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

Volumes IV through VI

(Binder 2 of 3)

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.
Northway 10 Executive Park
313 Ushers Road
Ballston Lake, NY 12019

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 IV

FINAL
TECHNICAL MEMORANDUM
SUBAREA HSA-5C
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AREA IV RADIOLOGICAL STUDY
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75 Hawthorne Street
San Francisco, CA 94105

Prepared by:

HydroGeoLogic, Inc.
Northway 10 Executive Park
313 Ushers Road
Ballston Lake, New York 12019

October 2012

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LIST OF ACRONYMS AND ABBREVIATIONS

AEC	U.S. Atomic Energy Commission
AETR	Advanced Epithermal Thorium Reactor
ARRA	American Recovery and Reinvestment Act
AI	Atomics International Division of North American Aviation, Inc.
CAT	Computer Aided Tomography
CDPHE	California Department of Public Health and Environment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
Ci	Curie
COC	Contaminants of Concern
CT	computed axial tomography
D&D	decontamination and decommissioning
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
FCEL	Fast Critical Experiment Laboratory
FOIA	Freedom of Information Act
HGL	HydroGeoLogic, Inc.
HR	House Resolution
HSA	Historical Site Assessment
kW	kilowatt
LLTR	Large Leak Test Rig
LMEC	Liquid Metal Engineering Center
µR/h	microroentgen per hour
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MCP	maximum concentration permissible
MDA	minimum detectable activity
MWd	megawatt days
NASA	National Aeronautics and Space Administration
NBZ	Northern Buffer Zone
NRC	Nuclear Regulatory Commission
ORISE	Oak Ridge Institute for Science and Education
pCi/g	picocuries per gram

RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
S8DR	SNAP 8 Development Reactor
SBZ	Southern Buffer Zone
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
UPS	uninterruptible power supply

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TEXT

FINAL
TECHNICAL MEMORANDUM
SUBAREA HSA-5C
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 gamma scanning or 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-5C. This TM, along with subsequent 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 TM 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 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 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-5C and the drainage channels that lead to and from this area. The location of subarea HSA-5C is shown on Figure 1.3. Plate I presents a summary of the features related to potential radiological sources identified within the HSA-5C subarea. Detailed information pertaining to the use of radioactive materials and the potential release of radionuclides at sites and buildings within HSA-5C are provided in Sections 2 and 3 of this TM. Preliminary findings specific to HSA-5C 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 contamination.
- *Class 3 Areas:* Areas that have a low potential for 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-5C. 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.[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.

Table 1.2
Research Reactors Located at the Santa Susana Field Laboratory[4]

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

[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
[4] 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[1]

Reactor Acronym	Building No.	Facility Name	Power Level (kW)	Period of Operation	Power Generated (MWd)	Radioactivity at End of Operation (10^3 Ci)
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 are 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]

Table 1.3
Criticality Test Facilities at the Santa Susana Field Laboratory[4]

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

[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
[4] 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.

downslope to surrounding populated areas.[1] 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 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-5C

Subarea HSA-5C is approximately 21.9 acres of flat land. Over the years, 21 buildings have been situated within HSA-5C. It includes F, G, J, and 22nd through 24th streets. Drainage is generally to the southeast. There is one retention pond in this subarea used for alcohol retention. Radiological operations in the HSA-5C area were related to the SNAP and SNAP 8 programs as well as to the Advanced Epithermal Thorium Reactor, which was a separable-half critical experiment operating at less than 200 watts (thermal), and the Fast Critical Experiment Laboratory.

1.5 Sites in HSA-5C

During the peak of operations, Subarea HSA-5C comprised 23 sites, most of which were buildings. This TM addresses each of these 23 sites within Subarea HSA-5C. Of the 23 sites, one was a reactor (Building 4059), one was a criticality test facility (Building 4100) and others housed operations involving radioactive materials. 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 23 sites in Subarea HSA-5C, only 6 buildings 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;

[1] Agency for Toxic Substances and Disease Registry, *Draft Preliminary Site Evaluation, Santa Susana Field Laboratory*, Atlanta, GA, December 3, 1999, pp.2-5.

- 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 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-5C TM, 429 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 429 documents relevant to past operations at facilities within HSA-5C and was therefore determined to warrant in-depth evaluation. Each of these 429 relevant documents was thoroughly evaluated for information considered useful for carrying out the goals listed in Section 1.2 of this TM. 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 Analysis

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;
- 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 have been completed 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-5C according to six logical "clusters" (a.k.a. groups) based on operational characteristics and geographic locations. Plate 1 depicts the entire HSA-5C subarea and should be referenced while reading Section 2. Each HSA-5C group (discussed in Sections 2.1 through 2.6, 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-5C Group 1 are presented. HSA-5C Group 1 includes three building areas containing the Building 4059 Systems for Auxiliary Nuclear Power (SNAP) reactor and associated buildings.

2.1.1 Building 4039 Area

Site Description: The Building 4039 area comprises the former Building 4039 and the land around it located on 20th Street. Building 4039 was constructed in approximately 1964 as an office building.[1, 2] Figures 2.1.1a through 2.1.1b 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 4039. Buildings 4038, 4057, and 4626, located south of Building 4039 are discussed in this TM. Building 4757, located west of Building 4039, is an electrical substation for Buildings 4038 and 4057. Building 4059, located north of Building 4039, housed the SNAP 8 development reactor. Plate 1 presents a summary of all identified features for this site.

Building Features: Building 4039 was a small single-story rectangular building constructed with galvanized steel walls and roof, anchored to a concrete floor. It had internal walls and partitions. A floor plan is presented in Figure 2.1.1b.

Former Use(s): Building 4039 was the Systems for Auxiliary Nuclear Power (SNAP) Administration Building, SNAP Office Building No. 4, and Liquid Metal Engineering Center (LMEC) Office Building. Building 4039 was later the health physics counting laboratory for sealed radioactive sources and a laboratory for a low-background alpha/beta counting system to analyze air and wipe samples.[3]

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

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[1] Rocketdyne, Historical Site Photograph.
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[3] Sapere, Consulting, Inc., *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California,* Volume 2 – Area IV Site Summaries, May 2005, p. V-1.

Current Use: Building 4039 was demolished in 2003. In 2009, a trailer is located at the site of Building 4039. Boeing uses this facility for copying documents contained in Building 4057.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): Boeing performed weekly radiological surveys from April 14, 2000, through April 11, 2001. Prior to its demolition in 2003, Boeing surveyed Building 4039 using wipe samples, beta detectors, and gamma exposure instruments. All wipe samples were less than Boeing's minimum detectable activity (MDA), and all instrument readings were non-detectable.[1] In 2003, the building structure, concrete slab, foundation, and footings were removed along with a sewer pipe. The slab footing was backfilled with No. 2 aggregate.[2]

Radiological Use Authorizations: Operations in Building 4039 were conducted under Use Authorization 160 while the building was used as a health physics counting laboratory.[3]

Former Radiological Burial or Disposal Locations: None found.

Aerial Photographs: Aerial photographs show undeveloped land until the 1965 aerial photograph when a small rectangular building is identified as Building 4039. This building continues to be seen in 1967, 1972, 1978, 1980, 1983, and 1988 aerial photographs. In the 1995 photograph, Building 4039 is not clearly seen. The building is missing from the 2005 aerial photograph, but a trailer appears in the location of Building 4039 in a 2009 aerial photograph.[4]

Radionuclides of Concern: The research team did not find evidence that high activity radioactive materials were used or stored within Building 4039. Radioactive air and wipe samples were analyzed in Building 4039. Sealed radioactive sources were also stored in Building 4039. Building 4039 is located approximately 50 feet south of Building 4059; consequently, there is some potential that other radionuclides associated with Building 4059 may have migrated to the area surrounding Building 4039. Radionuclides associated with the operations of SNAP reactor Building 4059 include natural and enriched uranium (U-238, U-234, U-235), isotopes of plutonium (Pu-238, Pu-239, Pu-240, Pu-241), americium-241 (Am-241), fission products (primarily cesium-137 (Cs-137) and strontium-90 (Sr-90)), and activation products (tritium (H-3), iron-55, (Fe-55), cobalt-58 (Co-58), Co-60, nickel-63 (Ni-63), Ba-133, europium-152 (Eu-152), Eu-154, Eu-155, promethium-147 (Pm-147), and tantalum-182 (Ta-182)).[5] All radionuclides of concern listed with the exception of Co-58 and Ta-182 are included in the August 2010 Final Field Sampling Plan for soil sampling in Area IV. Co-58 and Ta-182 both have half-lives of less than 1 year and thus do not meet the criteria for analysis. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Based on general site topography, surface water from Building 4039 likely flows north and east to a storm drain that runs along 20th Street and into an intermittent stream that flows southeast through Area III to a pond in Area II. Building 4039 was located

[1] Boeing, *Radiation Survey Report, Building T039*, Internal Document, No Document Number, April 15, 2003.
[2] *Job B (B4039, B4032, and B4042) Statement of Work*, Flysheet ETEC PB 02-009, March 3, 2003.
[3] Boeing, Radiation Safety Records Management System.
[4] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[5] Vitkus, T. J. and Morton, J. R., *Radiological Survey of the Building 059 Reactor Vault, Santa Susana Field Laboratory, Rockwell International, Ventura County, California*, Final Report, Oak Ridge Institute for Science and Education ORISE 95/G-18, June 1995, pp. I-2, 8-9.

south of S8DR reactor Building 4059. However, it appears that a series of storm drains separates Building 4039 and 4059. The year in which the storm drains were installed is not known. A sanitary sewer line is located on the northern side of the site.

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4039 area is Class 1, due to its location within ETEC, close proximity to SNAP reactor Building 4059, and because no site investigation has been conducted.

