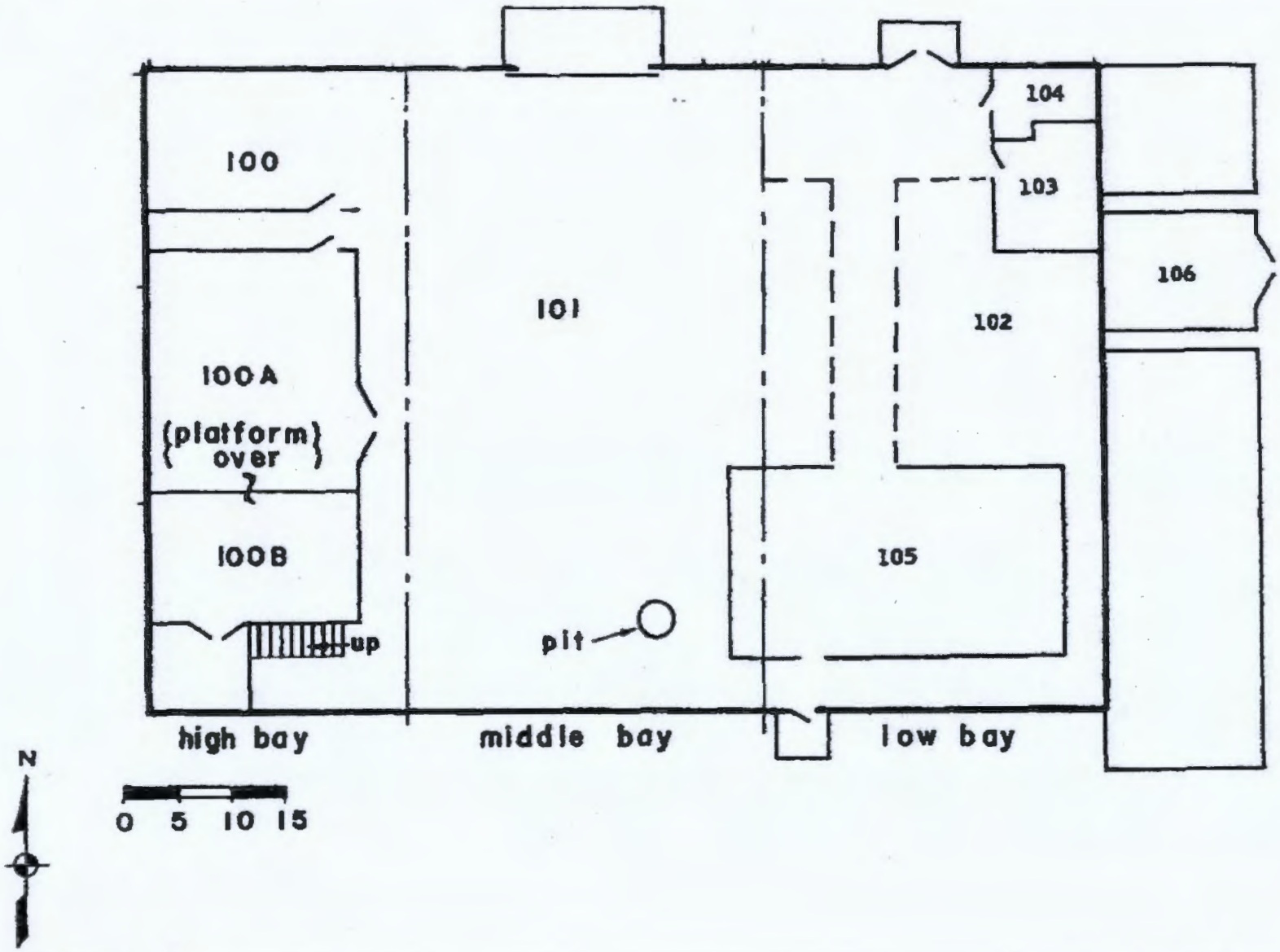
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.5a
Building 4025
Site Photograph



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U.S. EPA Region 9

Figure 2.1.5b
Building 4025
Floor Plan

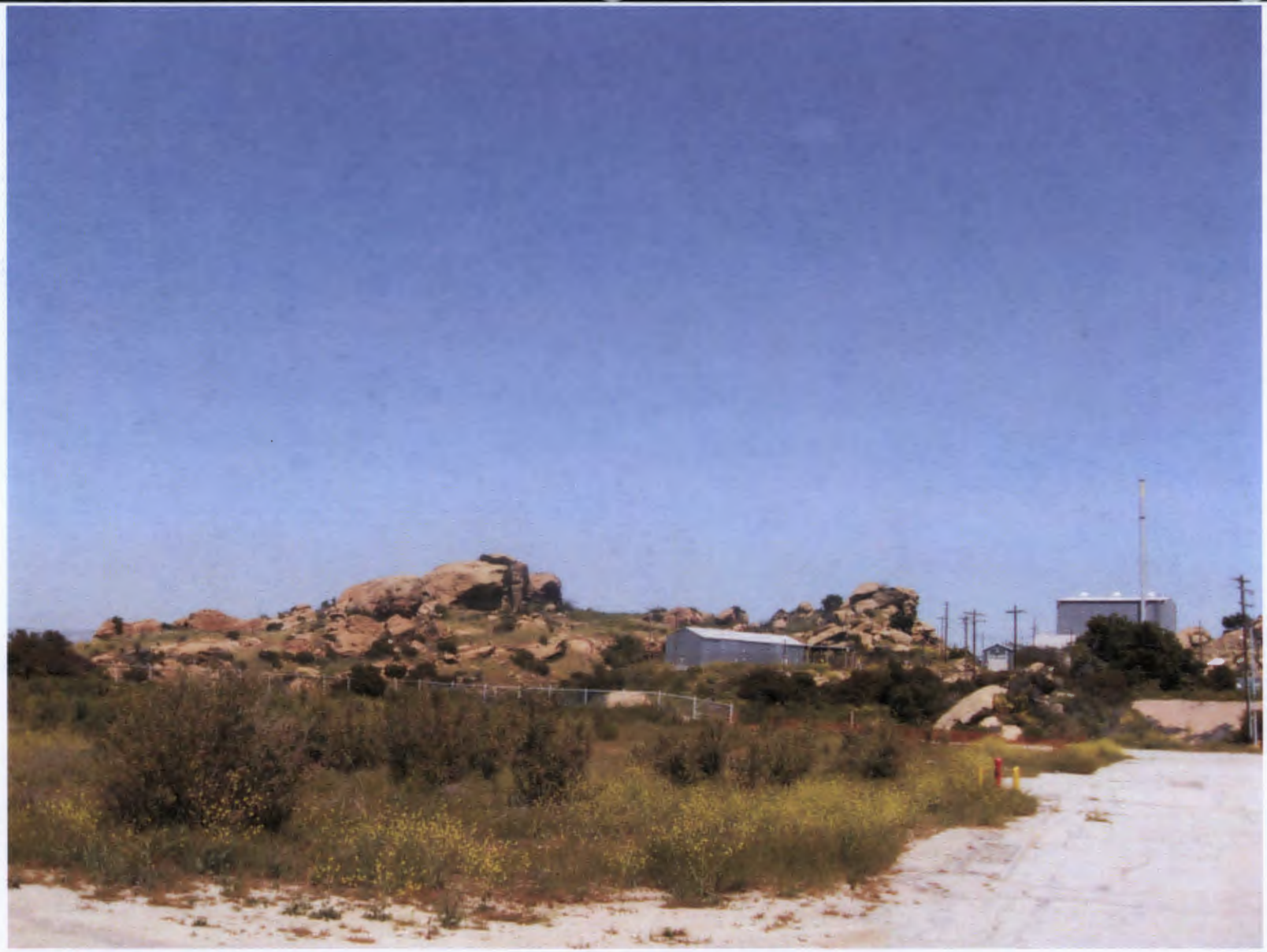

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Figure 2.1.6a
Building 4228
Site Photograph

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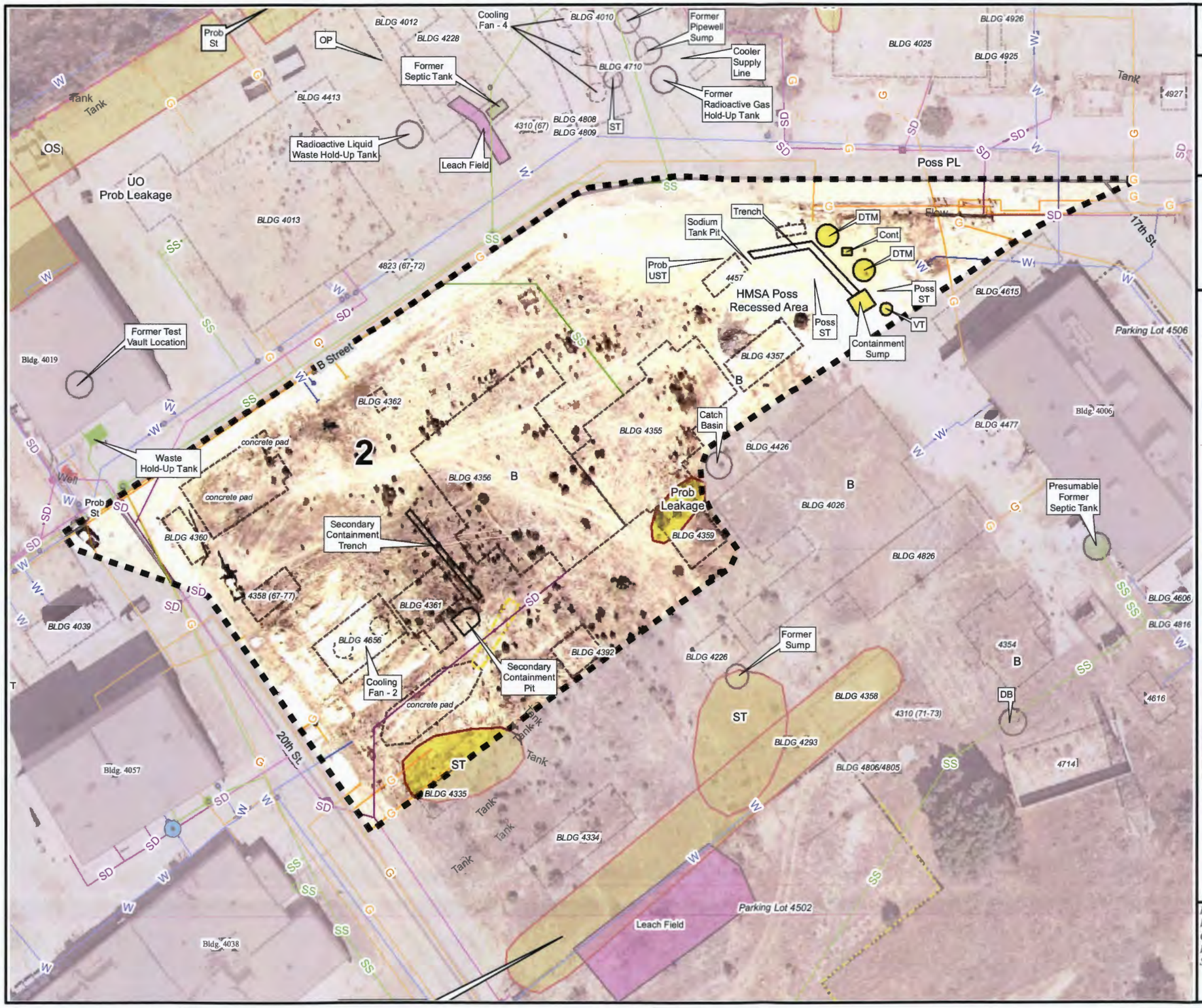
Revised: 09/07/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.7a
Building 4310
Site Photograph



Historical Site Assessment
Final Technical Memorandum - HSA-5B

Figure 2.2
Area IV Subarea 5B-2
Santa Susana Field Laboratory

U.S. EPA Region 9

Legend

- Subarea 5B-2 Boundary
- Primary Roads
- Secondary Roads
- Underground Storage Tank
- Unknown Tank Type
- Sump
- Dry Well
- Tank Footprint
- Above ground Storage Tank
- Demolished Bldg.
- Existing Bldg.
- Parking Lots
- Drainage
- Drain
- Well

Aerial Photo Features
- Aerial Photography Features
- Leach Field
- Other

Surface Water
- Intermittent Stream
- Permanent Stream
- Surface Water
- Lined Channel
- French Drain
- Drainage
- Leach Field
- Septic System

Utilities
- Channel
- Drain
- Drain
- Drainage Divide
- Gutter
- Tank
- Tank
- Vault
- Well
- Gas
- Storm Drain
- Sanitary Sewer
- Water

B	Building
CONT	Container
CR	Crates
DB	Debris
DG	Disturbed Ground
DTM	Dark Tone Material
EX	Excavation
FA	Fill Area
GS	Ground Scar
HT	Horizontal Tank
IM	Impoundment
MTMM	Medium Toned Mounded Material
OS	Open Storage
PA	Processing Area
PL	Parking Lot
POSS	Possible
PROB	Probable
S-T	Storage Tank
SS	Smoke Stack
ST	Storage
UO	Unidentified Object
VT	Vertical Tank
WDA	Waste Disposal Area

N

0 25 50 100
Scale In Feet

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CIRGIS, 2007

HGL HydroGeoLogic, Inc.

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U.S. EPA Region 9

Figure 2.2.1a
Building 4355
Site Photograph

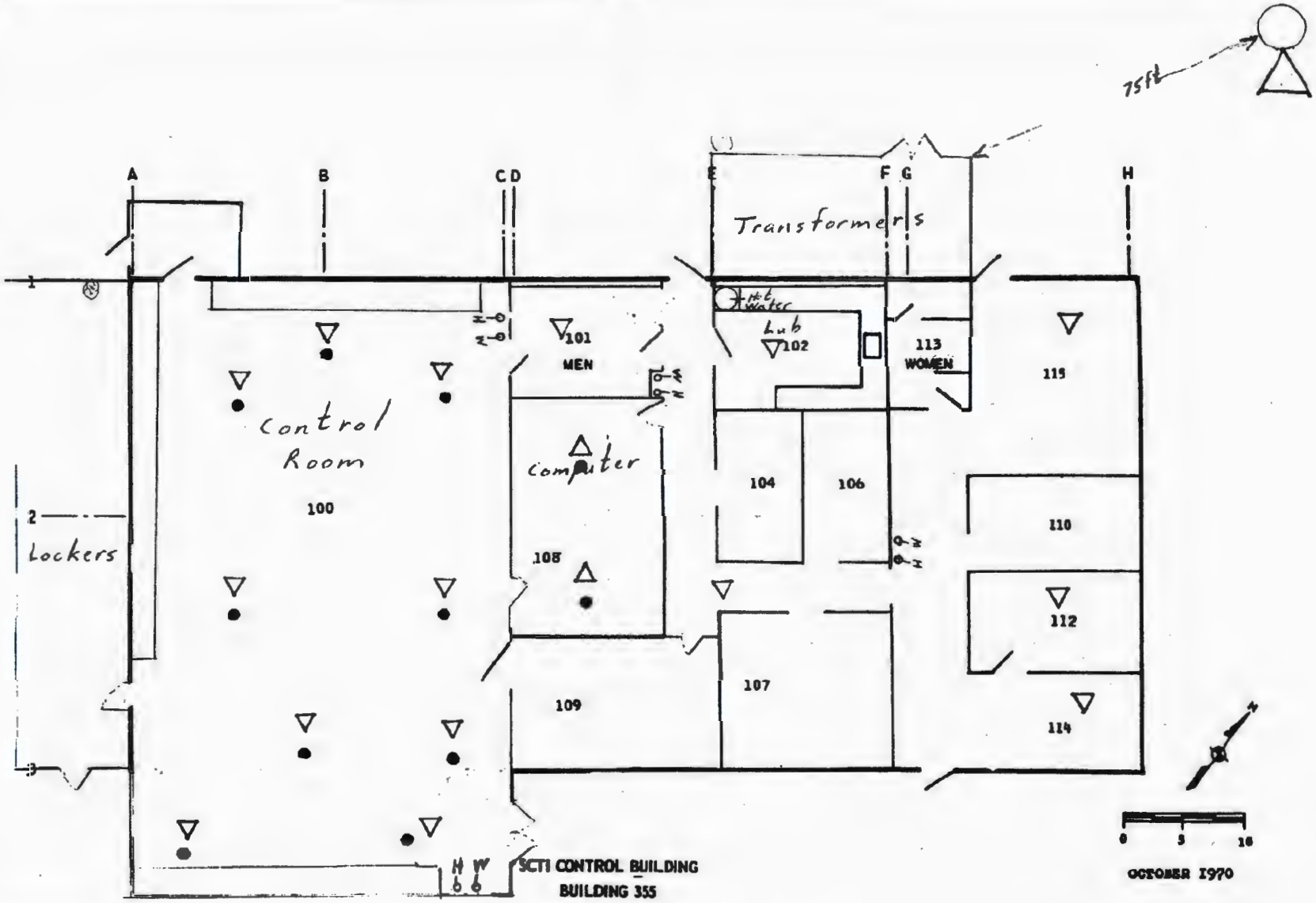

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Figure 2.2.1b
Building 4355
Floor Plan

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Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.2.2a
Building 4356
Site Photograph

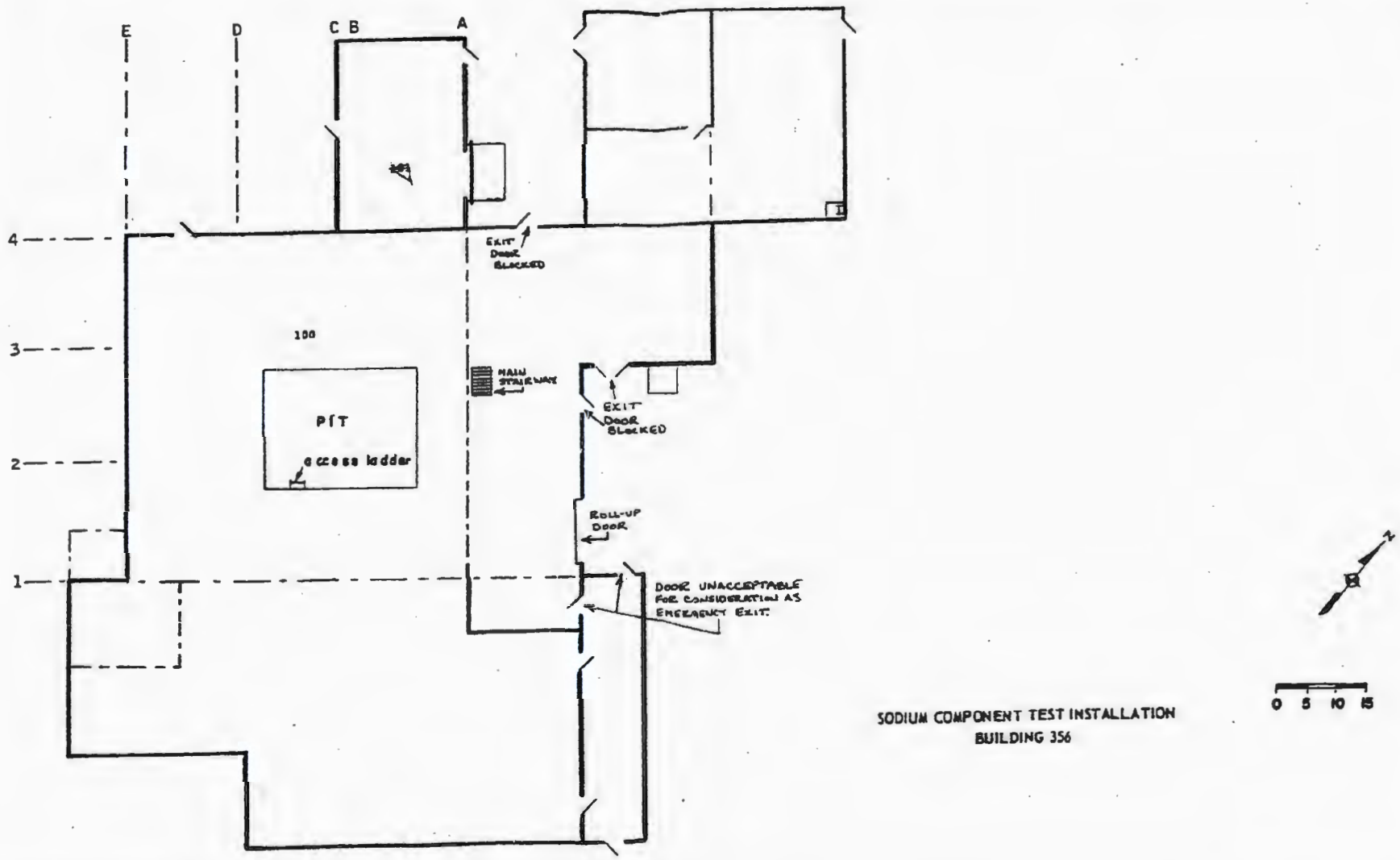

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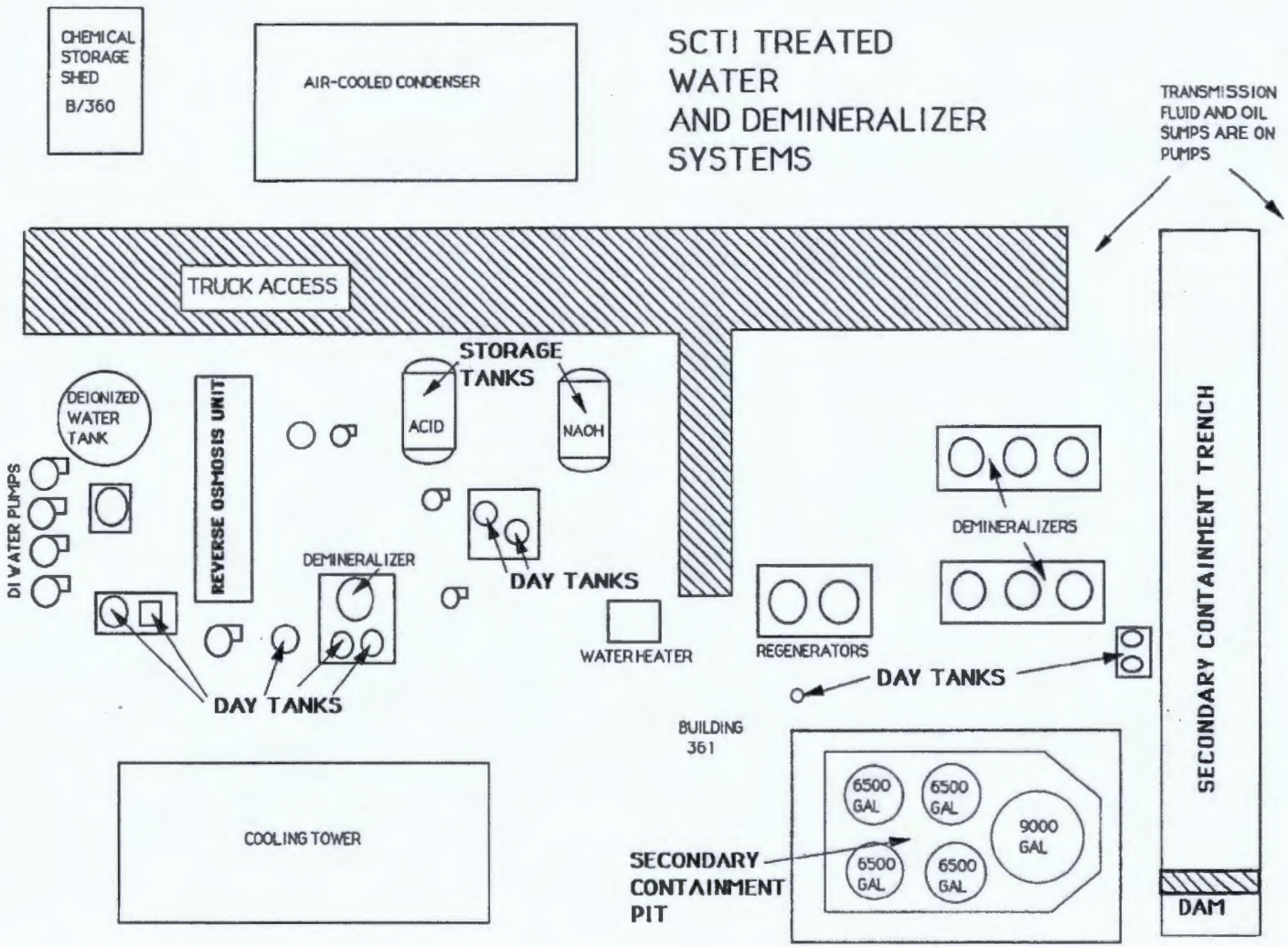
Figure 2.2.2b
Building 4356
Floor Plan