Recommended Locations for Soil/Sediment Sampling:

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

Previous characterization studies for the Building 4039 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 4039 area. This includes the following Building 4039 areas and appurtenances:

- The area between Building 4039 and Building 4059. Radionuclides originating from Building 4059 may have migrated to this area via surface water flow or airborne releases.

- The storm drains located on the northern and eastern side of the site. If radiological materials were released from Building 4039, they may have migrated to the storm drain network during precipitation events.

- The sanitary sewer lines located on the northern and eastern side of the site. If radioactive materials were released into the sanitary sewer system, residual contamination may exist in the materials surrounding the sewer lines.

2.1.2 Building 4059 Area

Site Description: The Building 4059 area comprised Building 4059 and the land surrounding it on 20th Street. Building 4059 was constructed in 1961 and was modified in 1964 to provide a simulated space environment for ground-testing the Systems for Auxiliary Nuclear Power (SNAP) prototype reactor, S8DR. Building 4059 was a 31-foot-tall concrete and Butler-type structure with approximately 10,764 square feet of floor space.[1, 2] Figures 2.1.2a through 2.1.2g 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 4059 contained a below-ground test vault 28 by 39 feet in area and 32 feet deep. The vault walls were of dense borated concrete. Building 4059 also contained a pipe chase room, vacuum equipment room, and a contaminated liquid holdup system. The pipe chase room, located adjacent to the vault, was sand filled and contained the vessel shield cooling pipes and a line from the vacuum chamber to the vacuum equipment room. The vacuum

[1] Vitkus, T. J. and Morton, J. R., *Radiological Survey of the Building 059 Reactor Vault, Santa Susana Field Laboratory, Rockwell International, Ventura County, California*, Final Report, Oak Ridge Institute for Science and Education ORISE 95/G-18, June 1995, pp. 1-2, 8-9.
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.

equipment room contained a chimney with thick concrete walls. The contaminated liquid holdup system included a 550-gallon steel holdup tank inside a concrete vault. No pipe or pipe chase penetrated the vault walls or floor.[1] In 1964, a French drain was added around three external sides below the foundations, to collect and remove any infiltrating groundwater.[2] Gas produced from the reactor was pumped to gas holdup tanks and after a delay for the needed decay of radioactive argon and xenon, discharged to the atmosphere through the facility stack. Figure 2.1.2b provides a floor plan of Building 4059 in 1965.[3] Additional building structural modifications are depicted in subsequent figures. Figure 2.1.2c provides a utility plan for Building 4059 in 1967. The contaminated waste holdup tank was located inside the building, below ground surface.

Former Use(s): Building 4059 housed the SNAP 8 prototype reactor, S8DR, Large Leak Test Rig, and Ground Prototype Test Facility. By January 1969, an unshielded SNAP 8 prototype reactor was operating at 600 kW in the north cell. It continued operating until December 1969 at 600 kW with a short period at 1MW. In 1970, the reactor and associated equipment were removed and the facility became inactive. In 1973, the Liquid Metal Engineering Center (LMEC) occupied the building, removed the shielding and remote handling equipment, and erected the Large Leak Test Rig (LLTR) in the test vault and high bay areas.[4] In 2004, the building shell and concrete cells and foundations were removed after which the large excavation area was backfilled with soils that had been removed from the excavation.

Information from Interviewees: In 2010, a number of former workers were interviewed about their experiences at the SSF. Two remembered Building 4059. Excerpts from their comments are presented below.

- "There was a SNAP reactor in building 59. In the 1990s, the plan for decommissioning it was to excavate the building down to ground level and fill it in. I worked on the final (at that time) decommissioning report. There were some solvents in the ground at one location. I made a very rough estimate about how much would be there and my calculations predicted that there might have been as much as one bottle! Eventually, the decision was made to excavate everything and then backfill."[4] This former employee worked at the SSFL between 1959 and 1981.
- "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... 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

[1] Memo from J. F. Lang, Engineer-in-Charge, to R.O. Meyer concerning Building 059, dated September 14, 1983.
[2] *SNAP 8 Ground Prototype Test Facility – Building 059*, fragment, circa 1980, p.1.
[3] Tuttle, R.J., *Tritium Production and Release to Groundwater at SSFL*. Safety Review Report No. RI/RD92-186, December 1, 1992, pp. 3-15 – 3-23.
[4] Interview No. 196 of former worker conducted by the DOE and EPA, September 2010.

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 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."[1] This former employee worked at the SSFL between 1967 and 1985.

Radiological Incident Reports: There have been 19 incidents associated with Building 4059 that could have resulted in releases to the environment. The following table provides information presented in an incidents database provided by Boeing. A summary of the incident reports is provided following the table.

Building 4059 Incident Report Summary

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
None	10/29/1969	S8DR REACTOR	H_2, MFP	FUEL ELEMENTS LEAKING HYDROGEN AND MIXED FISSION PRODUCTS DURING OPERATION
A0633 Incident report missing	02/12/1970	T059 TEST VAULT		ABSOLUTE FILTER ON VACUUM CLEANER RUPTURED CONTAMINATING AREA
A0576	02/19/1970	PIPE CHASE B59		CUTTING A NaK LINE IN PIPE CHASE ROOM CAUSED NaK FIRE
None	11/04/1981	BUILDING 59		FIRE BROKE OUT BURNING ARMS AND HAND OF ONE WORKER
A0183	01/27/1988	VACUUM DUCT ROOM	Co-60	PHOTOGRAPHER SENT INTO CONTROLLED AREA WITHOUT PROPER TRAINING OR PROTECTION
A0187	08/12/1988	PIPE CHASE ROOM	Co-60, Eu-152, Eu-154	TORCH CUTTING IN PIPE CHASE RESULTED IN CONTAMINATION OF OPERATORS

[1] Interview No. 255 of former worker conducted by the DOE and EPA, September 2010.

Building 4059 Incident Report Summary (continued)

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A0189	08/19/1988	PIPE CHASE ROOM	Co/Eu	BREATHING AIRLINE BECAME DISCONNECTED IN AIRBORNE AREA
A0194	01/31/1989	PIPE CHASE ROOM	Co/Eu	EMPLOYEE ENTERED RADIATION AREA WITHOUT FILM BADGE ON CHEST WITH DOSIMETER
A0197	04/06/1989	FILTER BANK	Co-60	IMPROPER PROCEDURE ON FILTER CHANGE CAUSED HIGH AIRBORNE CONTAMINATION
A0204	04/12/1990	TEST VAULT AREA		EMPLOYEE ENTERED CONTROLLED AREA W/O PRESCRIBED MONITORING/PROTECTIVE EQUIPMENT
A0206	05/08/1990	VACUUM EQUIPMENT ROOM	Co-60	EXIT SURVEY REVEALED CONTAMINATION ON PANT LEG
A0212	01/17/1991	ELECTRICAL ROOM	K/Co	CLEAN AREA FLOOR SWEEPING FOUND TO CONTAIN R/A MATERIAL
A0214	02/25/1991	TEST CELL	Co-60	TORCHING OPERATION GENERATED HIGH AIRBORNE ACTIVITY IN ADJOINING HIGH BAY
A0216	09/20/1991	TEST CELL		EMPLOYEE ENTERED CONTROLLED AREA WITHOUT FILM BADGE
A0219	09/02/1992	TEST CELL		TORCHING SLAG VIOLATED PROTECTIVE CLOTHING CONTAMINATING SHOE
A0307	12/03/1992	TEST CELL 1		EMPLOYEE'S DOSIMETER WENT OFF SCALE DURING D & D OPERATIONS
A0579	07/29/1993	B-59 RPT PIT		EXIT SURVEY INDICATED CONTAMINATION ON "T" SHIRT
A0692	12/22/1998	T059 HIBAY		CONTAMINATION OF FORK TRUCK/GLOVES WAS DUE TO NATURALLY OCCURRING RADON DAUGHTERS
A0691	01/05/1999	SSFL		NATURALLY OCCURRING RADON DAUGHTERS PLATED ON HARD HAT AND GLOVES

*Isotopes are written as they are presented in the incident database. The research team believes that MFP is an acronym for mixed fission products.

- In 1969, AI found fuel elements leaking hydrogen and fission products. A group of experts was gathered to analyze the leak and find its cause. At the time, the zirconium

hydride reactor was being considered for numerous space missions.[1] This was the second or third most serious accident at the SSFL. The reactor operated for a year with failing fuel.

- On February 13, 1970, an absolute filter on a vacuum cleaner ruptured contaminating the Building 4059 test vault. The incident report has not been located (A0633).[2]

- On February 19, 1970, a sodium/potassium (NaK) fire broke out in the Pipe Chase Room while an employee was cutting a pipe during demolition activities. Approximately one teacup of NaK spilled into a drip pan on the floor and began to smolder. The fire was extinguished by shoveling calcium carbonate onto the pan. When a dense cloud of white smoke filled the vault, personnel evacuated, bolting the access door in place. A subsequent inspection of the exhaust duct filter revealed no increase in airborne radioactivity (Report No. A0576).[3]

- On November 4, 1981, a fire broke out at Building 4059. The cause and region of the fire are unclear from the report. A worker received burns to his right hand and arms and is taken to the "nurse." The local fire service extinguished the blaze using three hoses.[4]
- On January 27, 1988, a photographer was sent to the Vacuum Duct Room without proper safety precautions. He entered a "High Radiation Area" without protective clothing, a film badge, or a pocket dosimeter. Upon exiting the room, one pant leg was found to be contaminated. Radiation levels in the area were in excess of 100 milliroentgens per hour (mR/h). Loose contamination consisted primarily of Co-60 in sand. The contamination was removed successfully at the Radioactive Material Handling Facility (Report No. A0183).[5]

- On August 12, 1988, two employees were contaminated as a result of cutting in the Pipe Chase Room during demolition activities. Contamination was measured at 17,500 dpm of beta-gamma contamination per 100 square centimeters. These employees were subsequently decontaminated (Report No.A0187).[6]

- On August 19, 1988, an employee working in the Pipe Chase Room in an air-line respirator felt his filter cartridge pod disconnect from his face mask. He picked it up and had his co-worker try to reconnect it. His co-worker thought the coupling was broken so they evacuated the room within 2 minutes. Nasal and facial smears and the inside of the face mask indicated no detectable activity. Analysis of a work area air sample indicated 1.5×10^{-11} µCi/mL, below the maximum permissible concentration of 9×10^{-9} µCi/mL.