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U.S. EPA Region 9

Figure 2.2.2c
Building 4356
West Yard
Area Plan

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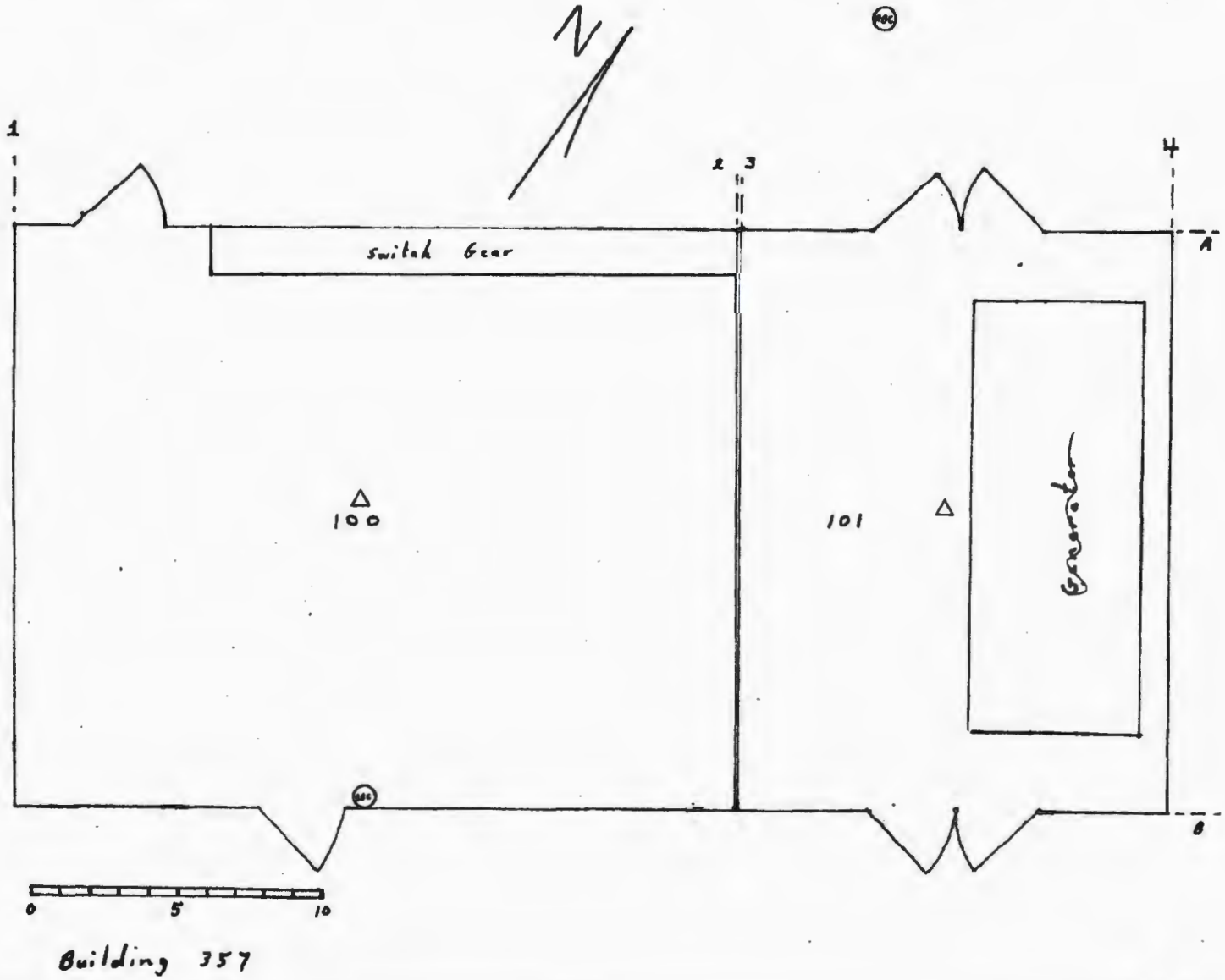
Revised: 09/07/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.2.3a
Building 4357
Site Photograph



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Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.2.3b
Building 4357
Floor Plan

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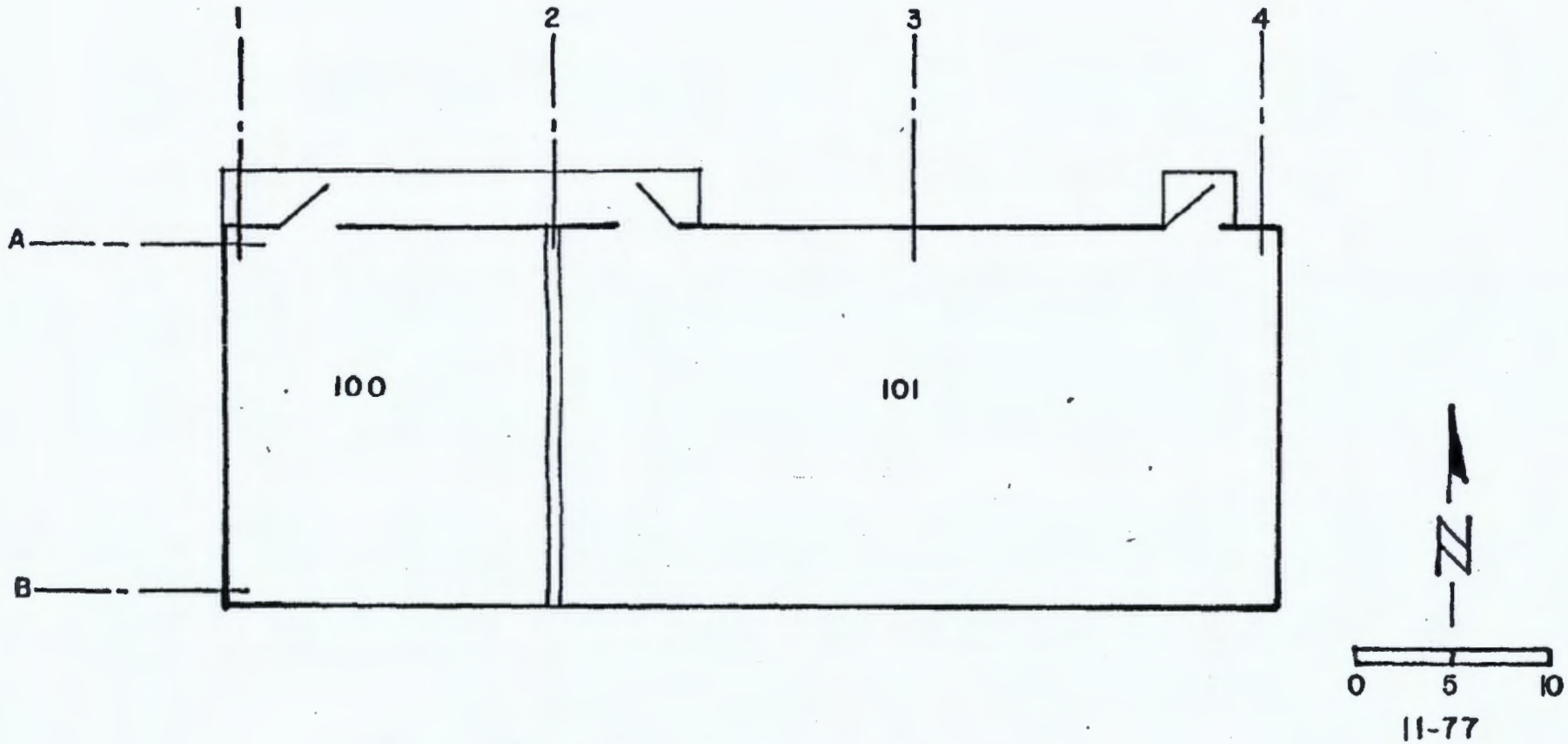
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.2.4a
Building 4358
Site Photograph



SCTI CHEMICAL STORAGE BUILDING NO. 358

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Revised: 09/08/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.2.4b
Building 4358
Floor Plan

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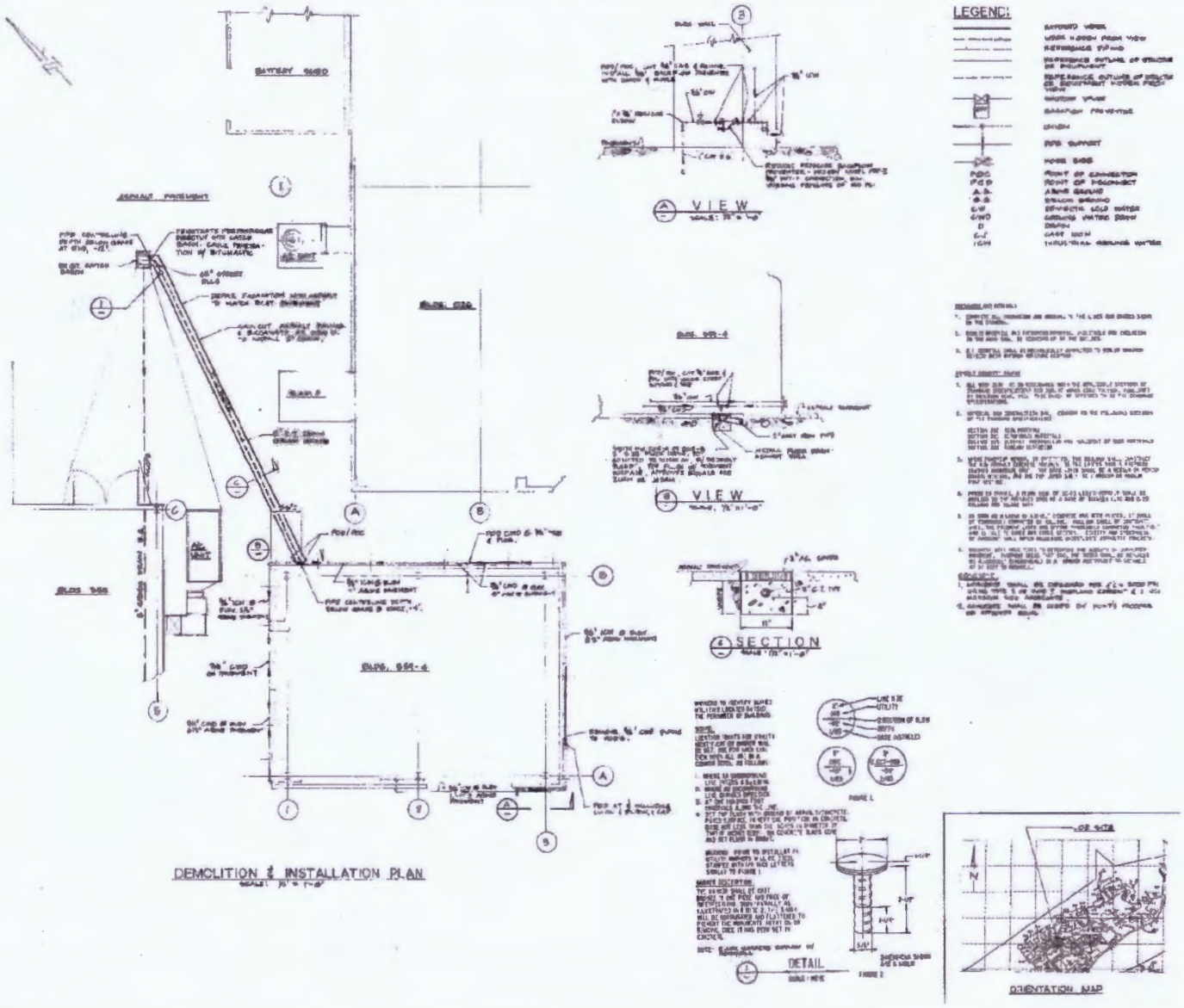
U.S. EPA Region 9

Figure 2.2.5a
Building 4359
Site Photograph



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U.S. EPA Region 9

Figure 2.2.5b
Building 4359
Water/Sewer
Distribution

Redacted

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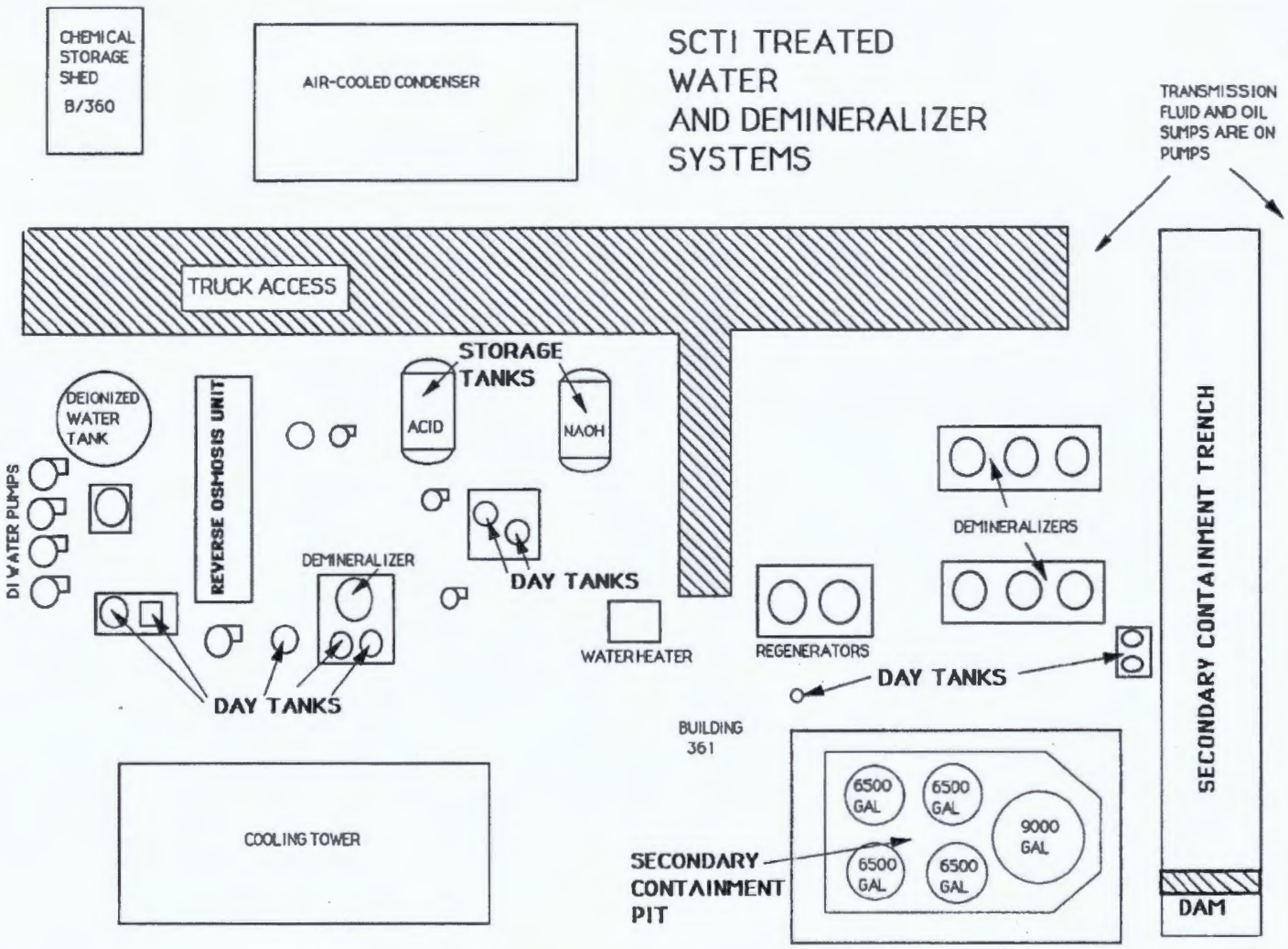
U.S. EPA Region 9

Figure 2.2.6a
Building 4360
Site Photograph



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U.S. EPA Region 9

Figure2.2.6b
Building 4360
Area Plan

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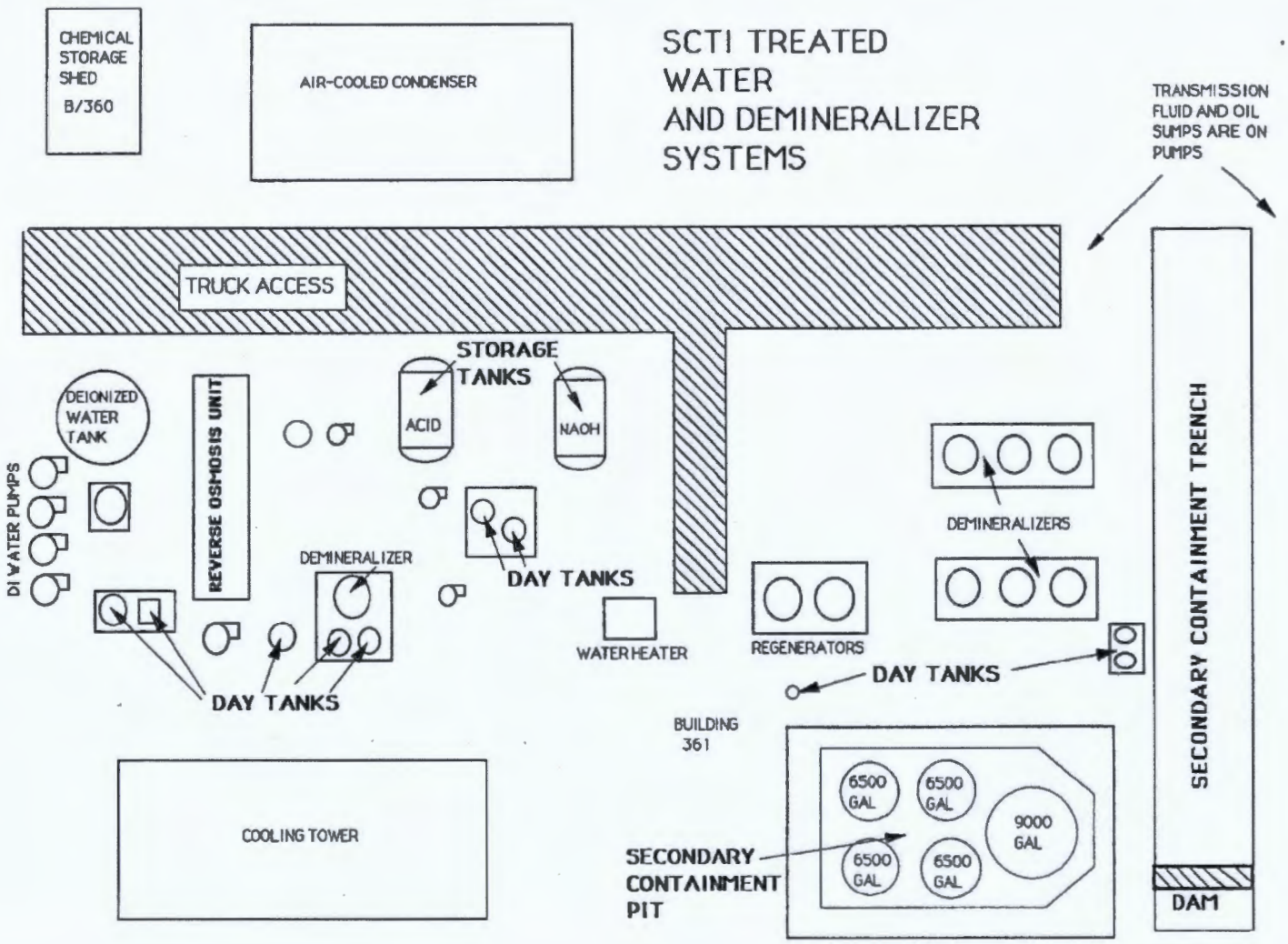
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.2.7a
Building 4361
Site Photograph



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Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.2.7b Building 4361 Area Plan

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Revised: 09/08/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.2.8a
Building 4362
Site Photograph

Y:/Santa_Susana/EP9038/TM/HSA_5B (2-2-9a)bldg4392.cdr
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Revised: 09/08/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.2.9a
Building 4392
Site Photograph

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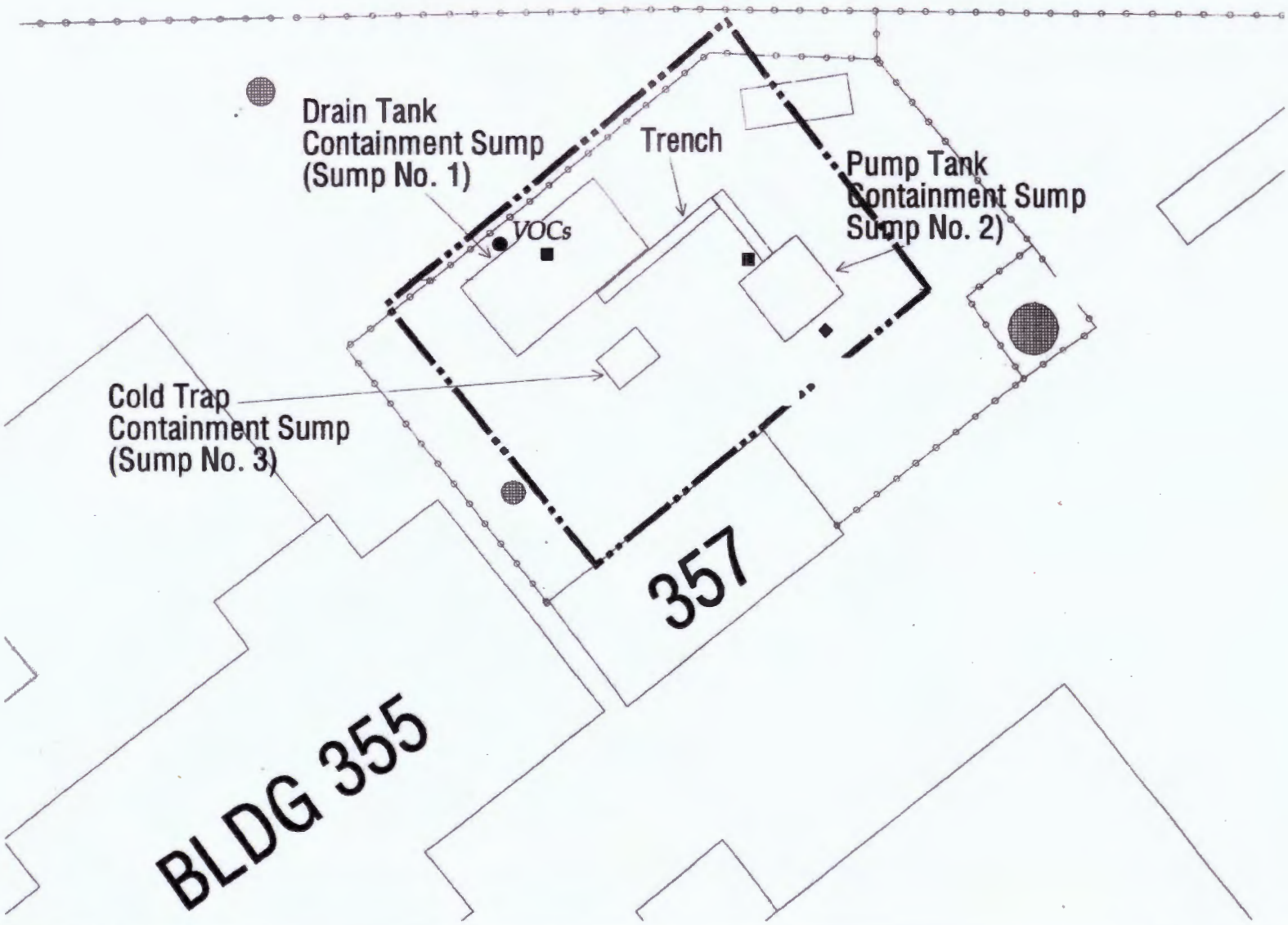
U.S. EPA Region 9

Figure 2.2.10a
Building 4457
Site Photograph



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U.S. EPA Region 9

Figure 2.2.10b
Building 4457
Former HMSA Site

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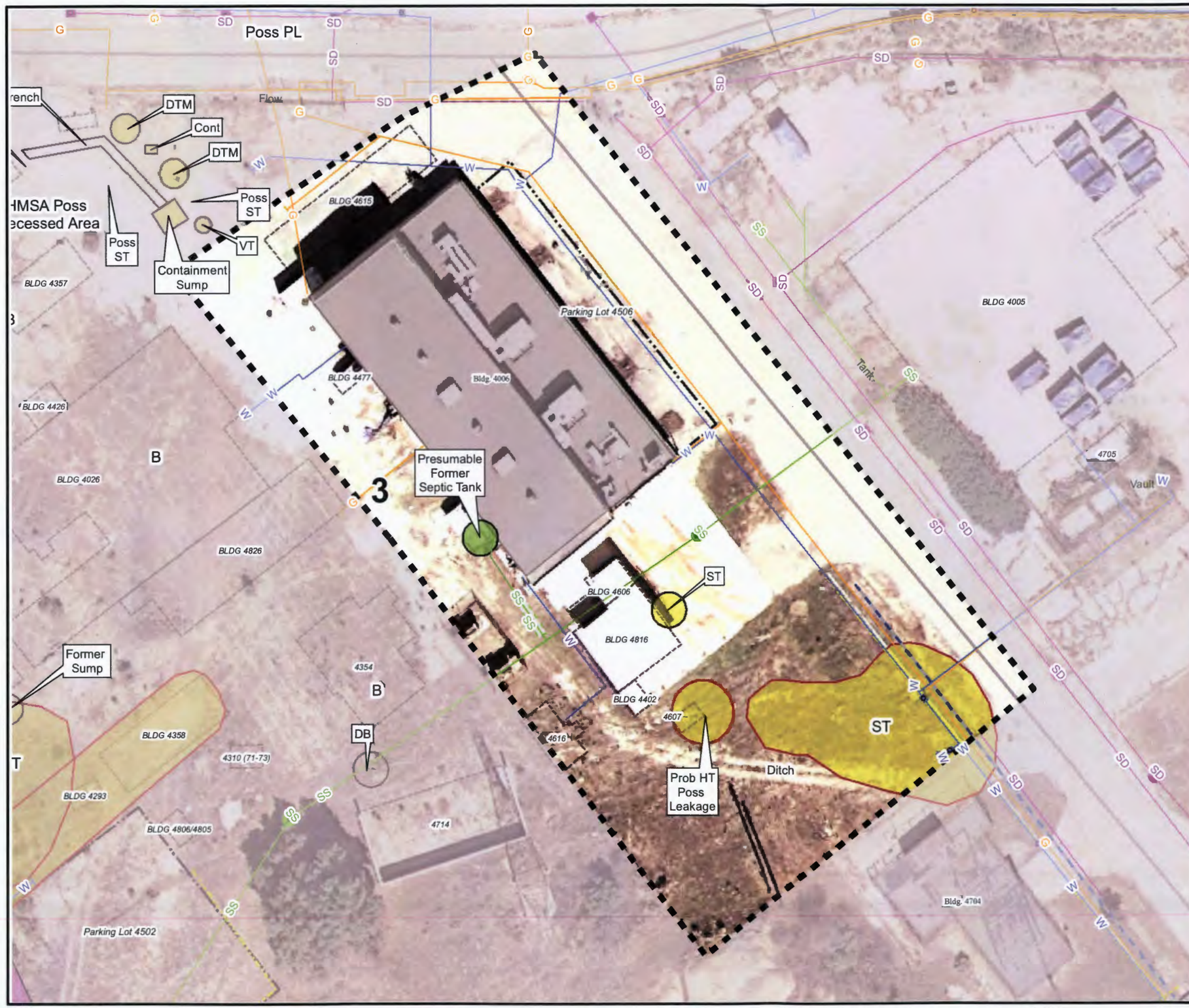
U.S. EPA Region 9

Figure 2.2.11a
Building 4478
Site Photograph

Figure 2.3
Area IV Subarea 5B-3
Santa Susana Field Laboratory

U.S. EPA Region 9



Legend

- Subarea 5B-3 Boundary
- Primary Roads
- Secondary Roads
- Underground Storage Tank
- Unknown Tank Type
- Sump
- Dry Well
- Tank Footprint
- Above ground Storage Tank
- Demolished Bldg.
- Existing Bldg.
- Parking Lots
- Drainage
- Drain
- Well

Aerial Photo Features

- Aerial Photography Features
- Leach Field
- Other

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- Intermittent Stream
- Permanent Stream
- Surface Water
- Lined Channel
- French Drain
- Drainage
- Leach Field
- Septic System

Utilities

- Channel
- Drain
- Drain
- Drainage Divide
- Gutter
- Tank
- Tank
- Vault
- Well
- Gas
- Storm Drain
- Sanitary Sewer
- Water

B	Building
CONT	Container
CR	Crates
DB	Debris
DG	Disturbed Ground
DTM	Dark Tone Material
EX	Excavation
FA	Fill Area
GS	Ground Scar
HT	Horizontal Tank
IM	Impoundment
MTMM	Medium Toned Mounded Material
OS	Open Storage
PA	Processing Area
PL	Parking Lot
POSS	Possible
PROB	Probable
S-T	Storage Tank
SS	Smoke Stack
ST	Storage
UO	Unidentified Object
VT	Vertical Tank
WDA	Waste Disposal Area

N

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Scale In Feet

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Created: TJansen
Revised: 10/25/2010 TJ
Sorce: Boeing Company, 2008
CIRGIS, 2007

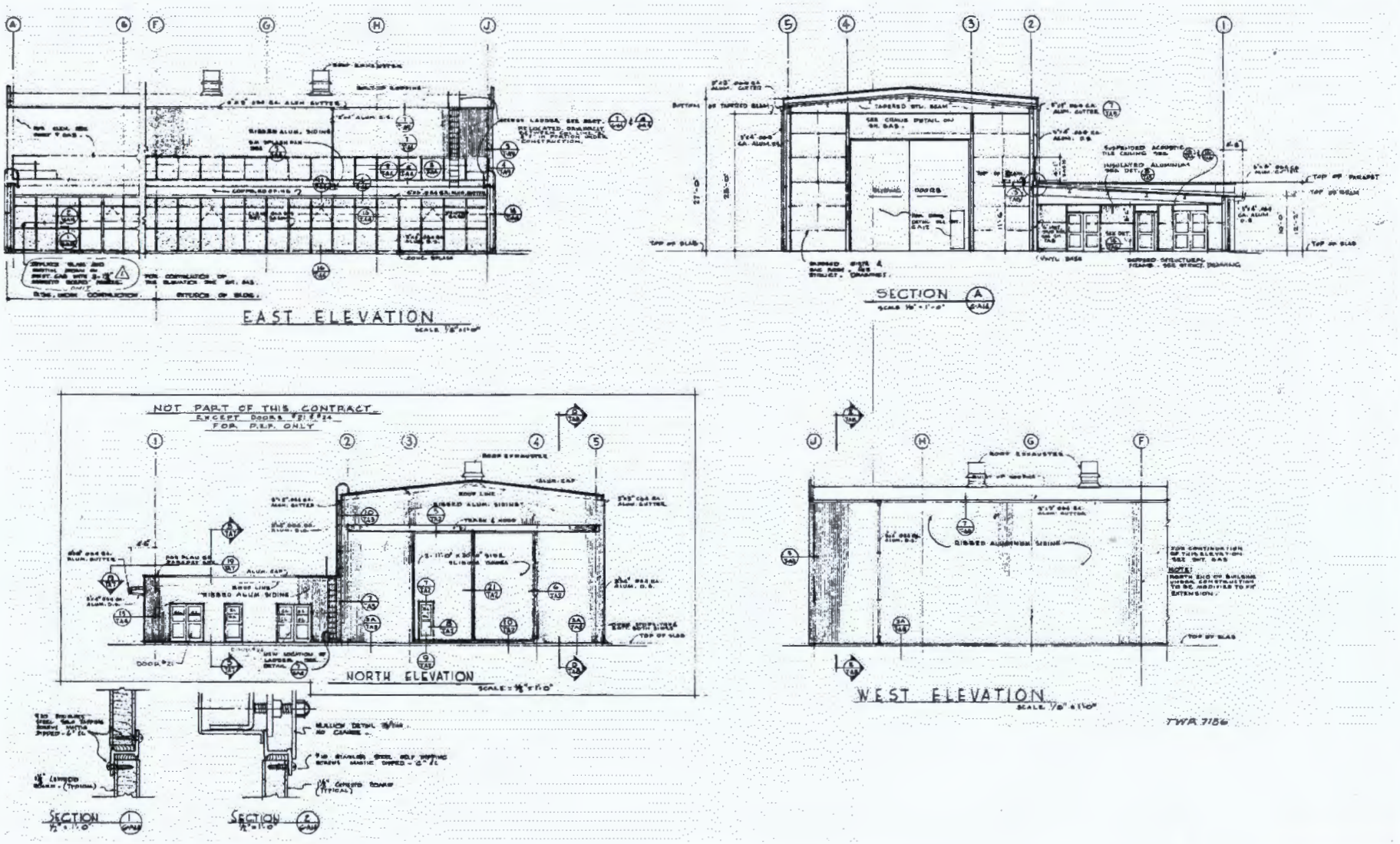
HGL HydroGeoLogic, Inc.

Redacted

Y:/Santa_Susana/EP9038/TM/HSA_5B (2-3-1a)bldg4006.cdr
Project:EP9038
Revised: 09/08/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.3.1a
Building 4006
Site Photograph



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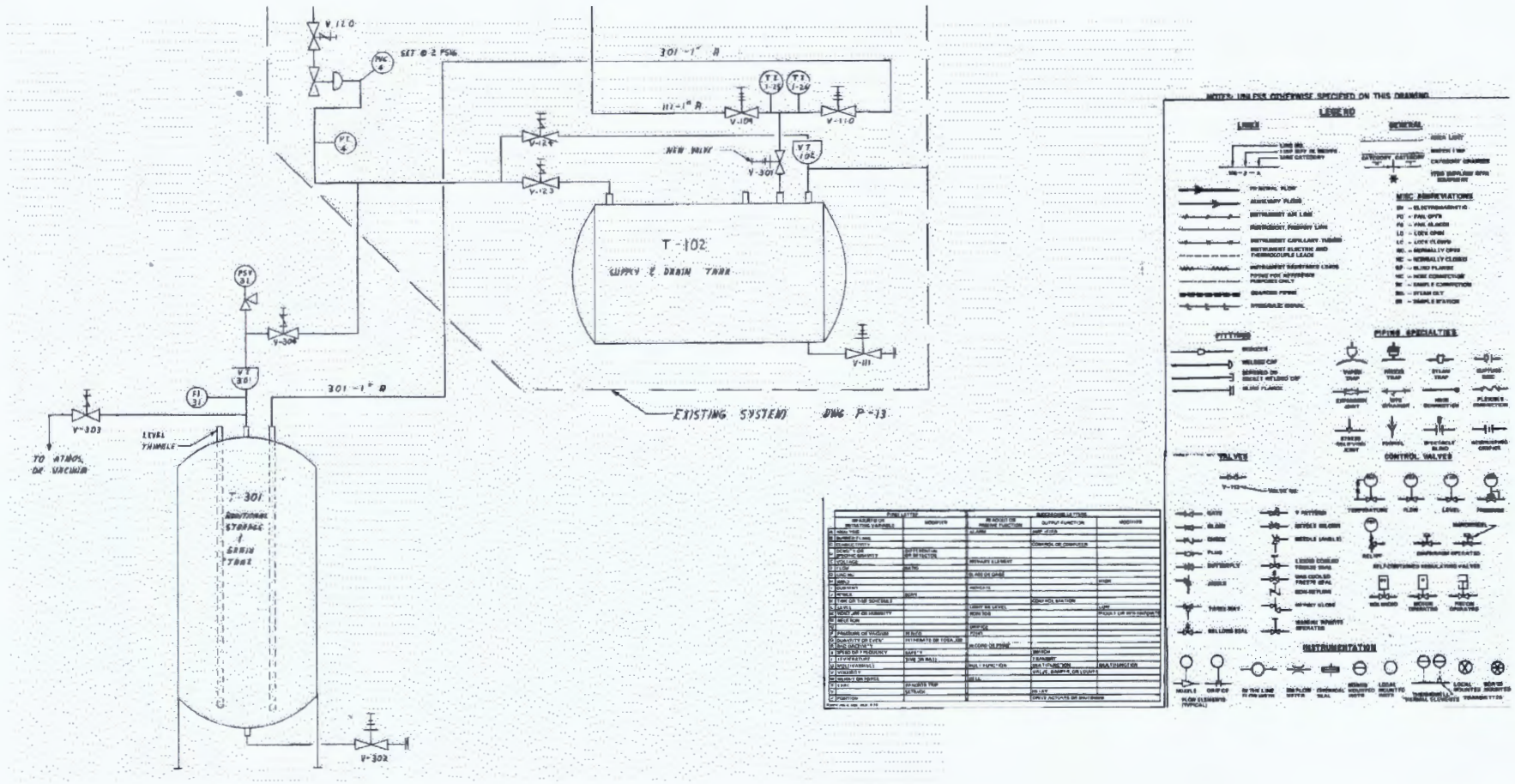
Project:EP9038
Revised: 09/08/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.3.1b
Building 4006
Elevations and Section



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Project:EP9038
Revised: 09/08/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.3.1c
Building 4006
Plumbing and Tanks

Redacted

Y:/Santa_Susana/EP9038/TM/HSA_5B (2-3-2a)bldg4402.cdr
Project:EP9038
Revised: 09/08/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.3.2a
Building 4402
Site Photograph

Y:/Santa_Susana/EP9038/TM/HSA_5B (2-3-3a)bldg4506.cdr
Project:EP9038
Revised: 09/08/2010 TJ
Source: Boeing Company, 2008

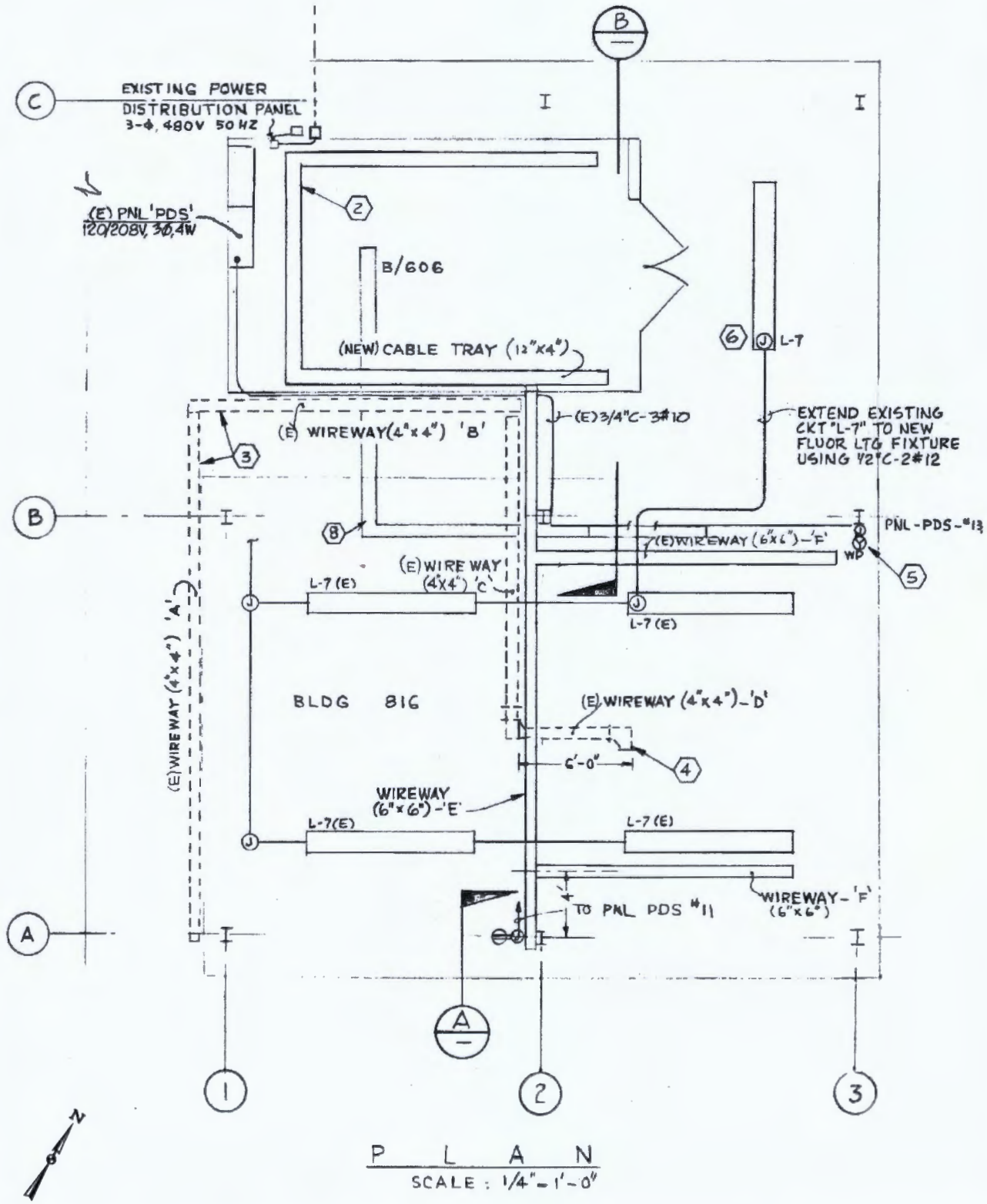
U.S. EPA Region 9

Figure 2.3.3a
Building 4506
Site Photograph

Y:/Santa_Susana/EP9038/TM/HSA_5B (2-3-4a)bldg4606.cdr
Project:EP9038
Revised: 09/08/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.3.4a
Building 4606
Site Photograph