[1] U.S. Atomic Energy Commission, Letter from M. Klein, AEC, to J. J. Flaherty, Atomics International, dated October 29, 1969.
[2] The Boeing Company Radiation Incident Database, 2010.
[3] Bresson, J. F., Rockwell Internal Letter to W. F. Heine, re: *Fire in Building T059 Vault*, February 26, 1970.
[4] Incident Report, dated November 4, 1981 (BNA05615738-744).
[5] Tuttle, R. J., Rockwell Internal Letter to J. A. Chapman, re: *Radiological Safety Incident Report, T059 Vacuum Duct Room*, January 27, 1988.
[6] Wallace, J. H., Rockwell Internal Letter to Radiation and Nuclear Safety Group, re: *Radiological Safety Incident Report, T059 Pipe Chase Room*, August 12, 1988.

A warning letter was issued alerting respirator users to the risk of uncoupling (Report No. A0189).[1]

- On January 31, 1989, a radiation worker entered a radiation area for work without a personally issued film badge although he wore the required pocket dosimeter, two TLD-LiF chips finger rings (one on each hand), a visitor film badge on his foot, and a TLD-CAF. A review of the pocket dosimeter and the TLD indicated an accumulated exposure of 74 mrem. Greater caution to observe safe work practices was recommended (Report No. A0194).[2]

- On April 6, 1989, an employee dropped an open box of used filters (approximately 10 feet) while changing the exhaust system filters during torching operations on the upper level of Building 4059. A cloud of dust arose from the filters when they landed on the floor and "a lot of dust" settled on the floor. Higher counts were recorded by the radiation detector. The employee's hands (4,350 dpm) and shoes (5,800 dpm) were subsequently decontaminated. No other activity was detected on his body or clothing. The filters were to be disposed of as radioactive waste and the area was to be vacuumed (Report No. A0197).[3]

- On April 12, 1990, an employee entered the test vault area on the lower level of Building 4059 without approval, without plastic shoe covers, and without a personally issued film badge or pocket dosimeter. When discovered and reprimanded, the employee left the area approximately 3 minutes after entering the vault (Report No. A0204).[4]

- On May 8, 1990, at the end of his shift, an employee surveyed himself and found a hot spot on his pant leg. Fixed contamination was localized to the 1-inch by 1-inch area on the pant leg reading 300 cpm. The employee had been decontaminating the vacuum equipment room shield blocks wearing a red-line laboratory coat. After several unsuccessful decontamination attempts, the pants were disposed of as radioactive waste. It was recommended that future work with shield blocks would require red-line coveralls (Report No. A0206).[5]

- On January 17, 1991, floor sweepings in the electrical room were found to contain Co-60 (0.85 pCi/g). The sweepings were disposed of as radioactive waste (Report No. A0212).[6]

- On February 25, 1991, open-tent torching operations generated high airborne Co-60 radioactivity in the adjoining high bay during demolition activities. Nasal smears

[1] Wallace, J. H., Rockwell Internal Letter to Radiation and Nuclear Safety Group, re: *Radiological Safety Incident Report, T059*, August 19, 1988.
[2] Saba, V. B., Rockwell Internal Letter to Radiation and Nuclear Safety Group, re: *Radiological Safety Incident Report, SSFL Building 059, Reactor Vault*, January 31, 1989.
[3] Begley, F. E, Rockwell Internal Letter to Radiation and Nuclear Safety Group, re: *Radiological Safety Incident Report, Lower Level of T059*, April 6, 1989.
[4] Saba, V. B., Rockwell Internal Letter to Radiation and Nuclear Safety Group, re: *Radiological Safety Report, SSFL Building 059*, April 12, 1990.
[5] Wallace, J., Rockwell Internal Letter to Radiation and Nuclear Safety Energy Systems Group, re: *Radiological Safety Incident Report, T059 Vacuum Equipment*, May 8, 1990
[6] McGinnis, E. R., Rockwell Internal Letter to Radiation Protection and Health Physics Services, re: *Radiological Safety Report, T059 Electrical Room*, January 17, 1991.

revealed that three of seven workers had collected detectable activity. All seven employees submitted 1-day and 5-day samples for bioassay. Operations ceased until the Co-60 radioactivity in the air dropped to a safe level (Report No. A0214).[1]

- On September 20, 1991, an employee noticed that his film badge was missing while working on a plastic containment shroud above the test cell tent in the reactor vault. He left the area and notified the facility health physicist. A search for the film badge was conducted, but the film badge was not found. A new film badge was issued to the employee (Report No. A0216).[2]

- On September 2, 1992, an employee performing torching operations had hot slag penetrate two pairs of plastic booties and lodge in the bottom of his shoe. The shoe was decontaminated by napping the leather and using duct tape to remove the slag. After decontamination, no beta-gamma activity was detected on the shoe (Report No. A0219).[3]

- On December 3, 1992, an employee's dosimeter showed an off-scale reading after exiting Test Cell 1 during decontamination and decommissioning activities. The employee's film badge was sent to the vendor to be read, and his dosimeter was sent to the instrument laboratory for an "as found" test. The film badge was processed the next day and read 170 mR for the quarter, within acceptable limits. Rockwell concluded that the increased dose rate could have been due to exposure of activated steel behind the portion of wall being removed (Report No. A0307).[4]

- On July 29, 1993, an employee upon exiting a pit was found to have 150 cpm beta gamma contamination on the rear shoulder of his personal tee shirt. He removed the tee shirt and no contamination was detected on his skin. The employee was wearing the tee shirt because of a previous contamination event in Building T020 (Report No. A0579).[5]

- On December 22, 1998, a fork lift truck was surveyed for radioactive contamination in the Building 4059 high bay. Naturally occurring radon daughters were found to have been plated on a hard had and gloves. Rockwell concluded that this was a natural phenomenon (Report No. A0692).[6]

- On January 5, 1999, an employee was found to have a hard hat and leather gloves contaminated with an alpha emitter. Based on isotopic analysis, the material was determined to be naturally occurring radon daughters. Rockwell concluded that this was a natural phenomenon (Report No. A0691).[7]

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[1] McGinnis, E. R., Rockwell Internal Letter to Radiation Protection and Health Physics Services, re: *Radiological Safety Report, T059 Restricted Area*, February 25, 1991.
[2] McGinnis, E. R., Rockwell Internal Letter to Radiation Protection and Health Physics Service, re: *Radiological Safety Report, T059 Vault*, September 20, 1991.
[3] McGinnis, E. R., Rockwell Internal Letter to P. D. Rutherford, re: *Radiological Safety Report, T059 Test Cell 1*, September 2, 1992.
[4] McGinnis, E. R., Rockwell Internal Letter to P. D. Rutherford, re: *Radiological Safety Report, T059 Test Cell 1*, December 3, 1992.
[5] Wallace, J. H., Rockwell Internal Letter to P. D. Rutherford, re: *Radiological Safety report, T059 RPT Pit*, July 29, 1993.
[6] Redacted, Rockwell Incident Report, re: *Contaminated Fork Truck/Gloves*, December 22, 1998.
[7] Redacted, Rockwell Incident Report, re: *Contaminated Hard Hat and Gloves*, January 5, 1999.

Current Use: Building 4059 was demolished in 2004. The above ground portions were removed and the activated vault cells were excavated and removed according to the drawings presented in Figures 2.1.2d through Figure 2.1.2g.[1]

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): A chronology of radiological investigations at this building is as follows:

- Building 4059 was inactive between 1970 and 1973. In 1973, Rockwell dismantled and removed all control consoles and reactor instrumentation, and all contaminated items were removed from the test vault. What remained in place were extensive below-grade, radiologically activated structures, including steel containment vessels and vacuum lines, concrete biological shielding, and sand fill.[2]

- In 1978, Rockwell removed the radioactive liquid and gas holdup tanks. The reactor core and Sodium-Potassium (NaK) systems were removed.[3] Residual contamination remained in place.

- In 1978, Rockwell conducted a survey for the building, soil, and water. The reactor vault was excluded from the survey. Beta gamma contamination was measured above the 1978 acceptable limit of 1,000 disintegrations per minute per 100 square centimeters (dpm/100 cm^2). Decontamination was conducted.[4]

- A 1983, during a routine facility inspection, Rockwell discovered groundwater leaking into the south test cell of the reactor vault and becoming contaminated. Radioactivity measurements in the water were less than maximum concentration permissible (MCP) limits in effect at the time. Countermeasures were established to pump out the water and prevent leaching of radioactivity.[4]

- Rockwell's 1987 inspection found more water on the north test cell floor of the reactor vault floor. Two radionuclides (Eu-152 and Na-22) were found to be above their MCP limits. This discovery prompted Rockwell to begin a decontamination and decommissioning program to remove the remaining radioactivity.[4]

- In July 1989, EPA sampling identified tritium in water from the French drain around the west end of the basement of Building 4059. Tritium was found at a level far above what could be described as a background, but orders of magnitude below the maximum contaminant level at the time. It was recommended that further testing be conducted to determine the origin and spread of tritium at the site.[5]

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[1] Vitkus, T. J., *Verification Survey of the Building 059 Excavation, Santa Susana Field Laboratory, The Boeing Company, Ventura County, California*, Final Report, Oak Ridge Institute for Science and Education, March 2005, p. 8.

[2] Graves, A. W., *Decontamination and Disposition Facilities Program Plan,* Atomics International Report No. PP-704-990-002, January 23, 1975, p. 11.