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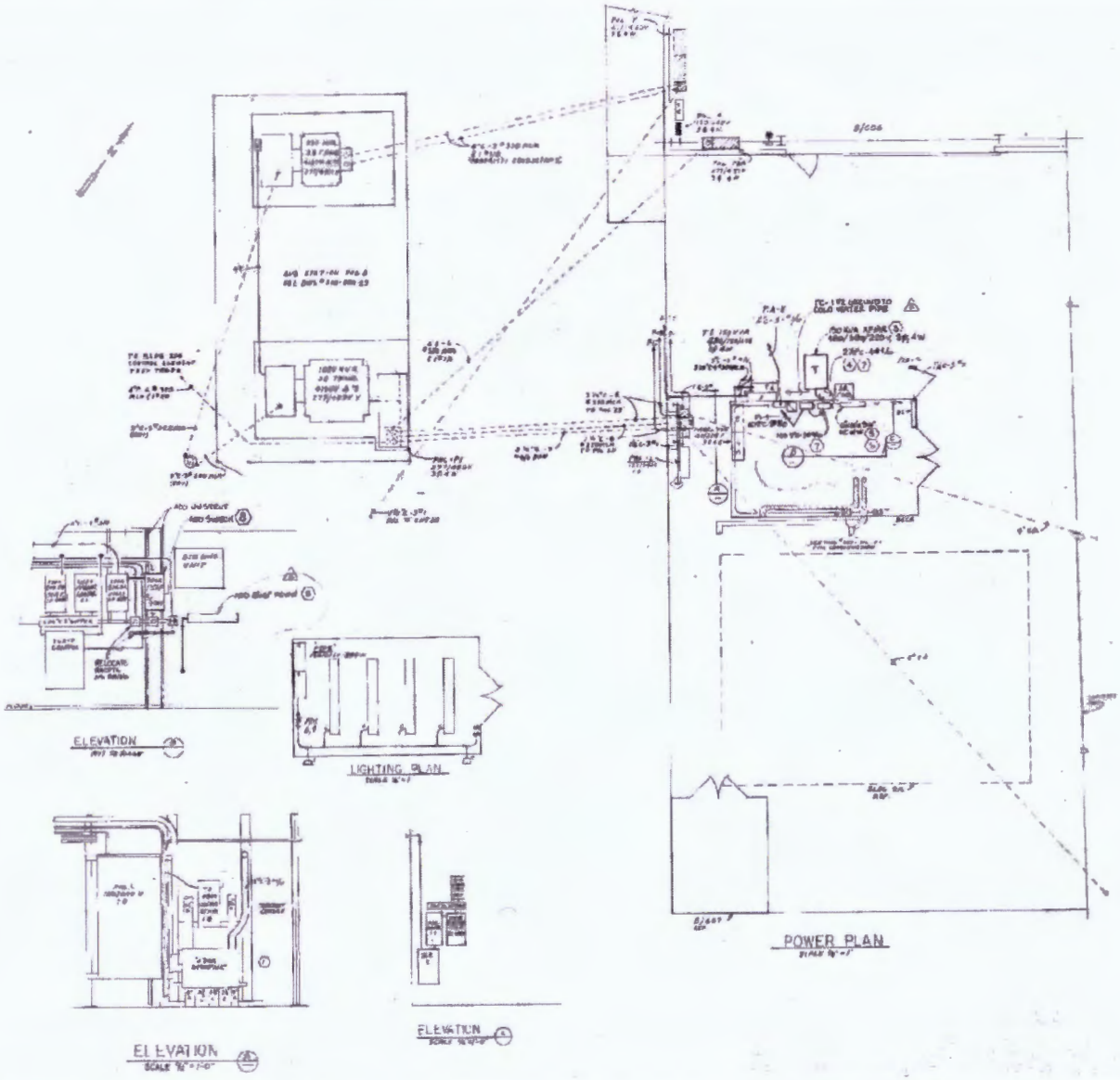
Revised: 09/08/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.3.4b
Building 4606
Recombiner Wireway



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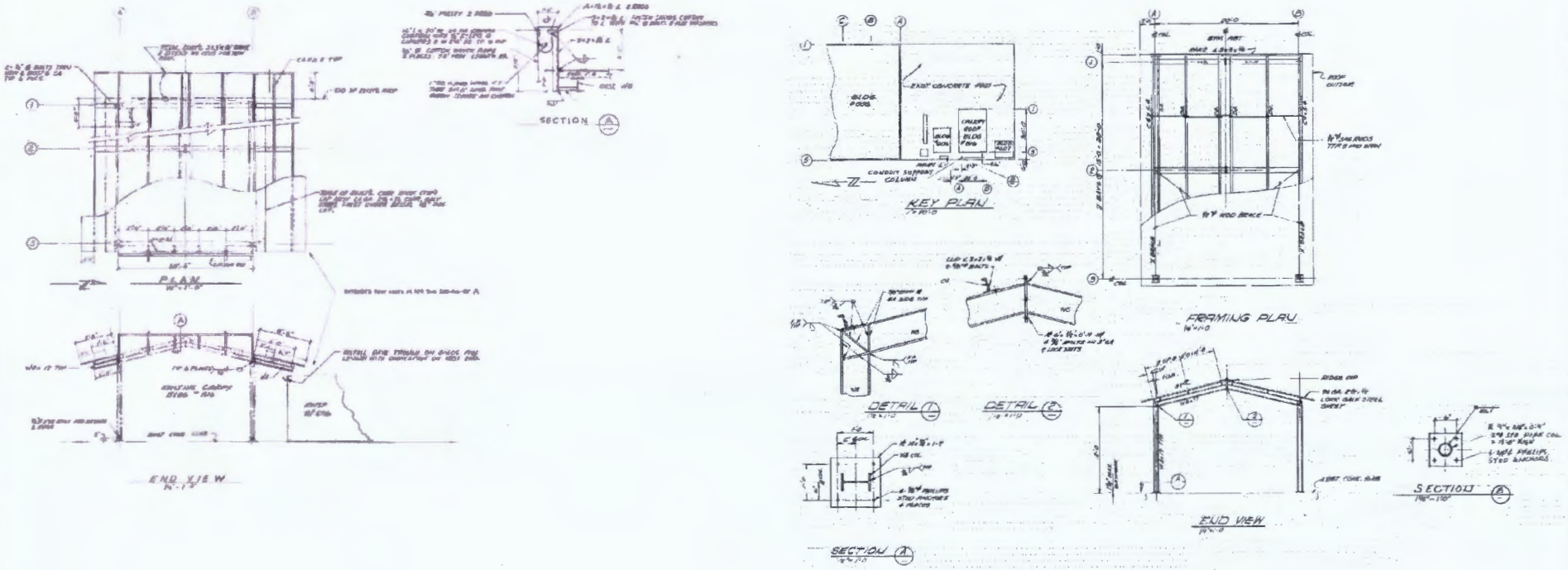
Revised: 07/08/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.3.4c
Building 4606
Yard Area

Redacted



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Revised: 09/08/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.3.4d
Building 4816
Hydrogen Recombiner Facility

Y:/Santa_Susana/EP9038/TM/HSA_5B (2-3-5a)bldg4607.cdr
Project:EP9038
Revised: 09/08/2010 TJ
Source: Boeing Company, 2008

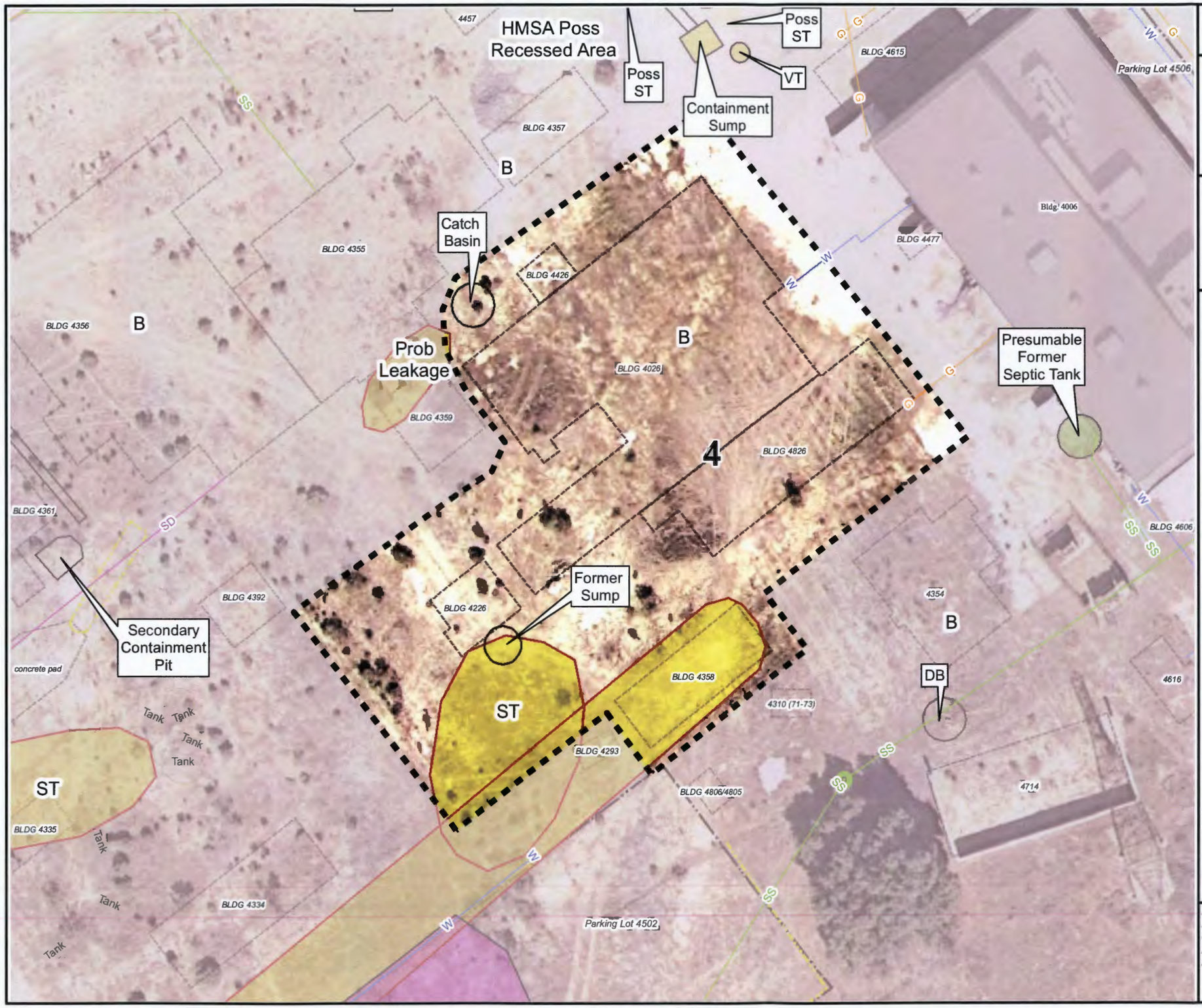
U.S. EPA Region 9

Figure 2.3.5a
Building 4607
Site Photograph

Y:/Santa_Susana/EP9038/TM/HSA_5B (2-3-6a)bldg4615.cdr
Project:EP9038
Revised: 09/08/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.3.6a
Building 4615
Site Photograph



Historical Site Assessment
Final Technical Memorandum - HSA-5B

Figure 2.4
Area IV Subarea 5B-4
Santa Susana Field Laboratory

U.S. EPA Region 9

Legend

- Subarea 5B-4 Boundary
- Primary Roads
- Secondary Roads
- Underground Storage Tank
- Unknown Tank Type
- Sump
- Dry Well
- Tank Footprint
- Above ground Storage Tank
- Demolished Bldg.
- Existing Bldg.
- Parking Lots
- Drainage
- Drain
- Well

Aerial Photo Features

- Aerial Photography Features
- Leach Field
- Other

Surface Water

- Intermittent Stream
- Permanent Stream
- Surface Water
- Lined Channel
- French Drain
- Drainage
- Leach Field
- Septic System

Utilities

- Channel
- Drain
- Drain
- Drainage Divide
- Gutter
- Tank
- Tank
- Vault
- Well
- Gas
- Storm Drain
- Sanitary Sewer
- Water

B	Building
CONT	Container
CR	Crates
DB	Debris
DG	Disturbed Ground
DTM	Dark Tone Material
EX	Excavation
FA	Fill Area
GS	Ground Scar
HT	Horizontal Tank
IM	Impoundment
MTMM	Medium Toned Mounded Material
OS	Open Storage
PA	Processing Area
PL	Parking Lot
POSS	Possible
PROB	Probable
S-T	Storage Tank
SS	Smoke Stack
ST	Storage
UO	Unidentified Object
VT	Vertical Tank
WDA	Waste Disposal Area

N

0 25 50 100
Scale In Feet

Filepath: Y:\Santa_Susana\EP9038\TM\HSA_5B\(2-4)5B-4.mxd
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Created: TJansen
Revised: 10/25/2010 TJ
Sorce: Boeing Company, 2008
CIRGIS, 2007

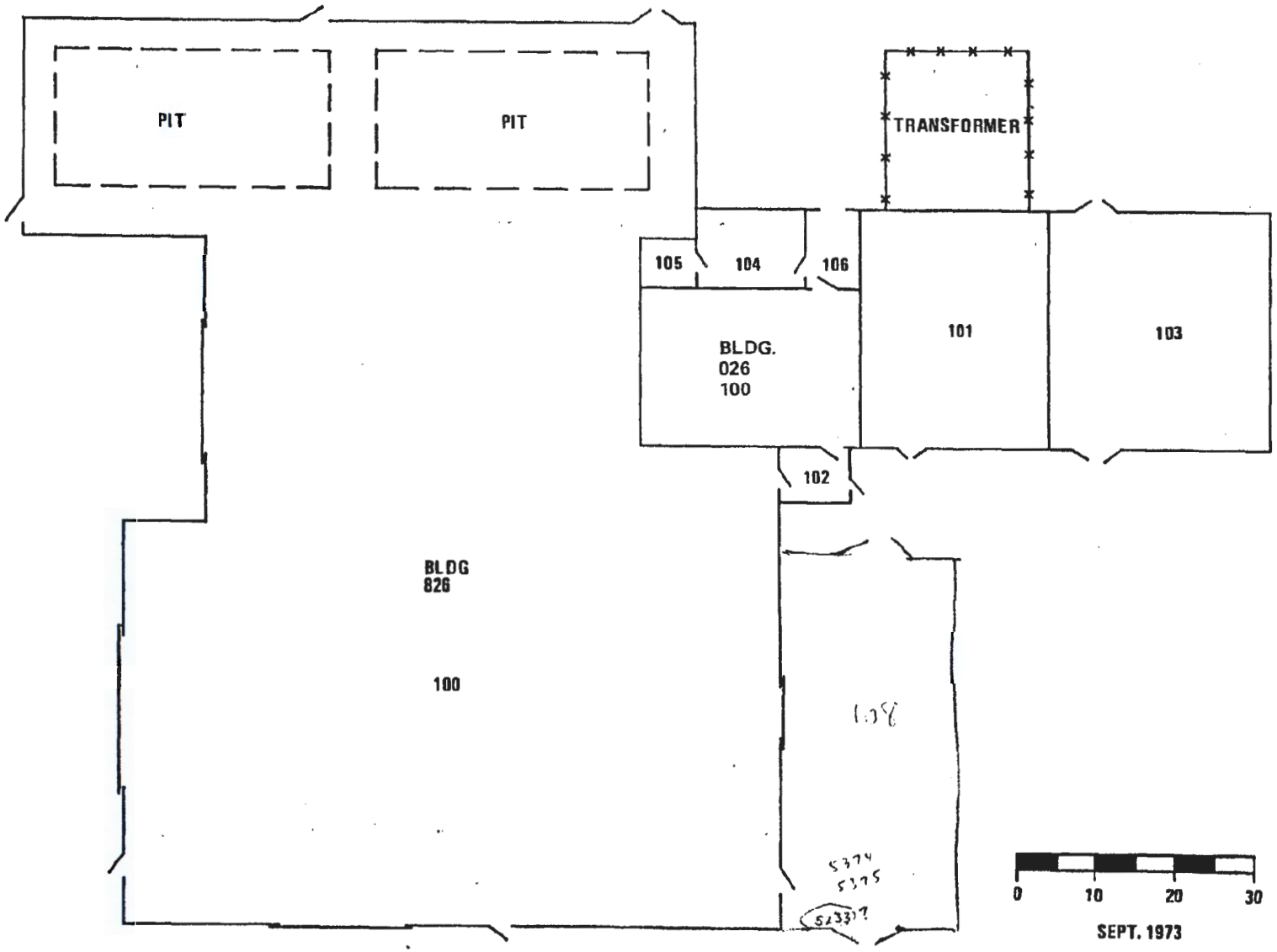
HGL HydroGeoLogic, Inc.

Redacted

Y:/Santa_Susana/EP9038/TM/HSA_5B (2-4-1a)bldg4026.cdr
Project:EP9038
Revised: 09/08/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.4.1a
Building 4026
Site Photograph



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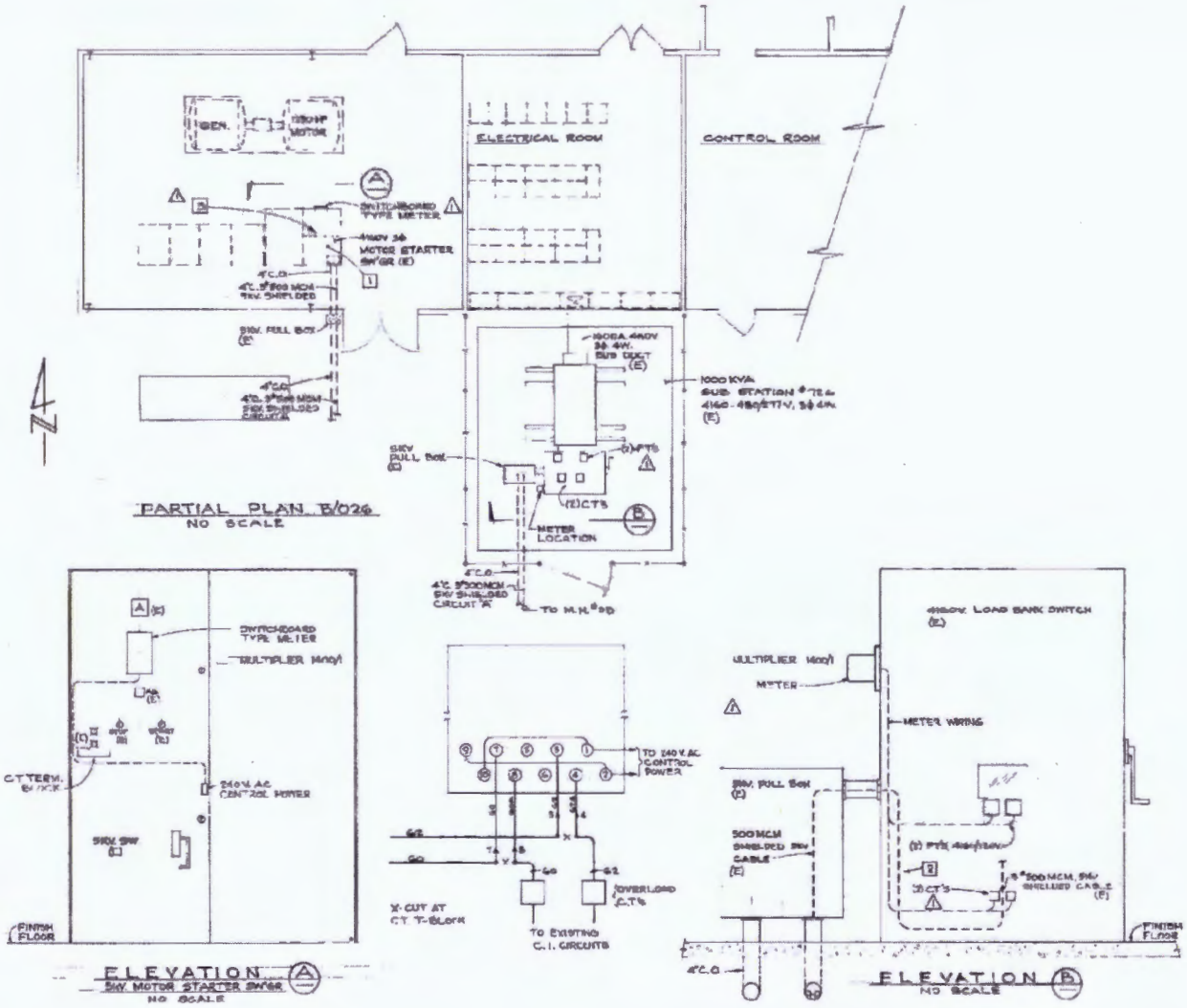
Revised: 09/08/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.4.1b
SCTL
Floor Plan



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Project:EP9038
Revised: 09/08/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.4.1c
Building 4026
Electrical Meter Installation

Redacted

026 After

Y:/Santa_Susana/EP9038/TM/HSA_5B (2-4-1d)building4026PA.cdr
Project:EP9038
Revised: 09/08/2010 TJ
Source: Boeing Company, 2008