[3] Sturtevant, W.C. et al., *Building 059 Remediation Program, Phase II Reactor Test Cell Remediation*, EID-04422, June 25, 1999, pp. 24-25.

[4] Rockwell International, *Radiological Survey Results – Interim Status, Building 059, Santa Susana Field Laboratory*, N704TI990043, November 28, 1978.

[5] Dempsey, Gregg, *Report on Environmental Samples Collected at the Rocketdyne Santa Susana Field Laboratory*, Environmental Protection Agency, Office of Radiation Programs, Las Vegas Facility, July 1989, pgs. 5-6.

- In 1995, Oak Ridge Institute for Science and Education (ORISE) performed a radiological survey of the vault and found the levels met acceptable limits in 1995.[1]

- In 1999, Boeing conducted a final status survey of the above-ground portion of Building 4059 and found it met acceptable limits in 1999.[2]

- In 2001, the EPA conducted an oversight verification survey for alpha, beta, beta-gamma, and gamma radiation. Contaminants of Concern (COCs) were mixed fission products, uranium, transuranic compounds, and activation products on the floors, walls, and ceilings. The EPA also collected concrete core and steel plate samples and analyzed them for photon-emitting isotopes. Activated Co-60 was identified in three steel plate samples.

- In 2002, Boeing collected samples in the yard surrounding the building below the asphalt and found no man-made gamma emitting radionuclides using 2002 detection limits.[3]

- In 2003, after excavation of the asphalt surrounding Building 4059, Boeing collected 15 soil samples and analyzed them for a suite of radionuclides. Detectable levels of H-3, Cs-137, and Eu-152 were found in one soil sample, but the concentrations were below the site's approved release criteria at the time.[4].

- In 2004, Boeing excavated the Building 4059 basement and foundation. As part of the excavation, a large volume of surrounding soil was removed. The main portion of the excavation measured 160 by 175 ft, with a depth of up to 50 ft. Soils were also excavated from a 20 to 40 ft wide area that extended 140 feet to the south. During the excavation, the soils that were removed from the excavation area were stockpiled. Upon completion of the building demolition, the stockpiled soils were returned to the excavation. Clean soil was used to backfill the upper portion of the excavation (approximately upper two feet).

- In September 2004, Boeing conducted a MARSSIM-based survey in the excavation at Site 4059 following removal of the building basement and foundations. The survey was divided into two phases. Phase A, which included one Class 1 and one Class 2 survey unit, was performed after the removal of the Test Cell and Pipe Chase Room. Surface gamma radiation scans indicated excavation locations with elevated dose rates. Soil samples were collected at these locations. No man-made gamma emitters were found in these samples. After the demolition work, the excavation was backfilled with clean soils. Phase B treated the entire Building 4059 site as one Class 3 survey unit. The surface scan in Phase B indicated only background gamma radiation levels. Analytical results

[1] Vitkus, T. J. and Morton, J. R., *Radiological Survey of the Building 059 Reactor Vault, Santa Susana Field Laboratory, Rockwell International, Ventura County, California, Final Report*, Oak Ridge Institute for Science and Education 95/G-18, June 1995, p. 10.
[2] Liddy, P., *Building 4059 Final Status Survey Report (Phase 1)*, Boeing Report No. RS-00008, September 11, 1999, p. 4.
[3] The Boeing Company, *Site Environmental Report for Calendar Year 2002, DOE Operations at The Boeing Company, Rocketdyne Propulsion & Power*, Report No. RD02-148-01, September 2003, pp. 3-8, 5-13.
[4] The Boeing Company, *Site Environmental Report for Calendar Year 2003, DOE Operations at The Boeing Company, Rocketdyne Propulsion & Power*, Report No. RD04-170, September 2004, pp. 3-9, 5-13.

indicated that the majority of the soil samples collected in both phases contained only naturally occurring radioisotopes. For the few samples with manmade radionuclides above detection limits, the levels were far below release limits and the sum of fractions of all radionuclides at all individual sampling locations was well below unity, so the site met the release criteria.[1]

- In October 2004, ORISE conducted an independent verification survey and found that other than naturally occurring radionuclides, only H-3 and Ni-63 were present. However, they reported that Boeing's H-3 and Ni-63 concentrations were 5.8 pCi/g and 10.7 pCi/g, respectively, well below 2004 acceptable limits of 31,900 picocuries per gram (pCi/g) and 55,300 pCi/g, respectively.[2]

- The California Department of Health Services (DHS) conducted a verification survey in October 2006. In February 2008, ORISE performed a verification survey of the building footprint confirming that 2008 release limits of 4.7 pCi/g for Cs-137 and 2.8 pCi/g for Eu-152 had been satisfied.[3]

Radiological Use Authorizations: A chronology of radiological use authorizations at this building is as follows:[4]

- Use authorization No. 027, permitted the transfer and storage of the SNAP 8 Development Reactor (S8DR) shield and reflector in Building 4059.

- Use authorization No. 104, permitted the use of a gamma densitometer in Building 4059.

- Use authorization No. 116, permitted the decontamination and decommissioning of Building 4059.

Former Radiological Burial or Disposal Locations: In 1964, a French drain was installed around three external sides below the foundations, before reactor testing commenced, to collect and remove infiltrating groundwater.[5]

Aerial Photographs: Aerial photographs show undeveloped land until the 1965 photograph when an irregularly shaped building is identified as Building 4059. An open storage area was also identified north of Building 4039 in the 1965 aerial photo. In the 1967 photograph a probable smokestack is identified north of the building and a possible vertical tank is identified at the northwest corner of Building 4059. These are also seen in 1972, 1978, 1980, 1983, 1988,

[1] McGinnis, E. R. and Liu, N., *Building 4059 Site Final Status Survey Report (Phase A and Phase B)*, Boeing Report No. RS-00036, April 21, 2006, pp. 7, 30.
[2] Vitkus, T. J., *Verification Survey of the Building 059 Excavation, Santa Susana Field Laboratory, The Boeing Company, Ventura County, California*, Final Report, Oak Ridge Institute for Science and Education, March 2005, pp. 7, 12.
[3] Vitkus, T. J., *Independent Verification Survey Report of the Building 4059 Site (Phase B); Post Historical Site Assessment Sites, Block1; and Radioactive Materials Handling Facility Holdup Pond (Site 4614), Santa Susana Field laboratory, The Boeing Company, Ventura County, California, Final Report*, ORISE, June 2008, pp. 11, B-4.
[4] The Boeing Company, Radiation Safety Records Management System.
[5] *SNAP 8 Ground Prototype Test Facility – Building 059*, fragment, circa 1980, p.1.

and 1995 photographs. In the 2005 and 2009 photographs, undeveloped land is observed where Building 4059 had previously been located.[1]

Radionuclides of Concern: The SNAP 8 reactor contained 211 fuel/moderator elements of zirconium-uranium hydride ((Zr-U)H_x) with beryllium reflector segments.[3] Some parts of this facility, such as steel and concrete, became activated by neutrons produced by the reactors. Tritium was produced and was detected in groundwater pumped from a French drain around the western end of the basement.[2] Potential radioactive contaminants include 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, and Ta-182.[3] All radionuclides of concern listed with the exception of Co-58 and Ta-182, are included in the August 2010 Final Field Sampling Plan for soil sampling in Area IV. Co-58 and Ta-182 both have half-lives of less than 1 year and thus do not meet the criteria for analysis. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Building 4059 is located south and east of a drainage divide. Based on general site topography, surface water likely flows into the storm drain system located around the site and subsequently along 20th Street to an intermittent stream that flows through Area III to a pond in Area II. A sanitary sewer line runs across the southern end of the site. A corrugated metal pipe extending northwest-southeast in front of Building 59, parallel with 20th street, is depicted in a 1969 facility plot plan. The purpose for the pipe is unknown, but it appears to join into the storm drainage system in this area. Because the pipe appears to have been located within the remediation excavation area for this building, it has likely been removed.

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4059 area is Class 1 due to its use as a reactor test building.

Recommended Locations for Soil/Sediment Sampling:

Plate 1 and Figure 2.1 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.

[1] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[2] Rockwell International letter from R. J. Tuttle to R. Vaille, U.S. Environmental Protection Agency, dated October 2, 1989, p. 8.
[3] Vitkus, T. J. and Morton, J. R., *Radiological Survey of the Building 059 Reactor Vault, Santa Susana Field Laboratory, Rockwell International, Ventura County, California*, Final Report, Oak Ridge Institute for Science and Education ORISE 95/G-18, June 1995, pp. 1-2, 8-9.

- 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.

2.1.3 Building 4459 Area

Site Description: The Building 4459 area comprised Building 4459 and the land surrounding it, located northwest of Building 4059 at the end of 20th Street. Building 4459 was constructed in 1963 to house the uninterruptible power supply (UPS). Building 4459 was an 800-square-foot storage building constructed with a steel frame, siding and roof.[1, 2] Figure 2.1.3a provides a current photograph. The research team was unable to find building-specific drawing(s) and no as-built drawings were located for Building 4459. Plate 1 presents a summary of all identified features for this site.

Building Features: Building 4459 contained a large diesel generator and flywheel. No other information was located.

Former Use(s): Building 4459 housed the UPS and was an Energy Technology Engineering Center (ETEC) Storage Building. In 1992, Building 4459 was used for non-radiological storage.[2]

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: Building 4459 was demolished in 2003. 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): Boeing, ORISE, and the DHS both performed radiological surveys of Building 4459 while surveying Building 4059. Building 4459 met release criteria for unrestricted use in 1999. The highest total beta contamination measurement was 739.5 dpm/100 cm^2 and the highest removable beta contamination was 25.6 dpm/100 cm^2. The highest removable alpha contamination was 2.6 dpm/100 cm^2. The highest net gamma level was 4 microroentgen per hour (µR/h) above the inside background levels of the building.[3]

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Locations: The research team did not find evidence of radiological waste burial or disposal associated with Building 4459. However, the building is located less than 40 feet from the S8DR reactor Building 4059, and a portion of the Building 4059 footprint is within the area that was excavated during the Building 4059 excavation.

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[1] Energy Research and Development Administration, *Site Development Plan: 1977-1981*, LR-03026, Part 1, June 1975.
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[3] Liddy, P., *Building 4059 Final Status Survey Report (Phase I)*, RS-00008, September 11, 1999, p. 24.

Aerial Photographs: Aerial photographs show undeveloped land until the 1965 photograph when Building 4459 is identified and a possible open storage area to the east of Building 4459 is also observed. A possible vertical tank is identified to the east of Building 4459 in the 1967 photograph. This is also identified in 1972, 1978, 1980, 1983, 1988, and 1995 photographs. Undeveloped land is seen in the place of Building 4459 in the 2005 and 2009 photographs.[1]

Radionuclides of Concern: The research team did not find evidence that radioactive materials were used or stored in Building 4459. However, the building is located approximately 35 feet northwest of Building 4059; consequently, there is some potential that radionuclides associated with Building 4059 may have migrated to the area surrounding former Building 4459. The S8DR Reactor Building 4059, located adjacent to the site, contained 211 fuel/moderator elements of (Zr-U)H_x with beryllium reflector segments.[2] Potential radioactive contaminants include 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, and Ta-182.[3] All radionuclides of concern listed with the exception of Co-58 and Ta-182, are included in the August 2010 Final Field Sampling Plan for soil sampling in Area IV. Co-58 and Ta-182 both have half-lives of less than 1 year and thus do not meet the criteria for analysis. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Building 4459 is located south of the drainage divide and north of the S8DR reactor Building 4059. Based on general site topography, surface water likely flows southeast or northwest. A storm drain is located north and west of Building 4459. The storm drain system extend to 20th Street and continues southeast to connect to an intermittent stream that flows southeast through Area III to a pond in Area II. A sanitary sewer line is located on the southern side of the site.

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4459 area is Class 1, primarily due to its close proximity with SNAP reactor Building 4059 and because of the open storage located on the east side of Building 4459.

Recommended Locations for Soil/Sediment Sampling:

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

Previous characterization studies for the Building 4459 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 4459 area. This includes the following Building 4459 areas and appurtenances:

- The area to the northeast 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.

[1] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[2] Rockwell International letter from R. J. Tuttle to R. Vaille, U.S. Environmental Protection Agency, dated October 2, 1989, p. 8.
[3] Vitkus, T. J. and Morton, J. R., *Radiological Survey of the Building 059 Reactor Vault, Santa Susana Field Laboratory, Rockwell International, Ventura County, California*, Final Report, Oak Ridge Institute for Science and Education ORISE 95/G-18, June 1995, pp. 1-2, 8-9.

- The storm drain located on the west side 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 south of the site. If radioactive materials were released into the sanitary sewer system, residual contamination may exist in the materials surrounding the sewer lines.

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-5C Group 2 are presented. HSA-5C Group 2 includes six building areas containing office and support buildings, two sodium test rigs, a Systems for Auxiliary Nuclear Power (SNAP) vacuum test facility, instrument calibration facilities, and associated buildings.

2.2.1 Building 4038 Area

Site Description: The Building 4038 area comprises Building 4038 and the land surrounding it on 20th Street. Building 4038 was constructed between 1963 and 1965 as an office building. It is 15,297 square feet in area and is constructed with a steel frame, roof and siding anchored to a concrete floor.[1, 2] 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. Floor plans depicting other building configurations were not located. Plate 1 presents a summary of all identified features for this site.

Building Features: Building 4038 was a Systems for Auxiliary Power (SNAP) office building that expanded in size over the years. It contained offices and bathroom facilities and had a 3-inch deep drainage channel that carried surface water runoff to 20th Street. The floor plan for Building 4038, before expansion, is presented in Figure 2.2.1b.

Former Use(s): Building 4038 was the SNAP Office Building No. 2, Liquid Metal Engineering Center (LMEC) Administration and Information Building, and Energy Technology Engineering Center (ETEC) Administration Building.[2]

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: Building 4038 is standing in 2010. It is currently unoccupied.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): Rockwell conducted radiation surveys in Building 4038 to determine building interior

[1] Energy Research and Development Administration, *Site Development Plan: 1977-1981,* LR-03026, Part 1, June 1975.
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.

background data. No elevated (i.e., above then-current regulatory levels) of radiation were detected.[1] In 1988, Rockwell conducted a radiological survey of the storage yard located between Buildings 4038 and 4626 as part of a DOE site survey. In 1978, the yard had been used to store barrels of activated sand from Building 4059 that housed the SNAP 8 Development Reactor. Surveys were performed on the activated sand before the barrels were shipped off site. Rockwell's 1988 survey found radioactive contamination to be below acceptable limits, but these limits did not conform to current requirements.[3] Weekly entrance/exit radiation surveys were conducted after December 2002.

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Locations: None found.

Aerial Photographs: Aerial photographs show undeveloped land until a rectangular building appears in the 1965 aerial photograph. In the 1967 photograph, open storage is seen outside the northwest and southwest end of Building 4038. In the 1972 photograph, Building 4038 appears to be shorter in length. In the 1978 photograph, Building 4038 is both wider and longer than in 1972, with an increase in area of about 150 percent. In the 1980 and 1995 photographs, a probable stain is identified outside the western end of Building 4038. Building 4038 is observed in 2005 and 2009 aerial photographs.[2]

Radionuclides of Concern: The research team did not find evidence that radioactive materials were used or stored within Building 4038. However, in 1978, a storage yard located at the northwest end of the Building 4038 site held barrels of activated sand from the vacuum duct room of the SNAP 8 Development Reactor Building 4059. The barrels contained activation products of europium (primarily Eu-152) and Co-60.[3] Building 4038 area is located approximately 420 feet south of Building 4059; consequently, there is some potential that other radionuclides associated with Building 4059 may have migrated to the area surrounding Building 4038. Radionuclides associated with the operations of SNAP reactor Building 4059 include 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.[4] All radionuclides of concern listed, with the exception of Co-58 and Ta-182, are included in the August 2010 Final Field Sampling Plan for soil sampling in Area IV. Co-58 and Ta-182 both have half-lives of less than 1 year and thus do not meet the criteria for analysis. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Based on general site topography, surface water likely flows to storm drains located along the southeastern and southwestern portions of the large parking lot that is located along the south side of Building 4038. These storm drain networks discharge water to two drainage ditches that are located close to Building 4015. Ultimately, these drainage ditches discharge to a pond in Area II. A sanitary sewer line is located at the eastern end of the site.

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[1] Sapere, Consulting, Inc., *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California,* Volume 2 – Area IV Site Summaries, May 2005, p. V-1.
[2] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, 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, 1988, pp. 25, 85, 91-92.
[4] Vitkus, T. J. and Morton, J. R., *Radiological Survey of the Building 059 Reactor Vault, Santa Susana Field Laboratory, Rockwell International, Ventura County, California*, Final Report, Oak Ridge Institute for Science and Education ORISE 95/G-18, June 1995, pp. 1-2, 8-9.

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4038 area is Class 1, due to its location within ETEC, and because the open storage area held activation products from Building 4059.

Recommended Locations for Soil/Sediment Sampling:

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

Previous characterization studies for the Building 4038 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 4038 area. This includes the following Building 4038 areas and appurtenances:

- Open storage areas along the western portion of the Building 4038 area. The open storage area northwest of the building contained activation products from the Building 4059 SNAP reactor. Other radioactive materials could have been stored in these open storage areas.

- The storm drains located along the southeastern and southwestern portion of the parking lot. If radioactive materials were released from the storage areas, storm water runoff may have transported them to the storm drains.

2.2.2 Building 4057 Area

Site Description: The Building 4057 area comprises Building 4057, Substation 4757, and the land surrounding these two buildings located on 20th Street. Building 4057 was constructed in approximately 1963 to house two sodium test rigs. It was constructed with a steel frame, siding and roof anchored to a concrete slab. The roof height is at two levels: 44 feet 7 inches and 20 feet 6 inches.[1, 2] Figures 2.2.2a through 2.2.2d 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 4057 contained a 5-ton and a 20-ton crane. In 1975, Building 4057 also contained two identical sodium test rigs that were used during research and development for the Space Station power generation system. The rigs comprised vessels and piping mounted on steel skids. The test vessels were 2 feet in diameter and 4 feet deep. Positive argon cover gas pressure was maintained to limit cover gas contamination. A sodium vapor trap prevented sodium aerosol from escaping to the atmosphere. A cooling water system was provided to protect the test vessel O-ring seals from excessive temperature.[3] The floor plan for Building 4057 is presented in Figure 2.2.2b. A dry well of unknown purpose and function was located on the south side of Building 4057. This is shown in Figures 2.2.2c and 2.2.2d.

[1] Atomics International, *Nuclear Operations Support Building 057, Floor Plan and Elevations*, Map No. 303-057-A4, November 6, 1972.
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[3] Argonne National Laboratory, *Liquid Metal Fast Breeder Reactor Programs, Facility Profiles*, ERDA-68, December 1975, p. 71.

Former Use(s): Building 4057 was used as the Launch Handling and Mobile Equipment Development Building, Liquid Metal Engineering Center (LMEC) Laboratory, Static Sodium Test Facility Building, and Energy Technology Engineering Center (ETEC) General Test Building. In 1998, Building 4057 was decommissioned for laboratory use and became a records room.

Information from Interviewees: None to date.

Radiological Incident Reports: There has been one incident associated with Building 4057 that could have resulted in a release to the environment. The following table provides information presented in an incidents database provided by Boeing. A summary of the incident report is provided following the table.