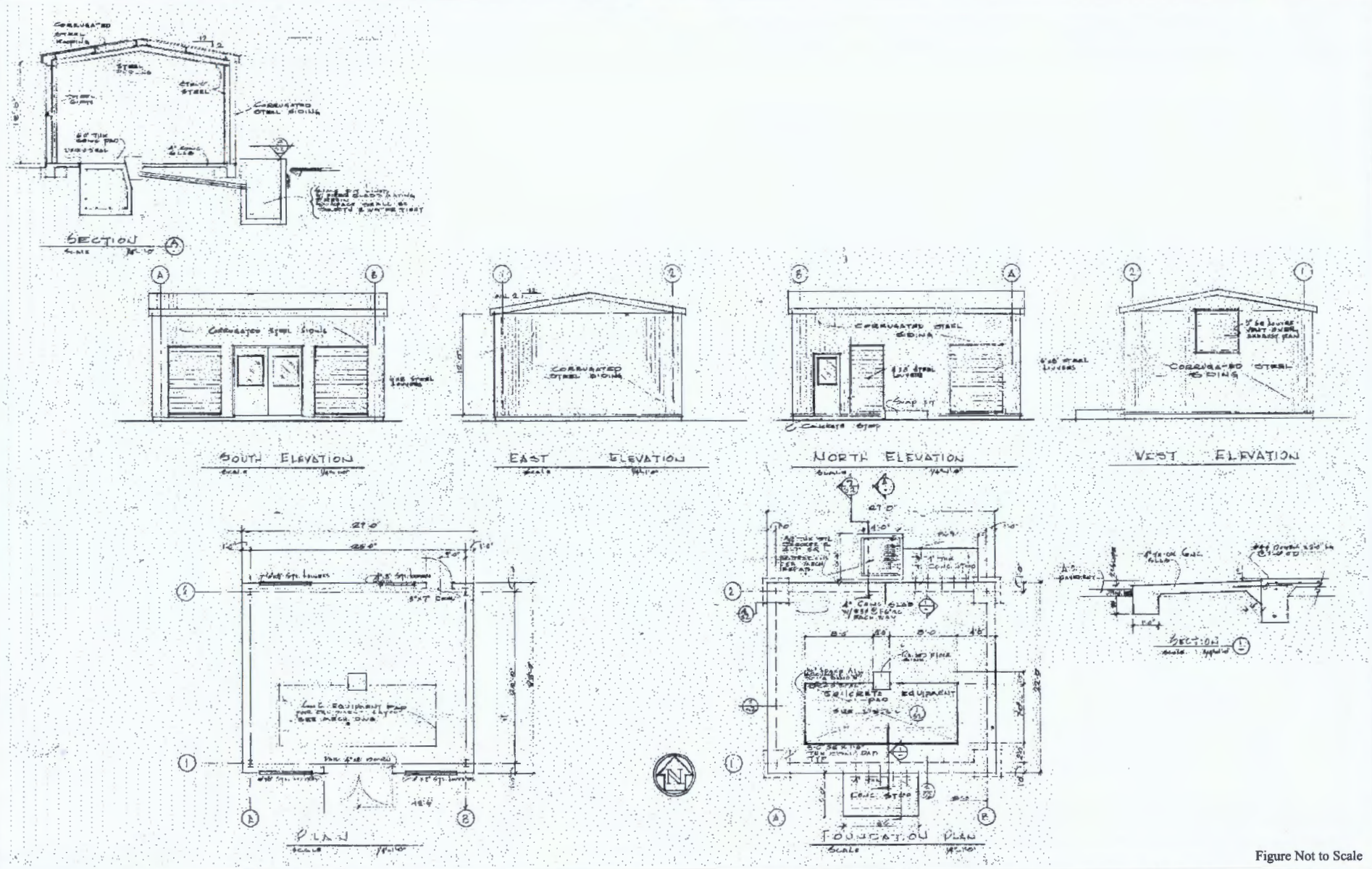
U.S. EPA Region 9

Figure 2.4.1d
Building 4026
After Demolition
Photograph

Y:/Santa_Susana/EP9038/TM/HSA_5B (2-4-2a)bldg4226.cdr
Project:EP9038
Revised: 09/08/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.4.2a
Building 4226
Site Photograph



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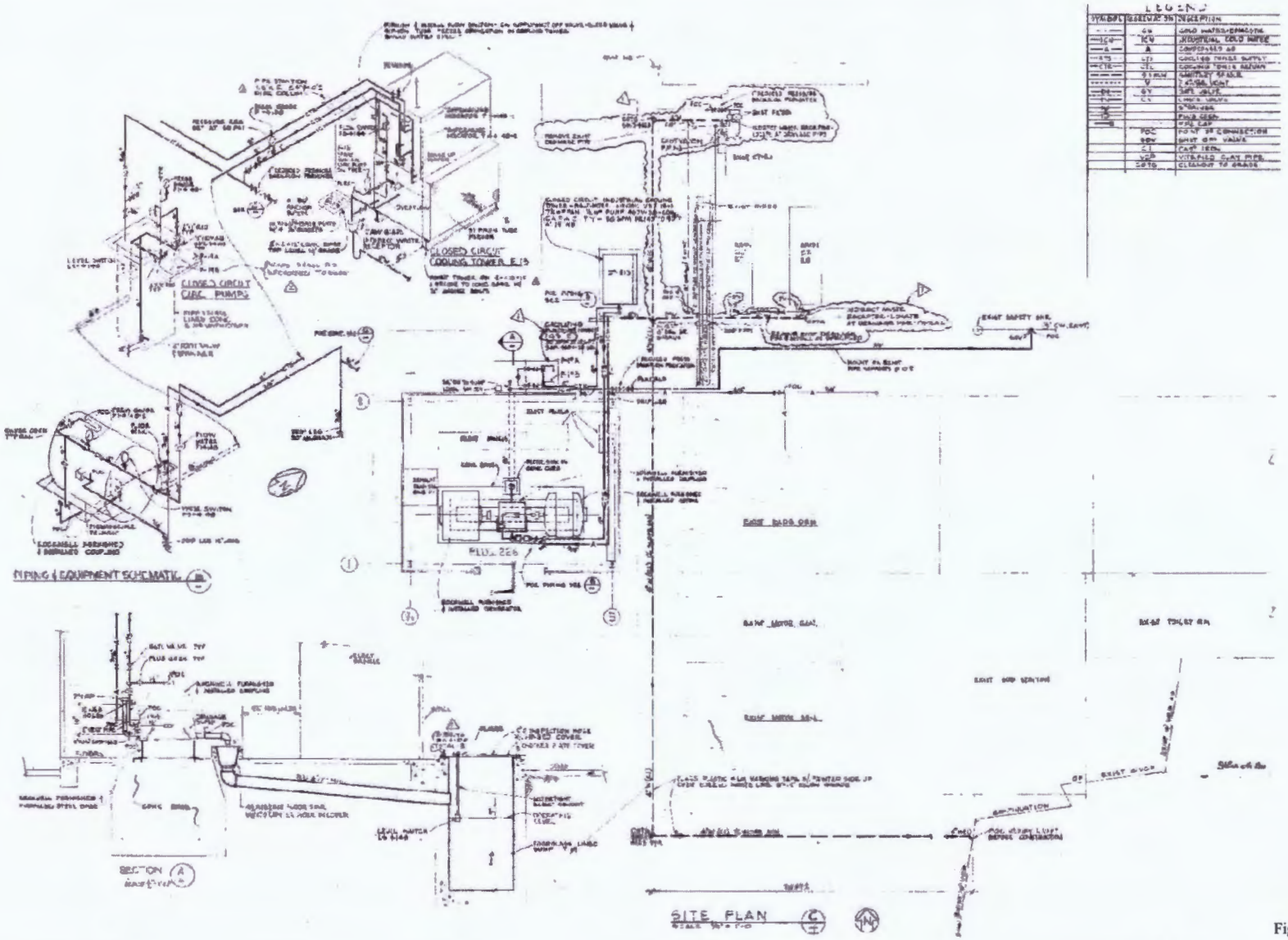
Revised: 09/08/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.4.2b
Building 4226
Foundation and Elevations



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Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.4.2c
Building 4226
Piping and Equipment

Redacted

Y:/Santa_Susana/EP9038/TM/HSA_5B (2-4-3a)bldg4358.cdr
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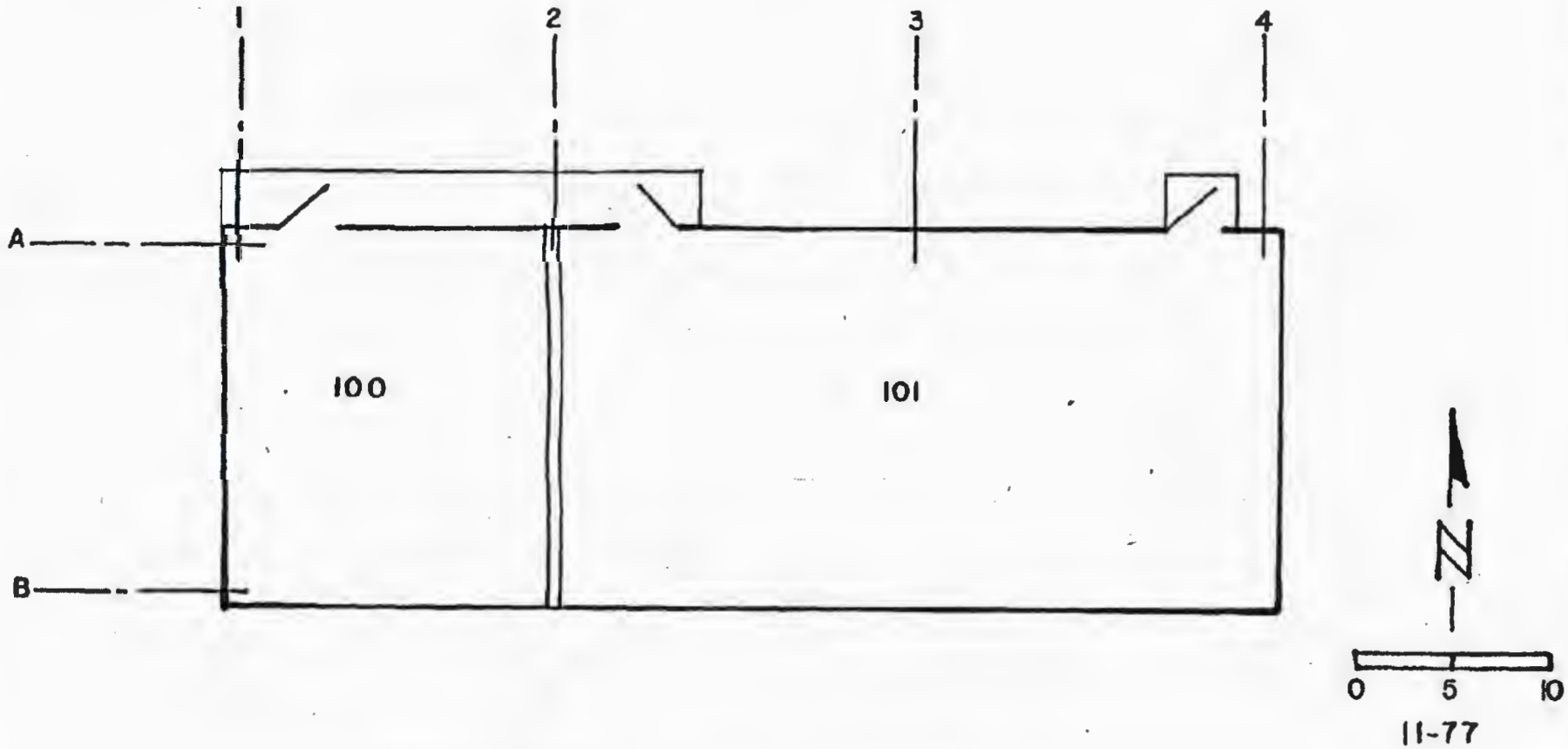
Revised: 09/08/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.4.3a
Building 4358
Site Photograph



SCTI CHEMICAL STORAGE BUILDING NO. 358

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Revised: 09/08/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.4.3b
Building 4358
Floor Plan

Y:/Santa_Susana/EP9038/TM/HSA_5B (2-4-4a)bldg4826.cdr
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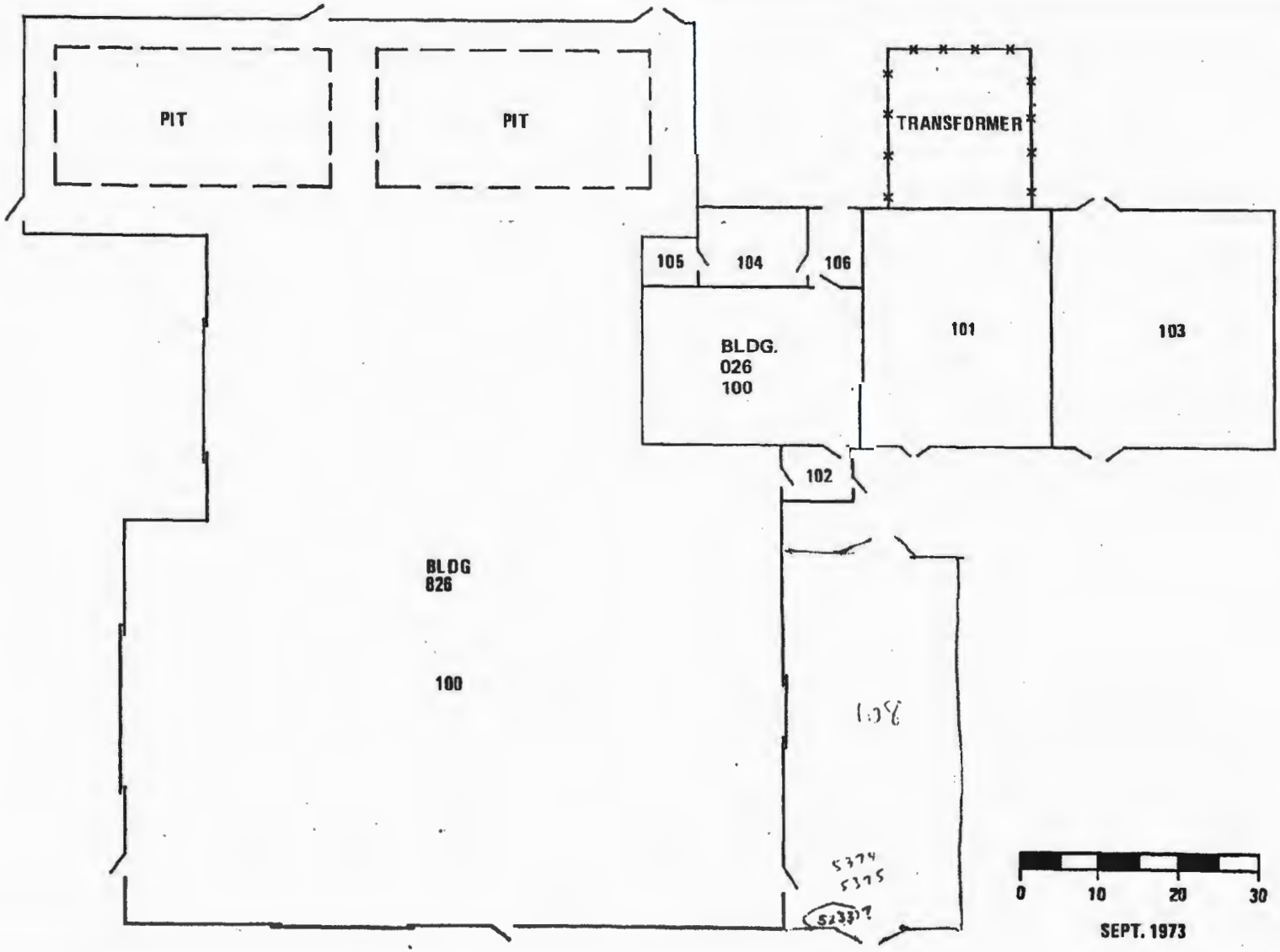
Revised: 09/08/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.4.4a
Building 4826
Site Photograph



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Revised: 09/08/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.4.4b
SCTL
Floor Plan

B/4826 SCTL T-2 & T-3 Sodium System Drain Tanks

Y:/Santa_Susana/EP9038/TM/HSA_5B (2-4-4c)building4826PT.cdr
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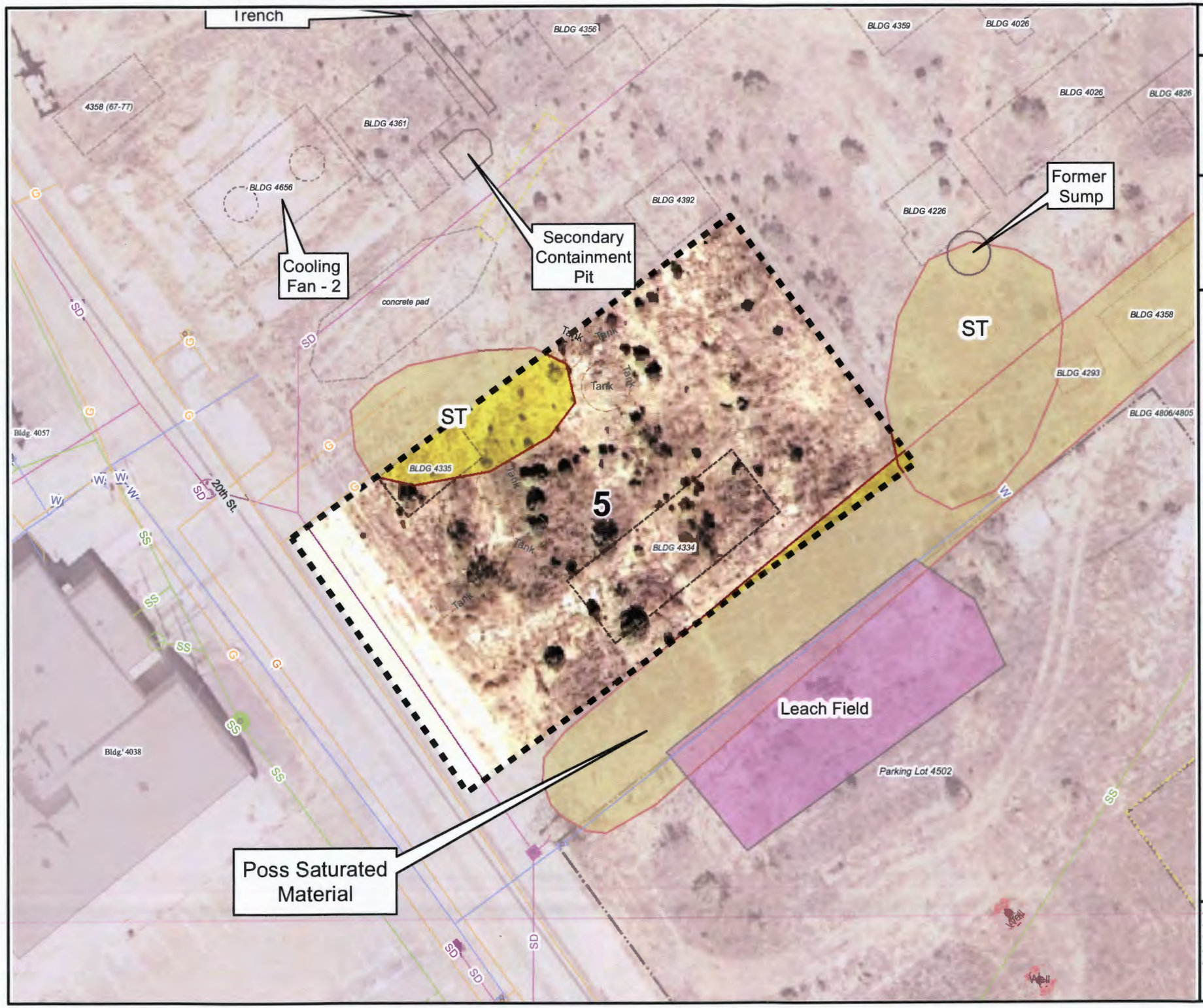
Revised: 06/24/2010 RB
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.4.4c
Building 4826
Drain Tanks
Photograph



Historical Site Assessment
Final Technical Memorandum - HSA-5B

Figure 2.5
Area IV Subarea 5B-5
Santa Susana Field Laboratory

U.S. EPA Region 9

Legend

- Subarea 5B-5 Boundary
- Primary Roads
- Secondary Roads
- Underground Storage Tank
- Unknown Tank Type
- Sump
- Dry Well
- Tank Footprint
- Above ground Storage Tank
- Demolished Bldg.
- Existing Bldg.
- Parking Lots
- Drainage
- Drain
- Well

Aerial Photo Features

- Aerial Photography Features
- Leach Field
- Other

Surface Water

- Intermittent Stream
- Permanent Stream
- Surface Water
- Lined Channel
- French Drain
- Drainage
- Leach Field
- Septic System

Utilities

- Channel
- Drain
- Drain
- Drainage Divide
- Gutter
- Tank
- Tank
- Vault
- Well
- G Gas
- SD Storm Drain
- SS Sanitary Sewer
- W Water

B	Building
CONT	Container
CR	Crates
DB	Debris
DG	Disturbed Ground
DTM	Dark Tone Material
EX	Excavation
FA	Fill Area
GS	Ground Scar
HT	Horizontal Tank
IM	Impoundment
MTMM	Medium Toned Mounded Material
OS	Open Storage
PA	Processing Area
PL	Parking Lot
POSS	Possible
PROB	Probable
S-T	Storage Tank
SS	Smoke Stack
ST	Storage
UO	Unidentified Object
VT	Vertical Tank
WDA	Waste Disposal Area

N

0 15 30 60
Scale In Feet

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Created: TJansen
Revised: 10/25/2010 TJ
Sorce: Boeing Company, 2008
CIRGIS, 2007

HGL HydroGeoLogic, Inc.