Building 4057 Incident Report Summary

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A01684	02/26/2003	CABINET DRAWERS		SIX FOLDERS IN CABINET DRAWERS CONTAIN AIR/WIPE SAMPLES WITH LOW-LEVEL CONTAMINATION

- In 2003, Boeing found sixteen folders containing air/wipe samples in cabinet drawers. Six of the folders were found to contain low levels of residual contamination, but this contamination had not escaped from the envelopes containing the filters. The majority of the contaminated samples measured less than the NRC Regulatory Guide 1.86 release limit of 1,000 dpm/100 cm^2 for removable contamination. Based on the survey results, the incident was deemed to be an insignificant hazard.[1] However, the incident report did not identify specific radionuclides tested for and did not speculate on the source of the contaminated air/wipe samples.

Current Use: Building 4057 serves as the Boeing records room.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): Boeing conducted a survey as a result of finding six sets of contaminated air filters confined to envelopes.[1]

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Locations: None identified.

Aerial Photographs: Aerial photographs show undeveloped land until the 1965 photograph when a rectangular building with a two-level roof is identified as Building 4057. This building is seen in photographs from 1967, 1972, 1978, 1980, 1983, and 1988. In the 1995 photograph, Building 4057 appears to have a new roof. Building 4057 is observed in 2005 and 2009 aerial photographs.[2]

[1] The Boeing Company, *Incident Report No. 01684*, February 26, 2003.
[2] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.

Radionuclides of Concern: The research team did not find evidence that radioactive materials were used or stored within Building 4057. However, the building was used as a research laboratory, so there is a possibility that radioactive materials may have been used. In addition, Building 4057 area is located approximately 130 feet south of Building 4059; consequently, there is some potential that other radionuclides associated with Building 4059 may have migrated to the area surrounding Building 4057. Radionuclides associated with the operations of nearby SNAP reactor Building 4059 include 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] All radionuclides of concern listed with the exception of Co-58 and Ta-182, are included in the August 2010 Final Field Sampling Plan for soil sampling in Area IV. Co-58 and Ta-182 both have half-lives of less than 1 year and thus do not meet the criteria for analysis. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Based on general site topography, surface water from Building 4057 likely flows northeast and south to storm drains that flow into drainage ditch near Building 4015 and ultimately to a pond in Area II.[2] Building 4057 is located south of S8DR reactor Building 4059 and may have received drainage from Building 4059. Piping has been plugged and abandoned in Building 4057 yet water was observed sometime after abandonment along the concrete trough at the bottom of the manhole located downgradient from restrooms in the building. The standing water could indicate a leak in the sewer line. A sanitary sewer line is located along the eastern and southern sides of the site.

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4057 area is Class 1, due to its location within ETEC, close proximity to SNAP reactor Building 4059, and because no site investigation has been conducted.

Recommended Locations for Soil/Sediment Sampling:

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

Previous characterization studies for the Building 4057 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 4057 area. This includes the following Building 4057 areas and appurtenances:

- The area between Building 4057 and Building 4059. Radionuclides originating from Building 4059 may have migrated to this area via surface water flow or airborne releases.

- The storm drains located along the southeast and northeast side of the Building 4057. If radiological materials were released from Building 4057 or 4039, they may have migrated to the storm drain network during precipitation events.

[1] Vitkus, T. J. and Morton, J. R., *Radiological Survey of the Building 059 Reactor Vault, Santa Susana Field Laboratory, Rockwell International, Ventura County, California*, Final Report, Oak Ridge Institute for Science and Education ORISE 95/G-18, June 1995, pp. 1-2, 8-9.
[2] Map located at: *www.dtsc-ssfl.com/files/maps/SSFL%20-%20Western%20Half.pdf.*

- The sanitary sewer lines located along the southeast and northeast side of the Building 4057. If radioactive materials were released into the sanitary sewer system, residual contamination may exist in the materials surrounding the sewer lines.

- The dry well located along the southern end of the building. If radiological materials were released from Building 4057 or surrounding area, they may have migrated into the dry well.

2.2.3 Building 4062 Area

Site Description: The Building 4062 area comprises Building 4062 and the land surrounding it located on 20th Street. Building 4062 was constructed in 1963 as a non-nuclear support building for the Energy Technology Engineering Center (ETEC) program. Building 4062 was constructed with steel beams, corrugated steel siding, and a corrugated steel roof.[1, 2] 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 4062. Plate 1 presents a summary of all identified features for this site.

Building Features: Building 4062 had a low bay with a concrete slab floor and concrete foundation, and a high bay over a concrete basement and plate floor at ground level. The building contained some internal partition walls with wood framing and drywall. There were pipe trenches in the concrete floor of the low bay.[1] Figure 2.2.3b provides a floor plan. While the floor plan does not match the site plan, these drawings represent the best available information for this TM.

Former Use(s): Building 4062 was the ETEC Instrumentation Operations Building and a storage facility for instrument calibration. According to available documentation, Building 4062 was a non-nuclear support building.

Current Use: Building 4062 was demolished in 1999. The demolition contractor removed the one-story metal building with a half basement, including slabs and footings to a depth of 3 feet below grade.[3]

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): The research team did not find evidence of previous radiological investigations, decontamination, or cleanups.

Radiological Use Authorizations: None found.

[1] Pendleberry, S. L., *Removal of DOE Buildings, Demo Pak A*, Boeing Report EID-04366, May 18, 1999, pp. 4-5.
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[3] Letter from S. McLain, G. D. Heil, Inc., to M. Mitchell, Boeing Company, dated June 8, 1999.

Former Radiological Burial or Disposal Locations: The research team did not find evidence of radiological waste burial or disposal in the Building 4062 area.

Aerial Photographs: Aerial photographs show undeveloped land until the 1965 photograph when an irregularly shaped building is identified as Building 4062. In the 1988 photograph, a probable vertical tank and possible cylindrical containers are identified on the southern side of Building 4062. Building 4062 is observed in the 1995 photograph, but undeveloped land and a parking lot are seen in 2005 and 2009 photographs.[1]

Radionuclides of Concern: The research team did not find evidence that radioactive materials were used or stored within Building 4062. However, the building is located approximately 500 feet south of Building 4059; consequently, there is some potential that other radionuclides associated with Building 4059 may have migrated to the area surrounding Building 4062. Radionuclides associated with the operations of nearby SNAP reactor Building 4059 include 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.[2] All radionuclides of concern listed with the exception of Co-58 and Ta-182, are included in the August 2010 Final Field Sampling Plan for soil sampling in Area IV. Co-58 and Ta-182 both have half-lives of less than 1 year and thus do not meet the criteria for analysis. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Surface water in the vicinity of the former Building 4062 likely flows east into a storm drain on 20th Street that directs the water southeast via an intermittent stream through Area III to a pond in Area II. A sanitary sewer line also runs along 20th Street on the eastern side of the site. Sewage from Building 4062 discharged into this sewer line. Based on recent facility maps, it appears that the sewer line between the building and the main line was removed.

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4062 area is Class 1, due to its location within ETEC, close proximity to SNAP reactor Building 4059, and because no site investigation has been conducted.

Recommended Locations for Soil/Sediment Sampling:

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

Previous characterization studies for the Building 4062 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 4062 area. This includes the following Building 4062 areas and appurtenances:

- The storm drain located east of the building along 20th Street. This storm drain collects storm water from the northern and eastern portion of Subarea HSA-5C. Storm water originating from the former SNAP reactor Building 4059 discharges into this storm drain.

[1] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[2] Vitkus, T. J. and Morton, J. R., *Radiological Survey of the Building 059 Reactor Vault, Santa Susana Field Laboratory, Rockwell International, Ventura County, California*, Final Report, Oak Ridge Institute for Science and Education ORISE 95/G-18, June 1995, pp. 1-2, 8-9.

Consequently, this storm drain may provide a pathway for the migration of radionuclides originating from the former research reactor.

- The sanitary sewer lines located along the northern and eastern side of the Building 4057. If radioactive materials were released into the sanitary sewer system, residual contamination may exist in the materials surrounding the sewer lines.

2.2.4 Building 4065 Area

Site Description: The Building 4065 area comprises Building 4065 and the land surrounding it located on F Street. Building 4065 was constructed in 1963 as a vacuum test facility for SNAP reactors. It was a 6,300-square-foot single-story building with galvanized steel walls and roof anchored to a concrete slab floor.[1, 2] 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. No as-built drawings were located for Building 4065. Plate 1 presents a summary of all identified features for this site.

Building Features: Building 4065 contained partition walls with wood framing and drywall. There were pipe trenches in the concrete floor and two external concrete pits.[1] Building 4065 contained a metals clarifier.[3] Figure 2.2.4b provides a floor plan.

Former Use(s): Building 4065 was the Systems for Auxiliary Nuclear Power (SNAP) Thermoelectric Converter Test Building, Liquid Metal Engineering Center (LMEC) Chemical Laboratory, and Chemistry and Metallurgical Laboratory.

Information from Interviewees: None to date.

Radiological Incident Reports: There has been one incident associated with Building 4065 that could have resulted in a release to the environment. The following table provides information presented in an incidents database provided by Boeing. A summary of the incident report is provided following the table.

Building 4065 Incident Report Summary

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A0311 Incident report missing	06/26/1974	X-RAY DIFFRACTION UNIT		VENDOR SERVICEMAN EXPOSED TO X-RAY WHILE REPAIRING X-RAY DIFFRACTION UNIT

- On June 26, 1974, two outside contractors were exposed to radiation from an X-ray machine during routine maintenance (Report No. A0311).[1]

[1] Pendleberry, S. L., *Removal of DOE Buildings, Demo Pak A*, Boeing Report EID-04366, May 18, 1999, pp. 4-5.
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[3] The Boeing Company, *Site Environmental Report for Calendar Year 2003, DOE Operations at The Boeing Company Rocketdyne Propulsion & Power*, September 2004, p. 6-11.

Current Use: Building 4065 was demolished in 1999.[1] The demolition contractor removed a one-story metal building, including slabs and footings to a depth of 3 feet below grade.[2]

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): The research team did not find evidence of previous radiological investigations, decontamination, or cleanups.

Radiological Use Authorizations: A chronology of radiological use authorizations at this building is as follows:[3]

- Use authorization Series 039, issued on May 14, 1971, permitted the examination of irradiated S8DR cladding and irradiated or un-irradiated S8DR fuel.
- Use Authorization 061, issued December 12, 1972, permitted 50 grams of uranium $UZrH_{1.67}$ in sealed containers for use in fuel friction tests for 1 year.
- Use Authorization Series 074, issued March 20, 1974, permitted the use of the Norelco XRG-5000 analytical X-ray generator, which emitted radiation at very low levels.
- Use Authorization Series 075, issued March 20, 1975 until 1996, permitted the possession and use of tritiated titanium foils as gas chromatography detectors.
- Use Authorization 164A, issued January 3, 1995, permitted the possession and use of a gas chromatograph probe containing a Ni-63 source.

Former Radiological Burial or Disposal Locations: The research team did not find evidence of radiological waste burial or disposal in the Building 4065 area.

Aerial Photographs: Aerial photographs show undeveloped land until the 1965 photograph when a rectangular shaped building is identified as Building 4065. Building 4065 is observed in 1967, 1972, 1978, 1980, 1983, 1988, and 1995 aerial photographs with possible open storage areas on the north, west, and east sides of the building during most of these years. Undeveloped land and a parking lot with a drainage channel on the east side of the former building are observed in 2005 and 2009 photographs.[4]

Radionuclides of Concern: By 1971, Building 4065 may have been used for X-ray examination of irradiated SNAP-8 fuel oxide and ceramic samples. Building 4065 used tritiated titanium foils and an X-ray generator.[5] The same types of radionuclides would be expected here as would be associated with irradiated SNAP 8 fuel, as discussed under the Building 4059 description, above. Building 4065 is located approximately 450 feet south of Building 4059; consequently, there is some potential that other radionuclides associated with Building 4059 may have migrated to the area surrounding Building 4062. Potential radioactive contaminants

[1] Rockwell International, Internal Letter, *Exposure Measurements with Analytical X-Ray Machine,* Tuttle, R. J. to Isotopes Committee, dated November 10, 1980.
[2] Letter from S. McLain, G. D. Heil, Inc., to M. Mitchell, Boeing Company, dated June 8, 1999.
[3] Boeing, Radiation Safety Records Management System.
[4] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[5] State of California, *Radioactive Material License*, License No. 0015-70, November 12, 1987, p. 3.

associated with Building 4059 include 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] All radionuclides of concern listed with the exception of Co-58 and Ta-182, are included in the August 2010 Final Field Sampling Plan for soil sampling in Area IV. Co-58 and Ta-182 both have half-lives of less than 1 year and thus do not meet the criteria for analysis. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Based on general site topography, surface water at the site likely flows east, but may be redirected locally to the south to a storm drain on F Street and east to a drainage channel that commences in the parking lot surrounding former Building 4065. The drainage channel leads to a storm drain on F Street that is connected to an intermittent stream that flows southeast through Area III to a pond in Area II. A sanitary sewer line is located on the southern side of the site. Based on recent facility maps, it appears that the sewer line between the building and the main line was removed.

A 1969 facility plan depicts a corrugated metal drain pipe emanating from the east side of Building 4065 and heading east toward the 20th Street storm drain. The research team was unable to identify the purpose of this pipe or what it may have drained. A north-south trending asphalt-concrete ditch was also observed west of Building 4065 in the 1969 facility plan. The ditch appears to have provided drainage from the north, near the southwest corner of Building 4038, toward the storm drainage system along F Street.

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4065 area is Class 1, due to its location within ETEC, close proximity to SNAP reactor Building 4059, documented use of nuclear materials, and because no radiological survey specific to Building 4065 has been conducted.

Recommended Locations for Soil/Sediment Sampling:

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

Previous characterization studies for the Building 4065 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 4065 area. This includes the following Building 4065 areas and appurtenances:

- The storm drains located southeast and southwest of Building 4065. If radionuclides were released from Building 4065, they may have migrated to the storm drains. This storm drain collects storm water from the northern and eastern portion of Subarea HSA-5C. Storm water originating from the former SNAP reactor Building 4059 discharges into this storm drain.

- The area of the corrugated metal drain pipe emanating from the east side of Building 4065 and heading east toward the 20th Street storm drain in the 1969 facility plan should

[1] Vitkus, T. J. and Morton, J. R., *Radiological Survey of the Building 059 Reactor Vault, Santa Susana Field Laboratory, Rockwell International, Ventura County, California*, Final Report, Oak Ridge Institute for Science and Education ORISE 95/G-18, June 1995, pp. 1-2, 8-9.

be investigated. In addition the north-south trending asphalt-concrete ditch west of Building 4065 in the 1969 facility plan should be investigated.

- The sanitary sewer line located along the southern portion of Building 4065. If radioactive materials were released into the sanitary sewer system, residual contamination may exist in the materials surrounding the sewer lines.

- Former metals clarifier. Elevated metals concentrations were detected in the vicinity of the metals clarifier.

2.2.5 Building 4066 Area

Site Description: The Building 4066 area comprised Building 4066, time clock Building 4806, and the land surrounding these two buildings located on 20th Street. Building 4066 was constructed in 1963 for use in calibrating and testing non-radiological equipment. Building 4066 was a 4,800-square-foot steel building with concrete foundations and floor, corrugated steel siding and roof, housing a 3,524-square-foot laboratory.[1, 2] 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. No as-built drawings were located for Building 4066. Plate 1 presents a summary of all identified features for this site.

Building Features: Building 4066 contained internal partition walls with wood framing and drywall. One room had copper shielding in the walls to provide radio-frequency shielding for instruments. A steel test stand was located outside the south side of Building 4066.[1] A floor plan is provided in Figure 2.2.5b.

Former Use(s): Building 4066 was the Instrumentation Repair and Calibration Building, and Instrument Laboratory.

Information from Interviewees: None to date.

Radiological Incident Reports: There has been one incident associated with Building 4066 that could have resulted in a release to the environment. The following table provides information presented in an incidents database provided by Boeing. A summary of the incident report is provided following the table.

Building 4066 Incident Report Summary

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A0599	10/31/1966	INSTRUMENT SHOP	U	CONTAMINATED FURNACE SWITCH TAKEN TO CLEAN INSTRUMENT SHOP FOR REPAIR

*Isotopes are written as they are presented in the incident database.

[1] Pendleberry, S. L., *Removal of DOE Buildings, Demo Pak A*, Boeing Report EID-04366, May 18, 1999, pp. 4-6.
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.

- In October 1966, an in-line vacuum switch was removed from the tiltpour pumping system and hand-carried to Building 4066. When the instrument technician opened the switch to calibrate it, a fine black powder, assumed to be uranium oxide, leaked out onto the technician's clothing and work bench. The technician's clothing was removed; he showered in Building 020, and was subsequently found to the free of contamination. The area around the work bench was decontaminated (Report No. A0599).[1]

Current Use: Building 4066 was demolished in 1999.[1] The demolition contractor removed the one-story metal building, including slabs and footings to a depth of 3 feet below grade.[2]

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): AI decontaminated Building 4066 after a spill of black powder, thought to be uranium oxide.

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Locations: The research team did not find evidence of radiological waste burial or disposal in the Building 4066 area.

Aerial Photographs: Aerial photographs show undeveloped land until the 1965 photograph when a rectangular shaped building is identified as Building 4066. Building 4066 is observed in 1967, 1972, 1978, 1980, 1983, 1988, and 1995 aerial photographs. Undeveloped land is observed in 2005 and 2009 photographs.[3]

Radionuclides of Concern: Possible uranium release from accidental introduction of black powder to Building 4066 (see below). In addition, Building 4066 is located approximately 600 feet south of Building 4059; consequently, there is some potential that other radionuclides associated with Building 4059 may have migrated to the area surrounding Building 4066. Potential radioactive contaminants associated with the SNAP reactor Building 4059 include 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.[4] All radionuclides of concern listed with the exception of Co-58 and Ta-182, are included in the August 2010 Final Field Sampling Plan for soil sampling in Area IV. Co-58 and Ta-182 both have half-lives of less than 1 year and thus do not meet the criteria for analysis. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Surface water in the vicinity of the former Building 4066 likely flows east into a storm drain on 20th Street that directs the water southeast via an intermittent stream through Area III to a pond in Area II. A sanitary sewer line also runs along 20th Street on the eastern side of the site. Sewage from Building 4066 discharged into this sewer line. Based on recent facility maps, it appears that the sewer line between the building and the main line was removed.

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[1] Anonymous, Atomics International Monthly Progress Report to M. E. Remley, re: *In-Line Vacuum Switch*, November 8, 1966.
[2] Letter from S. McLain, G. D. Heil, Inc., to M. Mitchell, Boeing Company, dated June 8, 1999.
[3] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[4] Vitkus, T. J. and Morton, J. R., *Radiological Survey of the Building 059 Reactor Vault, Santa Susana Field Laboratory, Rockwell International, Ventura County, California*, Final Report, Oak Ridge Institute for Science and Education ORISE 95/G-18, June 1995, pp. 1-2, 8-9.

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4066 area is Class 1, due to its location within ETEC, close proximity to SNAP reactor Building 4059, and because no site investigation has been conducted.

Recommended Locations for Soil/Sediment Sampling:

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

Previous characterization studies for the Building 4066 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 4066 area. This includes the following Building 4066 areas and appurtenances:

- The storm drain located east of the building along 20th Street. This storm drain collects storm water from the northern and eastern portion of Subarea HSA-5C. Storm water originating from the former SNAP reactor Building 4059 discharges into this storm drain. Consequently, this storm drain may provide a pathway for the migration of radionuclides originating from the former research reactor.