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Y:/Santa_Susana/EP9038/TM/HSA_5B (2-5-1a)bldg4334.cdr
Project:EP9038
Revised: 09/08/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.5.1a
Building 4334
Site Photograph

Y:/Santa_Susana/EP9038/TM/HSA_5B (2-5-2a)bldg4335.cdr
Project:EP9038
Revised: 09/08/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.5.2a
Building 4335
Site Photograph

Historical Site Assessment
Final Technical Memorandum - HSA-5B

Figure 2.6
Area IV Subarea 5B-6
Santa Susana Field Laboratory

U.S. EPA Region 9

Legend

- Subarea 5B-6 Boundary
- Primary Roads
- Secondary Roads
- Underground Storage Tank
- Unknown Tank Type
- Sump
- Dry Well
- Tank Footprint
- Above ground Storage Tank
- Demolished Bldg.
- Existing Bldg.
- Parking Lots
- Drainage
- Drain
- Well

Aerial Photo Features

- Aerial Photography Features
- Leach Field
- Other

Surface Water

- Intermittent Stream
- Permanent Stream
- Surface Water
- Lined Channel
- French Drain
- Drainage
- Leach Field
- Septic System

Utilities

- Channel
- Drain
- Drain
- Drainage Divide
- Gutter
- Tank
- Tank
- Vault
- Well
- Gas
- Storm Drain
- Sanitary Sewer
- Water

B	Building
CONT	Container
CR	Crates
DB	Debris
DG	Disturbed Ground
DTM	Dark Tone Material
EX	Excavation
FA	Fill Area
GS	Ground Scar
HT	Horizontal Tank
IM	Impoundment
MTMM	Medium Toned Mounded Material
OS	Open Storage
PA	Processing Area
PL	Parking Lot
POSS	Possible
PROB	Probable
S-T	Storage Tank
SS	Smoke Stack
ST	Storage
UO	Unidentified Object
VT	Vertical Tank
WDA	Waste Disposal Area

N

0 25 50 100
Scale In Feet

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HGL HydroGeoLogic, Inc

Redacted

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Project:EP9038
Revised: 09/08/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.6.1a
Building 4293
Site Photograph

Y:/Santa_Susana/EP9038/TM/HSA_5B (2-6-2a)bldg4310.cdr
Project:EP9038
Revised: 09/08/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.6.2a
Building 4310
Site Photograph

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Project:EP9038
Revised: 09/08/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.6.3a
Building 4354
Site Photograph

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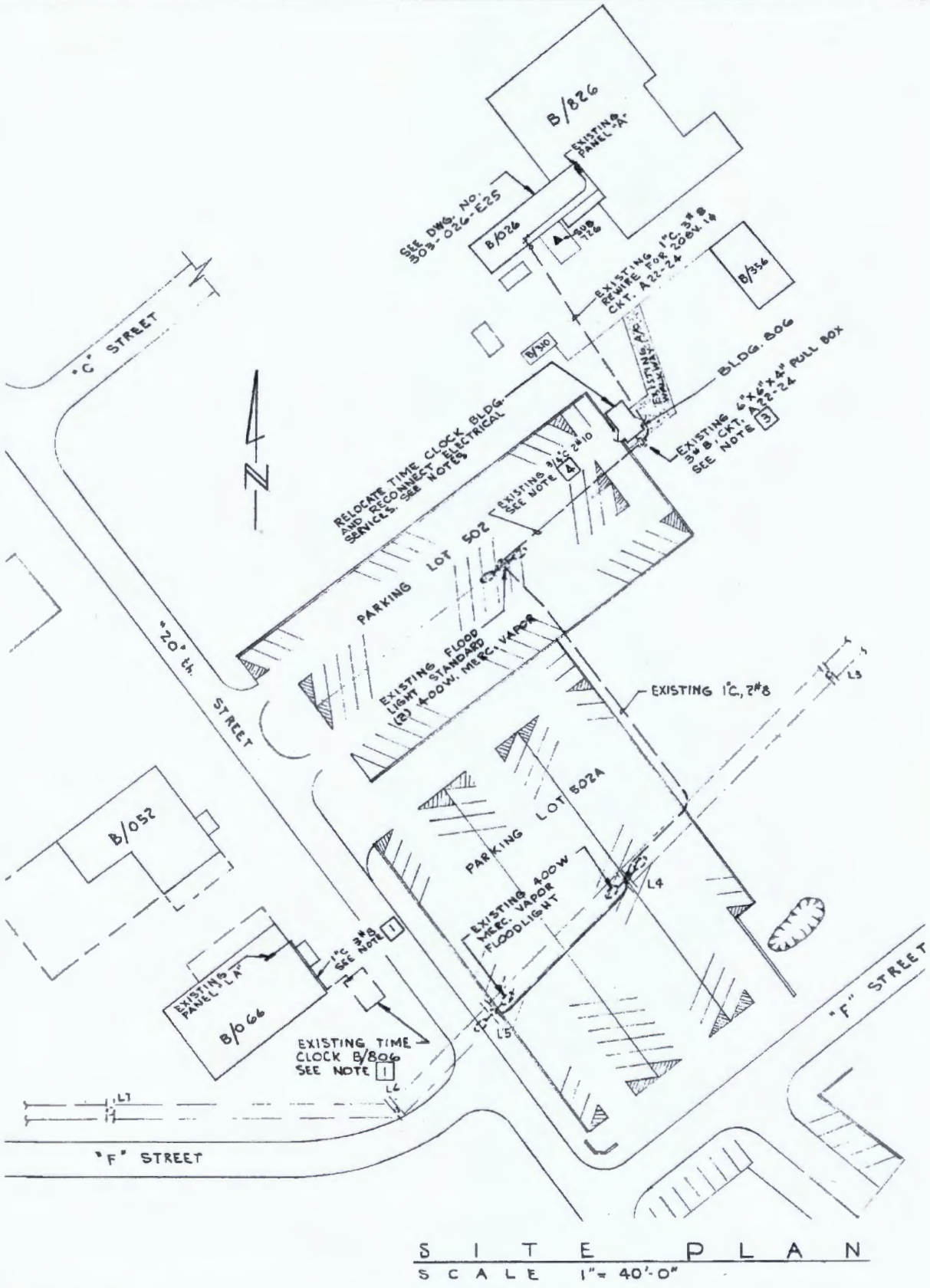
Revised: 09/08/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.6.4a
Parking Lot 4502
Site Photograph



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Revised: 09/08/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.6.4b
Parking Lot 4502
Power and Lighting

Y:/Santa_Susana/EP9038/TM/HSA_5B (2-6-5a)Bldg4639.cdr
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Revised: 09/08/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.6.5a
Building 4639
Site Photograph

Y:/Santa_Susana/EP9038/TM/HSA_5B (2-6-6a)Bldg4704.cdr
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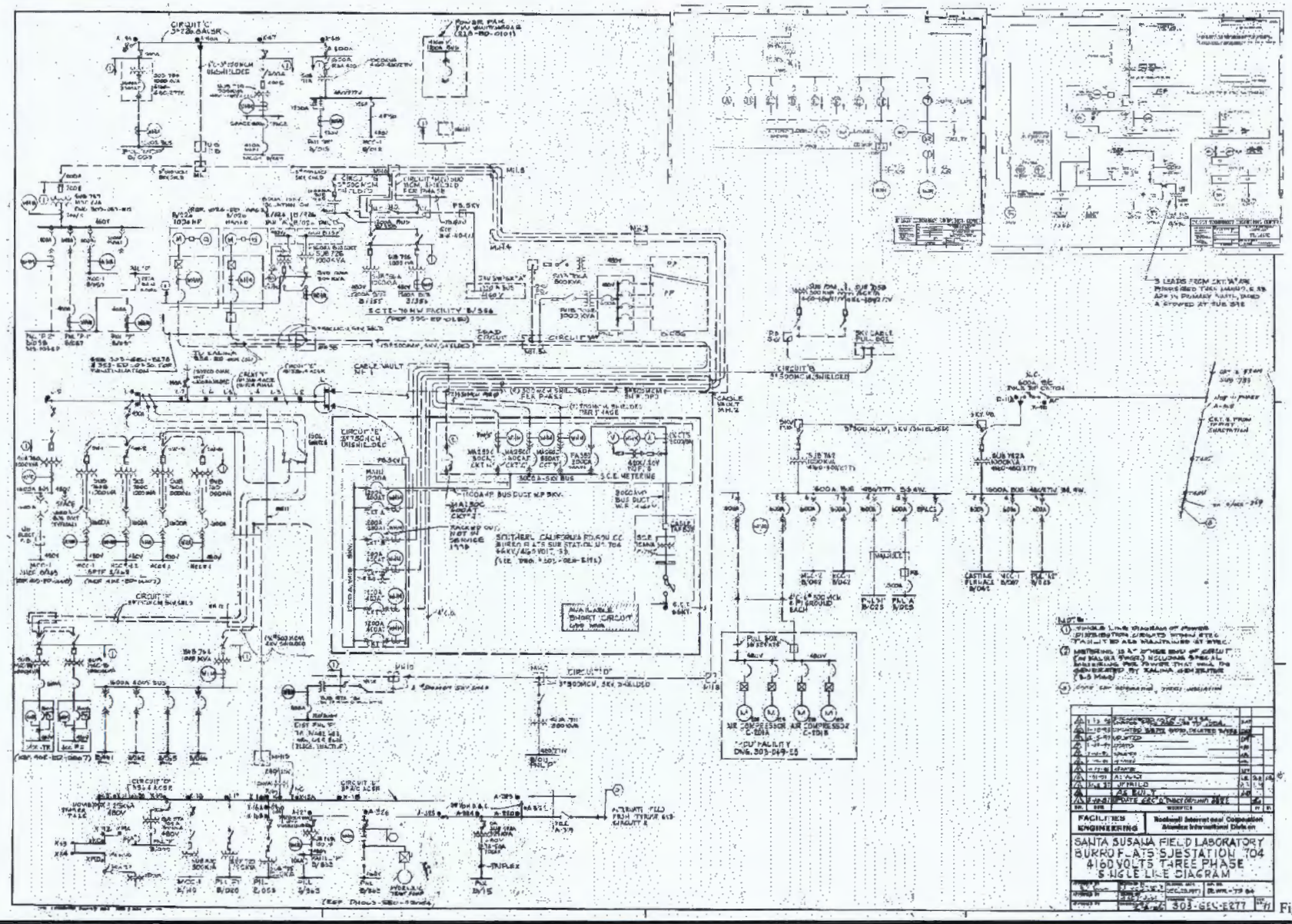
Revised: 09/08/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.6.6a
Building 4704
Site Photograph



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Revised: 09/08/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.6.6b
Building 4704
Substation Diagram

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Project:EP9038
Revised: 09/08/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.6.7a
Building 4714
Site Photograph

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Y:/Santa_Susana/EP9038/TM/HSA_5B (2-6-8a)FuelTank4735.cdr
Project:EP9038
Revised: 09/08/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.6.8a
Fuel Tank 4735
Site Photograph

Figure 2.7
Area IV Subarea 5B-7
Santa Susana Field Laboratory

U.S. EPA Region 9

Legend

- Subarea 5B-7 Boundary
- Primary Roads
- Secondary Roads
- Underground Storage Tank
- Unknown Tank Type
- Sump
- Dry Well
- Tank Footprint
- Above ground Storage Tank
- Demolished Bldg.
- Existing Bldg.
- Parking Lots
- Drainage
- Drain
- Well

Aerial Photo Features

- Aerial Photography Features
- Leach Field
- Other

Surface Water

- Intermittent Stream
- Permanent Stream
- Surface Water
- Lined Channel
- French Drain
- Drainage
- Leach Field
- Septic System

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- Channel
- Drain
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- Drainage Divide
- Gutter
- Tank
- Tank
- Vault
- Well
- Gas
- Storm Drain
- Sanitary Sewer
- Water

B	Building
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CR	Crates
DB	Debris
DG	Disturbed Ground
DTM	Dark Tone Material
EX	Excavation
FA	Fill Area
GS	Ground Scar
HT	Horizontal Tank
IM	Impoundment
MTMM	Medium Toned Mounded Material
OS	Open Storage
PA	Processing Area
PL	Parking Lot
POSS	Possible
PROB	Probable
S-T	Storage Tank
SS	Smoke Stack
ST	Storage
UO	Unidentified Object
VT	Vertical Tank
WDA	Waste Disposal Area

0 25 50 100
Scale In Feet

N

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HGL HydroGeoLogic, Inc.

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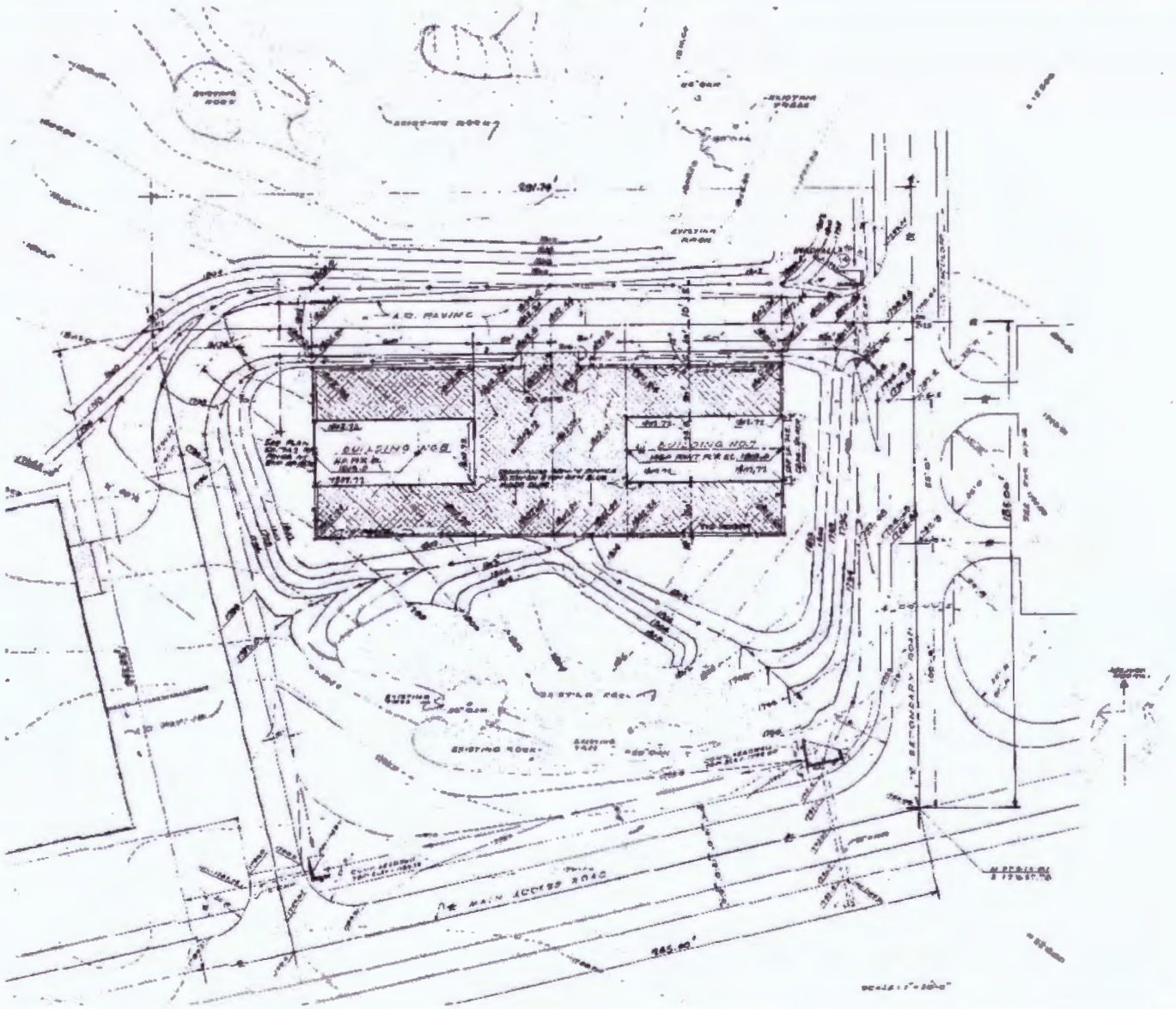
Revised: 09/08/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.7.1a
Building 4007
Site Photograph



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Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.7.1b
Building 4007
Paving and Grading

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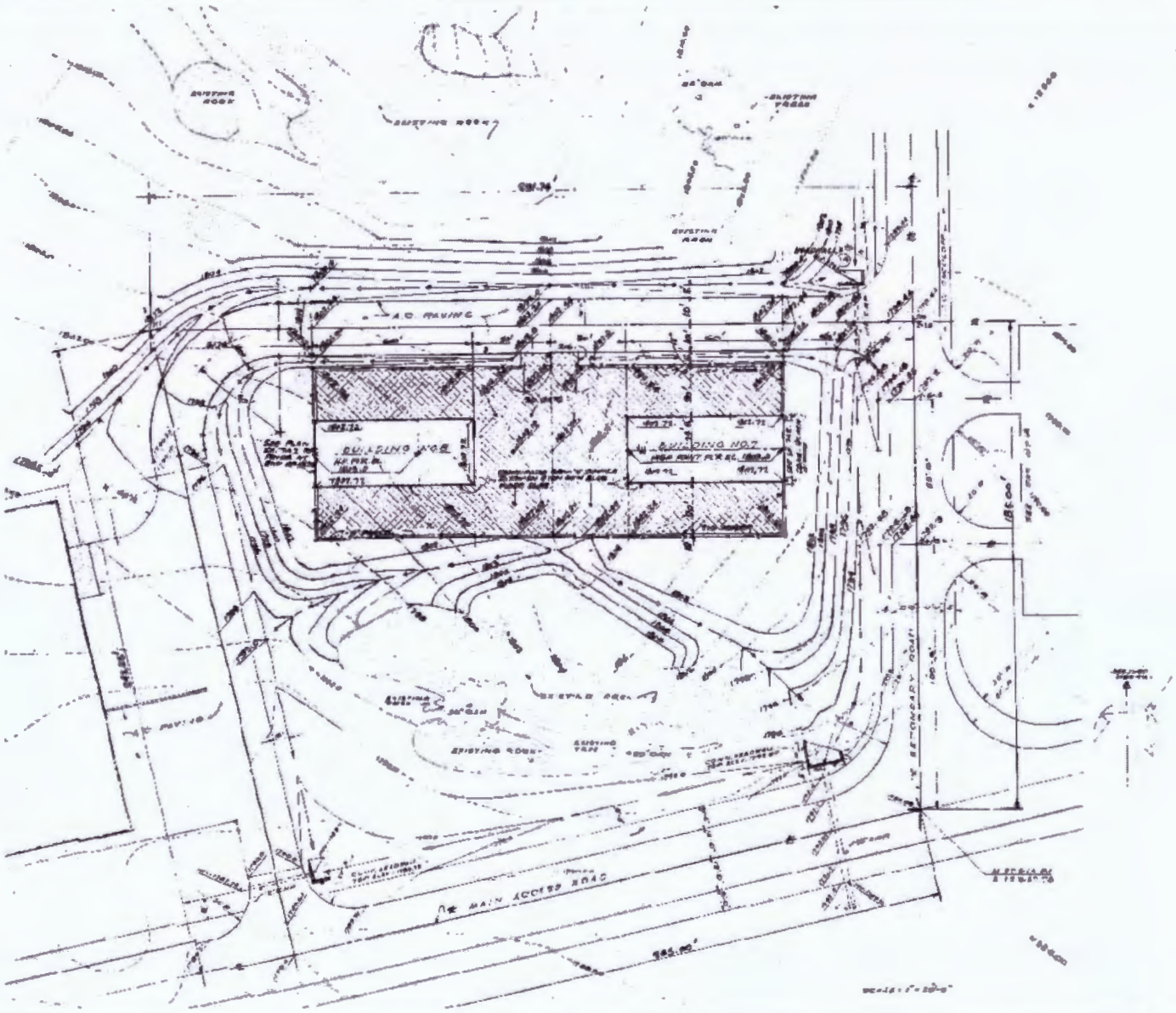
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.7.2a
Building 4008
Site Photograph



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Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.7.2b
Building 4008
Paving and Grading

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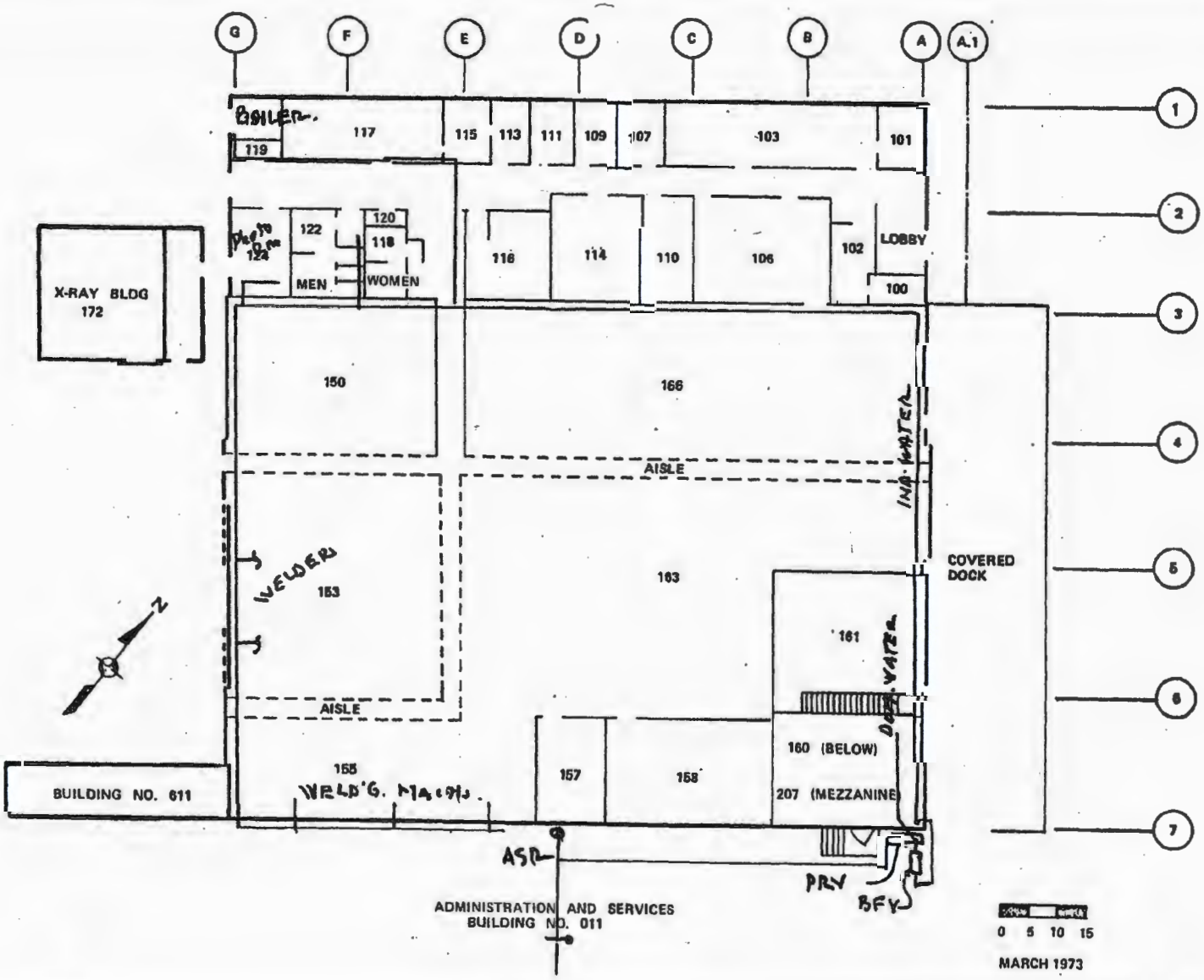
Project:EP9038
Revised: 09/08/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.7.3a
Building 4011
Site Photograph



Y:/Santa_Susana/EP9038/TM/HSA_5B (2-7-3b)building4011FP.cdr
Project:EP9038
Revised: 09/08/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.7.3b
Building 4011
Floor Plan

Y:/Santa_Susana/EP9038/TM/HSA_5B (2-7-3c)building4011SL.cdr
Project:EP9038
Revised: 06/24/2010 RB
Source: Boeing Company, 2008

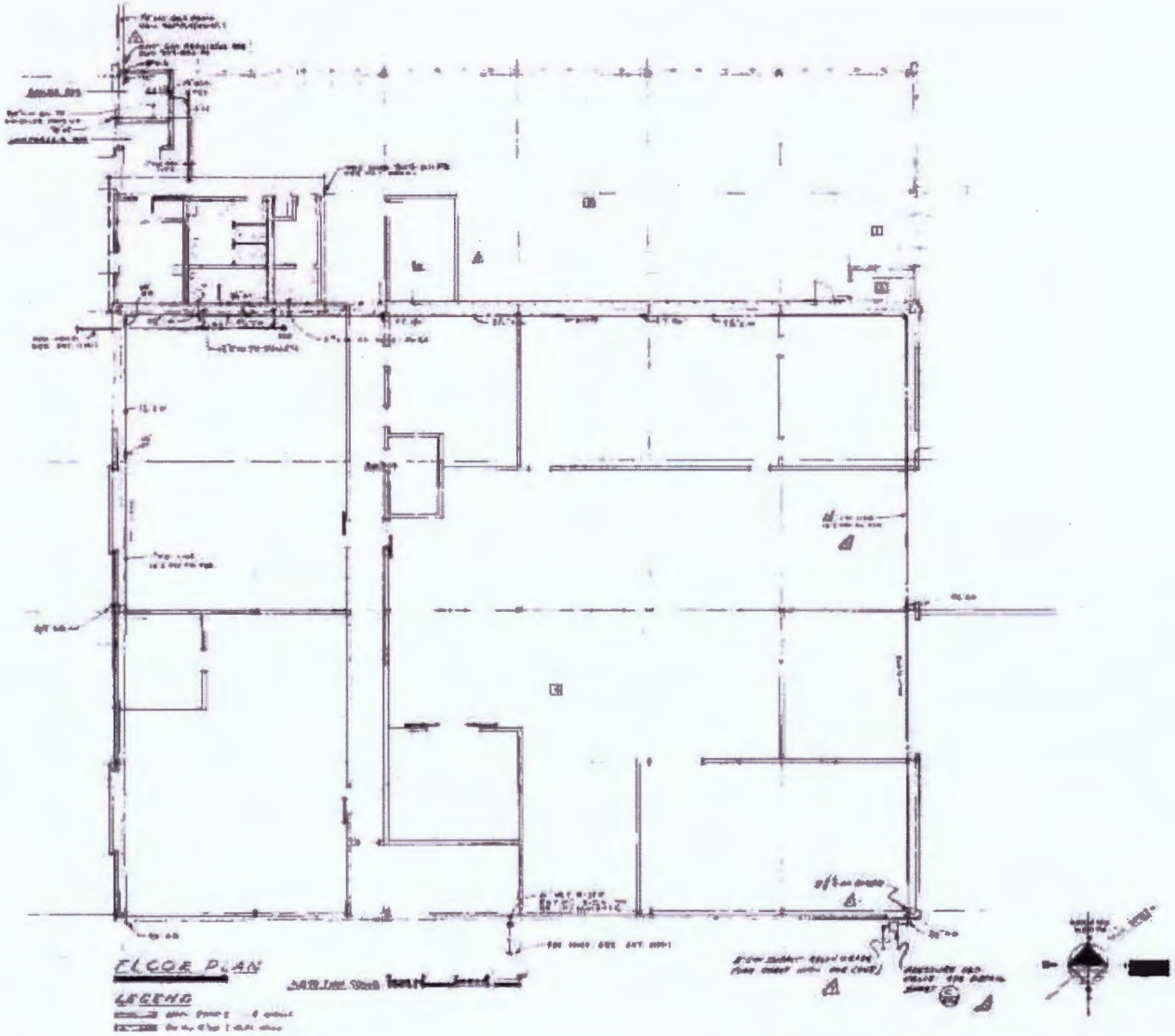
U.S. EPA Region 9

Figure 2.7.3c
Building 4011
Septic Area
Photographs

Y:/Santa_Susana/EP9038/TM/HSA_5B
(2-7-3d)building4011PL.cdr
Project:EP9038
Revised: 09/08/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

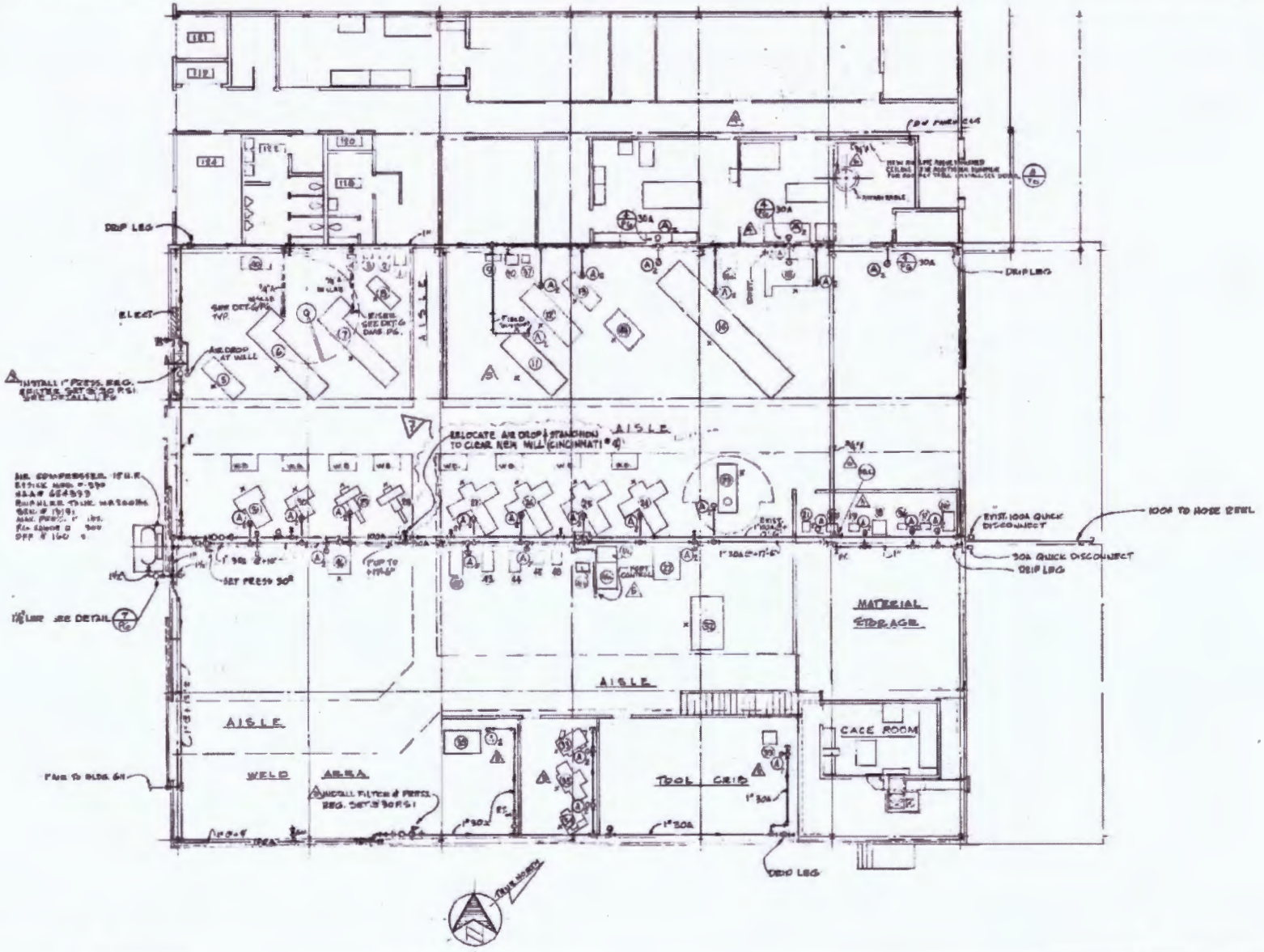
Figure 2.7.3d
Building 4011
Leach Field
Photograph



Y:/Santa_Susana/EP9038/TM/HSA_5B (2-7-3e)bldg4011ABPP.cdr
Project:EP9038
Revised: 09/08/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.7.3e
Building 4011
Plumbing Plan



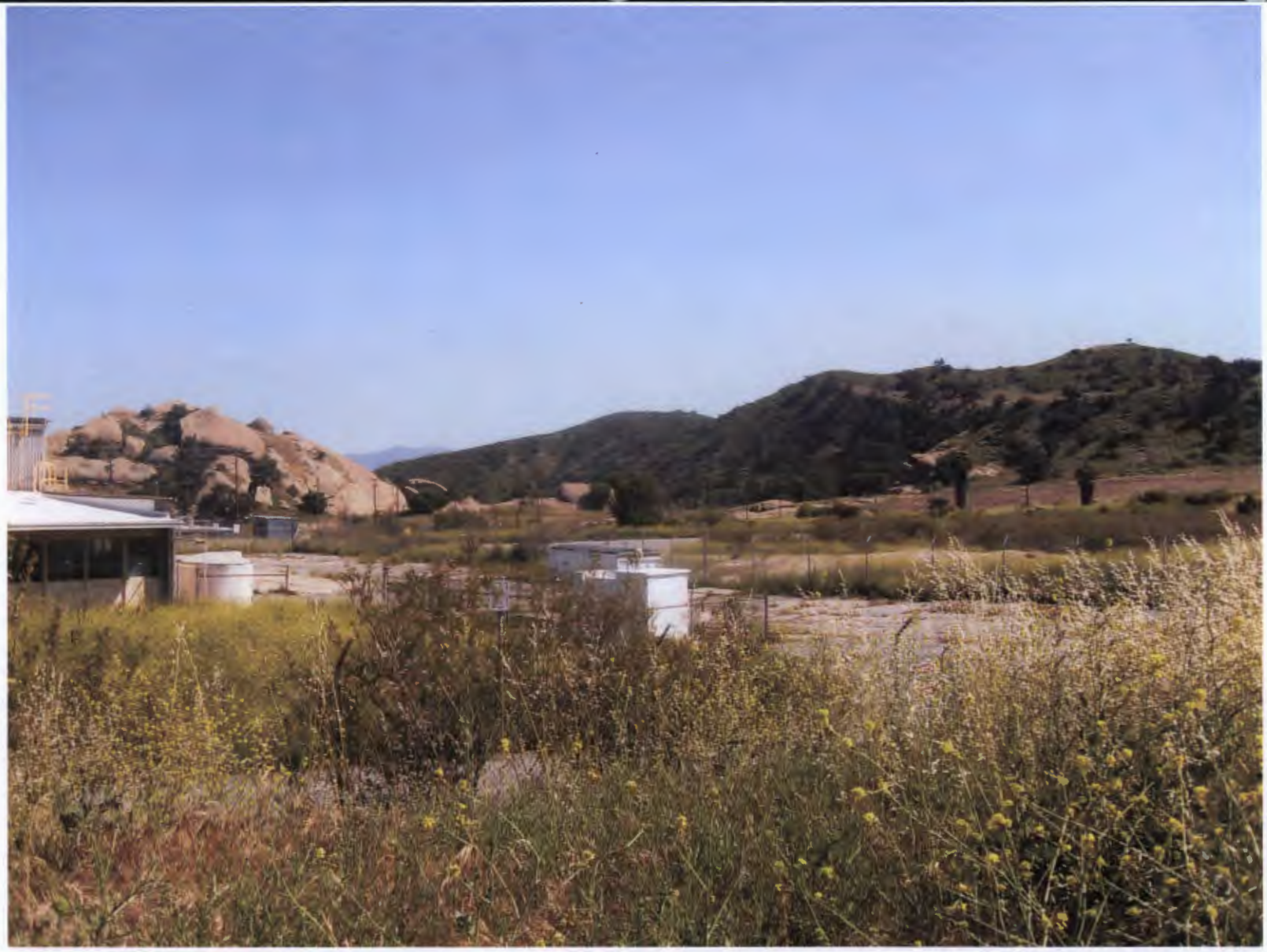
Y:/Santa_Susana/EP9038/TM/HSA_5B (2-7-3f)bldg4011ABAP.cdr
Project:EP9038
Revised: 09/08/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

LEGEND

Figure 2.7.3f
Building 4011
Air Piping Plan

Redacted



Y:/Santa_Susana/EP9038/TM/HSA_5B (2-7-4a)Bldg4171.cdr
Project:EP9038
Revised: 09/08/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.7.4a
Building 4171
Site Photograph

Y:/Santa_Susana/EP9038/TM/HSA_5B (2-7-5a)Bldg4172.cdr
Project:EP9038
Revised: 09/08/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.7.5a
Building 4172
Site Photograph

Y:/Santa_Susana/EP9038/TM/HSA_5B (2-7-6a)Bldg4500.cdr
Project:EP9038
Revised: 09/08/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.7.6a
Building 4500
Site Photograph

Y:/Santa_Susana/EP9038/TM/HSA_5B (2-7-7a)ParkingLot4521.cdr
Project:EP9038
Revised: 09/08/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.7.7a
Parking Lot 4521
Site Photograph

Y:/Santa_Susana/EP9038/TM/HSA_5B (2-7-8a)Bldg4611.cdr
Project:EP9038
Revised: 09/08/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.7.8a
Building 4611
Site Photograph

Y:/Santa_Susana/EP9038/TM/HSA_5B (2-7-9a)Bldg4612.cdr
Project:EP9038
Revised: 09/08/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.7.9a
Building 4612
Site Photograph

Figure 2.8
Area IV Subarea 5B-8
Santa Susana Field Laboratory

U.S. EPA Region 9

Legend

- Subarea 5B-8 Boundary
- Primary Roads
- Secondary Roads
- Underground Storage Tank
- Unknown Tank Type
- Sump
- Dry Well
- Tank Footprint
- Above ground Storage Tank
- Demolished Bldg.
- Existing Bldg.
- Parking Lots
- Drainage
- Drain
- Well

Aerial Photo Features

- Aerial Photography Features
- Leach Field
- Other

Surface Water

- Intermittent Stream
- Permanent Stream
- Surface Water
- Lined Channel
- French Drain
- Drainage
- Leach Field
- Septic System

Utilities

- Channel
- Drain
- Drain
- Drainage Divide
- Gutter
- Tank
- Tank
- Vault
- Well
- Gas
- Storm Drain
- Sanitary Sewer
- Water

B	Building
CONT	Container
CR	Crates
DB	Debris
DG	Disturbed Ground
DTM	Dark Tone Material
EX	Excavation
FA	Fill Area
GS	Ground Scar
HT	Horizontal Tank
IM	Impoundment
MTMM	Medium Toned Mounded Material
OS	Open Storage
PA	Processing Area
PL	Parking Lot
POSS	Possible
PROB	Probable
S-T	Storage Tank
SS	Smoke Stack
ST	Storage
UO	Unidentified Object
VT	Vertical Tank
WDA	Waste Disposal Area

N

0 25 50 100
Scale In Feet

Filepath: Y:\Santa_Susana\EP9038\TM\HSA_5B\(2-8)5B-8.mxd
Project: EP9038
Created: TJansen
Revised: 10/25/2010 TJ
Sorce: Boeing Company, 2008
CIRGIS, 2007

HGL HydroGeoLogic, Inc

Redacted

Y:/Santa_Susana/EP9038/TM/HSA_5B (2-8-1a)17thDrainage.cdr
Project:EP9038
Revised: 09/08/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.8.1a
17th Street
Drainage Area
Site Photograph

RESPONSE TO COMMENTS

Response to Comments on Draft HSA-5B Technical Memoranda Issued on October 25, 2010
Historical Site Assessment, Santa Susana Field Laboratory Site
Area IV Radiological Study, Ventura County, California

Item	Comment	Response
1	Starting with the above photo [in Commenter's letter dated 11/12/2010], there looks to be some type of white cask/drum storage in the area known as the 17th street drainage, which could explain the radiological contamination discovered here. Can these be explained by asking the Department of Energy (DOE) or The Boeing Co.?	Agreed. This area was targeted with a high sample density, which included sample locations placed along this particular spot.
2	Moving on to Figure 2.8 of the HSA-5B-8 Tech Memo (TM) that features the SSFL AREA IV/AREA III border above building 271 is incorrect and as the boundary line runs right through the said facility. The above image [in Commenter's letter dated 11/12/2010] is the more Correct Version of Mapping as taken from the 1984 Survey Map created by R.K. Boyles as seen in the link below. http://www.rocketdynearchives.com/images/Rockwell_Map_of_the_SSFL_1984_Rocketdyne_archives_boeing_ssfl_santa_susana_field_lab_nuclear_laboratory.pdf	Noted. EPA anticipates keeping the boundary as depicted in Figure 2.8 with Building 271 within Area IV. If the property owner objects, we will revisit the Area III/IV survey building at that time.
3	The Tritium groundwater plume could pose a potential problem for the soil as stated in several reports that have identified Tritium in the Soil in, and around AREA IV including offsite in the Runkle Canyon area. A commitment needs to be made in writing by DOE and EPA that Tritium (in Soil) will be on the list for Investigation and Remediation [see inset description and oblique aerial photograph in Commenter's letter dated 11/12/2010].	Noted. Tritium is identified in Table 2-4 of the Master Soil FSP as an analyte that will be tested for in soils at the SRE, Buildings 4010, 4059, 4028, and 4024, and at the site of the tritium groundwater plume.
4	The above photo [in Commenter's letter dated 11/12/2010] may help in some identification of pipes to and from Building 4011, this is the 2001 excavation of the Building 11 Leach Field.	Agreed. EPA appreciates the photo provided by the Commenter and it was considered in development of the Subarea 5C Addendum to the FSP for Soil Sampling. Twelve surface and subsurface samples were located in the area of these pipe lines to characterize potential contamination left behind post removal action.

Agree – Comment will be integrated in HSA and soil testing program as appropriate. **Noted** - Comment will not be integrated into HSA or soil testing program.

5	The above photo from 1988 shows a few areas that are not facilities, yet might need extra investigation as a potential radiological or chemical Area of Concern (AOC). In the upper right we see the Central Parking area of the HAS – 5-B reporting area that has what appears to be roll off bins that are charred and could be used in waste destruction. Just to the left of this is Tank #735 which was used as Fuel Storage, not Water, this needs to be addressed. To the North of the Central Parking area, we see an Open Field with what appears to be a pond and debris storage. From several aerial photographs this area indicates that is was used for waste storage and/or destruction and the fact that there is/was no facility located here this should be listed as an AOC. There appears to be a storage area of blue 55 gallon drums under the 4010 Facility, and needs to be investigated. We see Building 13 in the bottom middle and to its left we see how Building 12 has been modified from its original design as seen in the black and white photograph on the following page. Have the responsible parties given EPA use to such photos as the above. We need to examine more of these and insert them in all portions of the HAS.	Agreed. All the input provided by the Commenter was considered by EPA. The findings described in the HSA, as well as review of gamma and geophysical survey results, led to the placement of 99 total soil samples over 60 locations within groups 2, 3, 4, and 5 in Subarea 5B. These sample locations coincide with the areas identified by the Commenter as well as those identified by this evaluation process. In the area of Building 4010 footprint alone (group 1) approximately 40 surface and subsurface samples were collected from 26 locations.
6	I would like a higher resolution version of the Document Named HSA-5B_Figs_2-of-2.pdf, there are some details I am concerned with and cannot read the fine print.	Agreed. EPA provided higher resolution files on CD-ROM and the Stakeholder Sharepoint website. The higher resolution maps and photographs result in file sizes that are too big to send via e-mail conveniently.

Agree – Comment will be integrated in HSA and soil testing program as appropriate. **Noted** – Comment will not be integrated into HSA or soil testing program.

7	Point of clarification: I am a bit surprised at Commenter's insistence to move the property line based on an old map. I would just like to point out that moving the line would effectively reduce the EPA study area of area IV. This is important considering the investigative process on the other side of that line does not Include the EPA led RAD investigation and surface water flows to the south in this area. Personally, I appreciate the approach EPA has of overlapping the border and hope they will choose to proceed without reducing the study area in this way.	Agreed. EPA provided higher resolution files on CD-ROM and the Stakeholder Sharepoint website. The higher resolution maps and photographs result in file sizes that are too big to send via e-mail conveniently.
8	This is a similar situation for the storage debris area (photo attached to e-mail comment dated 9/27/2010).	Agreed. Issues such as this were discussed and addressed during the technical stakeholder meeting on Subarea 5B.
9	Many (most) of the figures, including the call-outs, do not retain resolution when zoomed in Acrobat. Hence most details are illegible.	Agreed. EPA provided higher resolution files on CD-ROM and the Stakeholder Sharepoint website. The higher resolution maps and photographs result in file sizes that are too big to send via e-mail conveniently.

Agree – Comment will be integrated in HSA and soil testing program as appropriate. **Noted** – Comment will not be integrated into HSA or soil testing program.

10	Page 3, Paragraph 1 The following comment was also made on the Revised 5C Tech Memo. The use of the MARSSIM DCGL to define and distinguish between MARSSIM Class 1, 2, or 3 areas is only meaningful when $DCGL_w$s of similar or greater than background concentrations are used. Post SB 990, the $DCGL_w$ for cesium-137 is the EPA agricultural PRG of 0.0012 pCi/g. This is significantly less than the average background of 0.087 pCi/g, and a hundred times less than the 2 variability of background of +/- 0.12 pCi/g*. Attempting to distinguish between "greater than", "less than", and "a small fraction" of 0.0012 pCi/g in a background distribution of 0.087 +/- 0.12 pCi/g is statistically impossible. Nevertheless the HSA claims to make these determinations based on prior potential or known soil concentration data. Yet little or no soil concentration data is presented in the HSA. SB 990 has made it impossible to perform MARSSIM classification based on prior soil concentrations. Furthermore EPA is not making these determinations based on soil concentration data. Most of the reasons for Class 1 classification given in the various sections entitled "Radiological Contamination Potential" in this tech. memo. are due to location, • Proximity to SNAP building 4XXX • Proximity to storm water channels leading from 4XXX • Potential for airborne releases from 4XXX I suggest EPA redefine its definition of classifications to reflect the fact that "contamination potential" is being used to classify areas, e.g., Class 1. High potential for contamination Class 2. Medium potential for contamination Class 3. Low potential for contamination * 1995 McLaren Hart Study	Noted. The approach of designating MARSSIM class described in Section 1.0 of the HSA explains that these designations are preliminary and based on radiological process knowledge and that as soil radiological results become available, these designations can be adjusted to more accurately reflect the potential for contamination.

Agree – Comment will be integrated in HSA and soil testing program as appropriate. **Noted** – Comment will not be integrated into HSA or soil testing program

11	Page 7, 1st paragraph The following comment was also made on the Revised 5C Tech Memo. Change "California Department of Public Health and Environment (CDPHE)" to "California Department of Public Health (CDPH)" Correct all subsequent references to CDPHE.	Agreed. This correction will be made to future TMs.
12	Page 8, Section "Previous Rad Investigations" The following comment was also made on the Revised 5C Tech Memo. The note "It is recognized that none [surveys] were adequate in that they did not comply with the requirements of SB 990" is misleading as written, and requires some contextual amplification. Suggest deleting or including the following to provide context. Prior surveys (including many conducted by EPA) were deemed "adequate" and to meet existing state and federal cleanup standards by the respective agencies with jurisdiction. These standards were, and still are, based on safe and protective, structural surface contamination limits and soil concentration limits that are similar to those enforced at other cleanup sites in the U.S. Furthermore, soil concentration standards were based on a suburban residential land use scenario that will not occur, and is therefore ultra-conservative. Ultimate SSFL land use will be open-space parkland. Theoretical risks for this "realistically anticipated land use" will be significantly less than suburban residential theoretical risks upon which prior soil cleanup standards were based. The fact that SB 990 (which applies only to SSFL and to no other site in California or the U.S.) attempts to mandate cleanup standards based on a non-anticipated land use, in violation of CERCLA, does not invalidate the "adequacy" of prior surveys, nor does it make the current radiological status of Area IV "less safe" for either current workers or future public users of the site.	Agreed. Text referencing SB990 has been modified in subsequent HSA TMs.

Agree – Comment will be integrated in HSA and soil testing program as appropriate. **Noted** – Comment will not be integrated into HSA or soil testing program.

13	Page 28, 2nd paragraph An interviewee states, *"I had to call security first so they would adjust the radiation monitors that were across the road and down the hill."* This statement is puzzling. Security was not authorized or knowledgeable enough to *"adjust radiation monitors."* What external radiation monitors are being referred too? We had radiation alarm systems inside nuclear facilities, but not outside facilities. Environmental and fence line radiation exposure was monitored using dosimeters similar to those worn by personnel. These are not real time monitors and cannot be "adjusted." Air samples located around Area IV operated 24/7, but these sample airborne activity, not radiation exposure. What is the relevance of this comment to potential environmental contamination?	Noted. This statement is what the interviewee said, therefore no changes to the TM are proposed. Airborne activity is of potential environmental concern.
14	Page 210, Section 3.1 A similar comment to that below was also made for the revised 5C Tech memo. This section in the 5B Tech Memo is identical to the 5C Tech Memo. The SNM-21 license was not amended 8 times, it was renewed, extended and/or amended 79 times in its 40 year history. NAA and Rockwell (as non-governmental entities) required the SNM-21 license in order to possess and use special nuclear material in company owned facilities, i.e. non-federally owned facilities. Therefore buildings 4010, 4012 and 4019 were not included in the SNM-21 license because they were owned by the federal government, not by NAA or Rockwell. Therefore SNM-21 is not relevant to the nuclear facilities discussed in subarea 5B, and should be deleted from this tech. memo. It will however be relevant for subarea 5D that includes the Rockwell owned Hot Lab (Building 4020) and Building 4055. Both of these facilities were on the SNM-21 license.	Agreed. In the final HSA document, the HSA-5B TM will be updated in regard to SNM-21 to correct this factual error.

Agree – Comment will be integrated in HSA and soil testing program as appropriate. **Noted** – Comment will not be integrated into HSA or soil testing program.

15	Page 210, Section 3.2 The critical facilities in building 4100 (which was owned by (NAA and Rockwell) had a separate reactor license, namely CX-17 (as discussed in section 3.2). However License CX-17 (for Building 4100) is not relevant to subarea 5B as 4100 is in subarea 5C. This section should therefore be removed from the subarea 5B Tech Memo.	Agreed. In the final HSA document, the HSA-5B TM will be updated in regard to License CX-17 to correct this factual error.
16	Page 211, Section 3.3 A similar comment to that below was also made for the revised 5C Tech memo. This section in the 5B Tech Memo is identical to the 5C Tech Memo. The statement *"This license [0015-59] is assumed to have covered the use and possession of radioactive materials in SNAP Reactor Building 4059"* is incorrect. Building 4059 was owned by the Atomic Energy Commission (and later by the DOE). The S8DR, as were all SNAP operations, was an AEC program using AEC owned nuclear materials. The AEC (as is DOE) was a self-regulating agency under the AEA. Therefore a California State Radioactive Materials License was not required for SNAP operations in 4059. Indeed California is not, and was not, authorized by the US Nuclear Regulatory Commission (or the then US AEC) to license either nuclear reactors or special nuclear material. In any case, building 4059 is not in subarea 5B, therefore references to 4059 should be removed from this section in the 5B Tech Memo.	Agreed. In the final HSA document, the HSA-5B TM will be updated in regard to License 0015-59 to correct this factual error.

Agree – Comment will be integrated in HSA and soil testing program as appropriate. **Noted** – Comment will not be integrated into HSA or soil testing program.

17	Page 212, Last paragraph of section 3.3 A similar comment to that below was also made for the revised 5C Tech memo. This section in the 5B Tech Memo is identical to the 5C Tech Memo. State radioactive license 0015-70 was renumbered to 0015-19 on December 5, 1996. As of November 17, 2010 there have been a total of 110 amendments.	Agreed. In the final HSA document, the HSA-5B TM will be updated in regard to License 0015-70 and the issue surrounding License 0015-59 as discussed above.

ATTACHMENT A

REPORTED INCIDENTS
NOT RESULTING IN ENVIRONMENTAL RELEASE

Building 4010

- On October 19, 1965, a high level of contamination (2 x 10^4 disintegrations per minute) was released into the high bay of Building 4010 during one of two operations. Cutting of the control drum drive rods to remove the beryllium control drums and reflectors or possibly changing of the saw blade resulted in cobalt-60 (Co-60), manganese-54 (Mn-54), and iron-59 (Fe-59) contamination in the high bay area. The level of contamination was found to be 200 millirads per hour (mrad/hr), including 100 milliroentgens per hour (mR/hr) due to gamma (Incident Report A0349).[1]

Building 4013

- On April 9, 1963, it was reported to the health and safety department that a personal film badge showed an exposure of 7.67 rem, which had occurred in the month of March. The film badge indicated exposure was due to low energy x-rays. The film badge was issued to an employee whose normal work assignment was in Building 4013, which contained a materials inspection x-ray booth with a 140 peak kilovoltage (kvp) x-ray machine. However, the employee also had a dermal condition on his right hand that was treated with high doses of low energy x-rays. Investigation found that it was possible the medical condition treatments could have affected the film badge and the health and safety department thought this was the most likely source of exposure and not the x-ray at Building 4013. The employee was issued two other film badges to take with him to the doctor's office to see if any exposure resulted (A0369).[2]

Building 4013

- On April 10, 1976, a 45 Curie iridium-192 (Ir-192) gamma source was being used to gammagraph welds on a large tank in Building 4019. The operator had run the source out for the first exposure and upon completion of the exposure time, he returned the source to the safe. As was standard practice, the operator took the survey instrument, a 5R Tech Associates Juno, with him to make sure the source was returned to the safe. The Juno indicated high level radiation and the operator left the area immediately and notified Industrial Security. At the time the operator and his helper were not wearing film badges, although one of the men had a dosimeter that indicated whole body dose of 12 millirems was received. All personnel were issued film badges and dosimeters before any attempt to return the gamma source to the safe was made. It was determined that the Ir-192 source was detached from the travel cable. A lead weight was positioned over the 7-foot cable containing the source to reduce the radiation levels to 150 milliroentgens (mR). This allowed the end of the 7-foot cable to be cut so the 21-foot travel cable could be

[1] Owen, R.K., *Incident Report, Building 010, Santa Susana*, October 21, 1965, HDMSP00050442.
[2] Internal Correspondence from Owen, R.K. to Busick, D.D., Atomics International, *Re: Investigation of Possible Overexposure of Personal Film Badge Issued to Redacted D/722-261*, April 11, 1963.

inserted to push the source out until the connector ball was exposed and the source could be fastened to the travel cable and returned to the safe. Radiation intensities at the connection point ranged from 3.5 roentgens per hour (R/hr) to greater than 5 R/hr. The source was reconnected and returned to the storage safe, which was verified by instrument survey. It was not known what caused the source to become disconnected from the cable (A0304).[1]

Building 4025

- On November 16, 1979, a radiograph operator reported that his dosimeter was off scale after conducting a routine radiograph of a check valve in Building 4025 using a columnated source of approximately 72 Curies of Co-60. A fellow employee working in the same area at the same time only reported 2-3 millirems (mr) on his dosimeter. The area both men were working in was roped off and monitored during the radiography operations with no signs of problems. The employee's film badge was sent for processing and he was not allowed to perform any other radiographic operations until the results were received. The film badge results showed an exposure of 150 mr from October 1, 1979 to November 16, 1979, indicating that the dosimeter reading had been incorrect. It was not known what caused the dosimeter to go off scale, but the employee was released to perform radiographic work (A0306).[2]

Building 4355

- On April 15, 1988, a truck driver from Sparkletts Water Company was observed passing through the radiation barrier ropes at the northwest corner of Building 4355 while making a water delivery to a construction trailer. The radiographer directed the truck driver to immediately leave the radiation area and report to the facility shift leader. The Ir-192 source used in radiography was found to be locked in its safe during the time frame the truck driver was inside the barrier rope so there was no chance of exposure. The truck driver was instructed on the hazards of radiation and the importance of observing all posted areas (A0184).[3]

Building 4356

- On October 7, 1974, during a semi-annual sealed source inspection and leak test, a 186 millicurie (mCi) Cs-137 liquid sodium level source mounted on expansion tank number 5 was found to be missing. The source was subsequently found at an interior storage area

[1] Internal Correspondence from Owen, R.K to Tuttle, R.J., Rockwell International, *Re: Gammagraphing Incident T-019*, April 20, 1976.
[2] Internal Correspondence from Vandervort, P.S. to Tuttle, R.J., Rockwell International, *Re: Dosimeter Reading Off Scale*, November 28, 1979.
[3] Internal Correspondence from Hunnicutt, T.D. to Tuttle, R.J., Rockwell International, *Re: Breach of Safety Barrier*, April 18, 1988.

where the source was leak tested. The source was confirmed to be intact and was then stored properly (A0639).[1]

- On February 20, 1986, two radiographers were working on the west end of the H2 heater at SCTI Building 4356. They were using a 23 Ci Ir-192 source with a 60 degree tungsten collimator aimed in the southeast direction. Barricades were set up and left in place during different radiography exposures. During one set up, the source was cranked out and one of the radiographers surveying the area found two employees working on the northeast corner of the nearby H1 heater. The employees were standing inside the barricade area and the barricade had been taken down. They were about 60 feet north of the Ir-192 source and in the opposite direction of the beam. The two employees were directed to leave. With the exposure still in progress, a survey was done in the area the employees were working in and indicated that the dose rate was less than 0.5 mR/hr. The incident appeared to be a result of a misunderstanding and stricter compliance with existing policies and procedures was called for to prevent removal of barriers or signs by non-authorized personnel (A0153).[2]

Building 4006

- On August 11, 1960, six zirconium samples from sodium reactor experiment moderator cans were prepared for examination in the metallurgical laboratory of Building 4006. The samples were ground and electrically polished for microscopic examination of grain size and hydride content. During the operation a clean area became contaminated with activation products as well as an employee's clothes and neck. The employee's neck became contaminated when he rubbed a contaminated sleeve against his neck. He washed his neck until no significant contamination was detected. An air sample taken during the polishing operation revealed 5×10^{-10} microcuries per cubic centimeter. The metallurgical laboratory was temporarily made a blue tag area during the operation. The Work was allowed to continue only after surveying revealed no further contamination (A0484).[3]

Building 4026

- On September 10, 1969, an employee disregarded a rope barrier signifying a radiation area where a 13 Curie (Ci) iridium-192 (Ir-192) gamma radiography source was exposed during inspection of electrical equipment. The dose rate from the source was about 75 rems per hour (rem/hr) at one foot away and the employee was reportedly 12 feet from the source where the radiation field would have been about 520 millrems per hour (mrem/hr) without shielding. The measured dose rate at the employee's location taken

[1] Internal Correspondence from Moore, J.D. to Tuttle, R.J., Rockwell International, *Re: Cesium-137 Source Removal, Bldg. 356, SCTI*, October 9, 1974.
[2] Internal Correspondence from Badger, F.H. to Radiation & Nuclear Safety Group, Rockwell International, *Re: Radiological Safety Incident Report, SCTI, T356, H2 Heater, 2/20/86*, March 18, 1986.
[3] Internal Correspondence from Warren, J.W. to Fisher, W.L., Atomics International, *Re: Radiological Safety Incident Report, Metallurgical Lab. Bldg. #006, 8/11/60*, September 30, 1960.

during a later exposure was found to be 120 mrem/hr, which would have given the employee a radiation dose of 2 mrem because the source was exposed for 1 minute. The radiation dose would have been delivered to the employee's head and torso. This was noted as a rule violation, although the employee stated he was not aware of the rope barrier. Recommendations included better training for personnel on the hazards of radiography and better radiation warning devices that use flashing lights or audible sounds (A0465).[1]

- On October 3, 1979, an iridium-192 source used in a routine pipe-weld radiographic exposure could not be retracted into the storage shield of the test instrument. The exposure was made in the eastern part of Building 4026. The maximum exposure rate found was 300 milliroentgens per hour (mR/hr) at 15 feet from the equipment setup. The exterior of Building 4026 was surveyed with the source in the collimator and no areas with exposure rates in excess of 0.5 mR/hr were found. The iridium source was eventually retracted on October 4, 1979 (A0238).[2]

Building 4011

- On July 14, 1964, a security patrol observed empty radioactive shipping containers in a private car near the intersection of F and 19th Street. A survey indicated no detectable radiation or contamination present in the area or on the vehicle. The health physics department recommended the cans be picked up and transported to the "ETB annex" and the employee be reminded of the standard operating procedures regarding movement of items in a private vehicle (A0519).[3]

- On July 2, 1980, a welder's visitor film badge showed an exposure of 1,490 millrems (mrem). A subsequent film badge checked out to the employee showed 20 mrem for a total of 1,510 mrem. This exposure exceeded the 1,250 mrem limit for a quarter. If the employee had regularly worked in radiation areas, the allowable limits would have been 3,000 mrem. The film badge showing the large exposure was investigated by reviewing working conditions, interviewing personnel involved, and reviewing dosimetry results. No likely cause for the exposure was identified. During the time of the large exposure, the employee welded 15 Rad-Pac sources containing 65 millicuries of tantalum-182 (Ta-182) each. It was noted that exposures of the magnitude identified in the film badge were not normally associated with this job and that the mechanic who had difficulty unloading and sorting the sources prior to welding only received 210 mrem. A number of hypotheses were reviewed as to how the film badge received such a high exposure, including error in processing or exposure from field radiography near the employee's toolbox where he sometimes stored his badge. Ultimately, the exposure was recorded in

[1] Internal Correspondence from Bresson, J.F. to Heine, W.F., Atomics International, *Re: Violation of Radiation Barrier and Signs at SS026*, September 18, 1969.
[2] Tuttle, R.J., *Unretractable Iridium-192 Source, SCTL, October 3, 1979*, Rockwell International, October 8, 1979, pgs. 1-2.
[3] Internal Correspondence from Clow, H.E. to Hill, R.M., Atomics International, *Re: Incident Report, B/11, Corner of 19th and F Street, 7-14-64*, July 15, 1964.

the employee's history with a note that the exposure did not appear to be a real, personal exposure (A0083).[1]

- On April 13, 1985, a high level gamma instrument calibrator source became disconnected from the source control rod. Two days later a member of the radiation and nuclear safety group was called to Building 4011 to examine the "problem." A radiation survey of the calibrator was conducted with no exposure hazard observed. The high level calibrator source capsule, containing approximately 40 Curies of cesium-137 (Cs-137), was no longer connected to the source handling rod. There were no signs of contamination on any part of the rod, which would have indicated the rupture of the sealed source capsule. It was thought that the source itself was still in the source shield at or near the normal storage position. The principal user of the calibrator looked through available drawings and contacted the calibrator supplier, Technical Associates, for assistance. The problem appeared to be the result of loose screws and the shearing of a screw. Plans were made to remove the broken screw and any other loose pieces and reattach the source to the source rod. The source was to remain fully shielded throughout the repair operation and thus no measureable radiation exposure above background was expected. The incident report notes that better observation of the operating conditions of the equipment and periodic preventative maintenance could prevent future incidents (A0318).[2]

- On January 6, 1994, the instrument calibration shop in Building 4011 reported the discovery of two regulated air supply sampling pumps with detectable radioactive contamination on the internal surfaces of the air mover chamber and impellers. These pumps were used for air sampling. The external surfaces of the pumps were surveyed for release prior to transferring them to the instrument shop in Building 4011. The internal surfaces of the pumps were not accessible for survey, but despite this the pumps were declared uncontaminated and released. The pumps were placed in storage in Building 4011 in an unlocked room. This failure to label and control the contaminated pumps constituted a loss of control of radioactive materials (A0651).[3]

- On December 6, 1994, a Cs-137 calibration source dislocated from the release pull rod. The source was left in a safe position with no release of activity. The Building 4011 calibration lab was immediately secured and the radiation protection department was notified. A radiation/contamination survey of the source containment box and release pull rod indicated normal background levels. The source containment box was red tagged. According to the incident report, the release pull rod probably broke due to wear and age (A0658).[4]

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[1] Internal Correspondence from Tuttle, R.J. to Remley, M.E., Rockwell International, *Re: Investigation of Film Badge Exposure*, November 7, 1980.
[2] Internal Correspondence from Speed, D.L. to Tuttle, R.J., Rockwell International, *Re: Cesium Calibrator Source Control Rod Disconnect and Reconnection Plans*, April 16, 1985.
[3] Internal Correspondence from Barnes, J. to Incident File, Rockwell International, *Re: Loss of Control of Radioactive Materials Inadequate Release Surveys*, January 6, 1994.
[4] Internal Correspondence from Wallace, J.H. to Rutherford, P.D., Rockwell International, *Re: Radiological Incident Report, T011 Calibration Lab*, December 6, 1994.

Building 4172

- On April 13, 1977, during an x-ray tube warm up period, the x-ray tube beam was directed at the x-ray control room approximately 7.5 feet from the wall. The machine was operated for 15 minutes. Three sheets of 70 millimeter film were developed against the darkroom wall closet to Building 4172. A manager in radiation and nuclear safety department was in the control room of Building 4172 during the full 15-minute warm up of the x-ray machine and at times was standing in the primary beam of radiation. The manager turned on a survey meter with a few seconds left in the warm up period and the meter went off scale. Apparently, the x-ray tube had been moved into position by another department earlier in the day and a visual check of the x-ray tube failed to indicate to radiographer that the beam was pointed to the office (the incident report states office, but it is not clear if it should say control room instead). A location badge mounted on the rear wall of the office read 50 mrem and the calculated dose was 20 mrem. The incident resulted from a number of different factors, including movement of the x-ray tube, failure of a visual check to redirect the x-ray beam, failure to turn on the survey meter, and failure of the radiographer to wear his film badge and dosimeter. Aside from rule enforcement, it was suggested that a cost benefit analysis be conducted for shielding all walls in the x-ray room with a lead liner (A0057).[1]

[1] Internal Correspondence from Tuttle, R.J. and Whitebirch, W.C. to Isotopes Committee, Rockwell International, *Re: Radiation Exposure Incident – April 13, 1977*, April 19, 1977.