- The sanitary sewer lines located along the northern and eastern side of the Building 4057. If radioactive materials were released into the sanitary sewer system, residual contamination may exist in the materials surrounding the sewer lines.

2.2.6 Building 4626 Area

Site Description: The Building 4626 area comprised Building 4626 and the land surrounding it located behind Building 4057 on 20th Street. Building 4626 was constructed in approximately 1963 for equipment storage. It had a steel frame, siding, and roof anchored to a concrete slab. The roof height ranged between 15 and 25 feet.[1, 2] 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. Plate 1 presents a summary of all identified features for this site.

Building Features: Building 4626 was equipped with sliding metal doors at its north and south ends and a 2-ton bridge. A storage yard, located west of Building 4626, was used to store barrels of sand containing activation products of europium (primarily Eu-152) and cobalt-60 (Co-60) from Building 4059.[3] The floor plan and elevation for Building 4626 are presented in Figure 2.2.6b. It appears that the building was modified over time. However, Figure 2.2.6b represents the best available drawing depicting the shape of the building.

[1] Energy Research and Development Administration, *Site Development Plan: 1977-1981*, LR-03026, Part 1, June 1975.
[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; and Area Northwest of T059, T019, T013, and T012; and a Storage Yard West of Buildings T626 and T038*, GEN-ZR-0010, 1988, pp. 25, 85, 92.

Former Use(s): Building 4626 was an equipment storage building, used for Liquid Metal Engineering Center (LMEC) inventory storage, Energy Technology Engineering Center (ETEC) inventory storage, and for storage of Systems for Auxiliary Nuclear Power (SNAP) components.

Information from Interviewees: See Plate 1 for interviewee information pertaining to this area.

Radiological Incident Reports: None found.

Current Use: Building 4626 was demolished in 2004. 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): Rockwell conducted a radiological survey of the storage yard west of Building 4626 because it had been used to store radioactive materials. Survey results were below acceptable limits in 1988.[1]

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Locations: A storage yard, located west of Building 4626 was used to store barrels of activated sand containing Eu-152 and Co-60 from Building 4059.[1]

Aerial Photographs: Aerial photographs show undeveloped land until the 1965 photograph when a rectangular-shaped building identified as Building 4626 can be seen. In the 1965 photograph, a possible open storage area was identified west of the building. By 1972, Building 4626 appears to have increased in area by about 50 percent. Building 4626 is replaced by bare ground in the 2005 and 2009 aerial photographs.[2]

Radionuclides of Concern: The research team did not find evidence that radioactive materials were used or stored within Building 4626. However, the building was used, in part to store equipment associated with the SNAP reactor program, so there is a possibility that radioactive materials may have been used. In addition, Building 4626 area is located approximately 150 feet south of Building 4059; consequently, there is some potential that other radionuclides associated with Building 4059 may have migrated to the area surrounding Building 4057. Radionuclides associated with the operations of adjacent SNAP reactor Building 4059 include 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.[3] All radionuclides of concern listed with the exception of Co-58 and Ta-182, are included in the August 2010 Final Field Sampling Plan for soil sampling in Area IV. Co-58 and Ta-182 both have half-lives of less than 1 year and thus do not meet the criteria for analysis. Table 3.3 presents a summary of contaminants of concern.

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[1] Chapman, J. A., *Radiological Survey of Buildings T019 and T013; and Area Northwest of T059, T019, T013, and T012; and a Storage Yard West of Buildings T626 and T038*, GEN-ZR-0010, 1988, pp. 25, 85, 92.
[2] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[3] Vitkus, T. J. and Morton, J. R., *Radiological Survey of the Building 059 Reactor Vault, Santa Susana Field Laboratory, Rockwell International, Ventura County, California*, Final Report, Oak Ridge Institute for Science and Education ORISE 95/G-18, June 1995, pp. 1-2, 8-9.

Drainage Pathways: Based on general site topography, surface water at the site likely flows northeast to a storm drain that continues along 20th Street and connects to an intermittent stream that flows through Area III to a pond in Area II. A sanitary sewer line is located on the northern side of the site.

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4626 area is Class 1, due to its location within ETEC, proximity to SNAP reactor Building 4059, and because the Building 4626 storage yard, west of Building 4626, held activation products from Building 4059.

Recommended Locations for Soil/Sediment Sampling:

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

Previous characterization studies for the Building 4626 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 4626 area. This includes the following Building 4626 areas and appurtenances:

- The area between Building 4626 and Building 4059. Radionuclides originating from Building 4059 may have migrated to this area via surface water flow or airborne releases.
- The general areas on the east, south and west sides of Building 4626 as there is evidence of open storage surrounding Building 4626.
- The storm drains located on the northern and eastern side of Building 4626 (near Buildings 4039 and 4057). If radiological materials were released from Building 4626, they may have migrated to the storm drain network during precipitation events.
- The sanitary sewer lines located on the northern and eastern side of Building 4626 (near Buildings 4039 and 4057). If radioactive materials were released into the sanitary sewer system, residual contamination may exist in the materials surrounding the sewer lines.

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 the building area within HSA-5C Group 3 are presented. HSA-5C Group 3 includes one building area containing criticality test facilities as well as adjacent disposal areas including trenches.

2.3.1 Building 4100 Area

Site Description: The Building 4100 area comprises Building 4100, substation Building 4800, cooling tower 4710, and the fenced land surrounding these buildings located on G Street. Building 4100 was constructed after 1962 for the Southwest Atomic Power Association; that use was terminated in 1974. Building 4100 is a steel and concrete structure 98 feet long, by 72 feet

wide.[1, 2] Figures 2.3.1a through 2.3.1b 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 4100 contained an experimental critical assembly located within a high bay (Room 110), special nuclear material stored within a vault (Room 112), supporting rooms, and a control room (Room 109). The facility included a ventilation system with filtered exhaust for the high bay area, a storage vault, and laboratories. A pit adjacent to the facility contained a liquid holdup tank system for liquid wastes.[1] Building 4100 also had a septic tank, a leach field, a trench outside the building, and two stacks, the higher of which reached 50 feet. Building 4100 currently houses one of the largest computed axial tomography (CT) scanners in the world. Figure 2.3.1b provides a floor plan of Building 4100 in 1967. This figure provides the most applicable floor plan available for Building 4100 and represents only a snapshot in time of the building layout, which was modified over time.

Former Use(s): Building 4100 housed the Advanced Epithermal Thorium Reactor (AETR), which was a separable-half critical experiment operating at less than 200 watts (thermal), Fast Critical Experiment Laboratory (FCEL), and Radiation Safety and Computed Tomography Laboratory. Twenty reactor core configurations were studied including thorium, uranium, and later, high-energy fast neutrons in the FCEL.[3] The FCEL operated until about 1974 under NRC License No. CX-17. The NRC terminated License No. CX-17, and released Building 4100 for unrestricted use in October 1980.[4] From the late 1980s until 2008, the high bay was used for high energy Computer Aided Tomography (CAT). NASA owned the scanner. The laboratories were used for radioactive sample counting and instrument calibration.[1]

Information from Interviewees: In 2010, a number of former workers were interviewed about their experiences at the SSFL. One remembered Building 4100. An excerpt from his comments is presented below.

- "In Building 100, there was a fuel storage room which had racks on the wall that were spaced to prevent criticality. There were rules for example, that you could only have one tray out at a time when you were loading. It did get "hot" in that room, the radioactivity was mostly due to the U-233. We wore coveralls, booties and film badges. We were set up where there was a changing room. I think the radioactive materials were handled with care. We also had beryllium blocks. Beryllium can be hazardous, but ours were solid metal blocks. The major hazard had been in making the blocks in the machine shop. We were aware of the possibility of a hazard, but I don't recall special precautions. The blocks were handled with gloves, as were all of the materials loaded into the drawers which made up the critical assembly."[5] This former employee worked at the SSFL between 1959 and 1981.

[1] Tetra Tech EM Inc., *Final Oversight Verification and Confirmation Radiological Survey Report for Buildings T-011, T-019, T-055, and T-100*, December 20, 2002, p. 11.
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[3] U.S. Nuclear Regulatory Commission, *Rockwell International Corporation Docket No. 50-147, Order Terminating Facility License*, October 1, 1980.
[4] Letter from Brook, H.E., NRC, to Remley, M.E., *NRC Inspection of Rockwell International's FCEL Inspection*, dated July 11, 1980.
[5] Interview No. 196 of former worker conducted by the DOE and EPA, September 2010.

Radiological Incident Reports: There have been two incidents associated with Building 4100 that could have resulted in releases to the environment. The following table provides information presented in an incidents database provided by Boeing. A summary of the incident reports is provided following the table.

Building 4100 Incident Report Summary

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A0217	12/17/1991	RESPIRATOR LABORATORY	MFP	RESPIRATOR LAB WASHINGTON MACHINE CONTAMINATED
A0220	10/23/1992	CAT X-RAY CELL		CONTRACTOR SERVICE REP. ACTIVATED X-RAY SYSTEM WHILE EMPLOYEE WAS IN CELL

*Isotopes are written as they are presented in the incident database. The research team believes that MFP is an acronym for mixed fission products.

- On December 17, 1991, Rockwell performed a radiological survey on the internal respirator laboratory washing machine in Building 4100. A smear wipe indicated 173 dpm/100 cm^2. Gamma spectroscopy of a 4,000-second scan indicated 254 dpm/100 cm^2. Rockwell recommended that the respirator laboratory decontaminate and routinely survey the washing machine on a monthly basis (Report No. A0217).[1]

- On October 23, 1992, a contract service technician activated the 2.5 MVp CAT X-ray system while the cell was occupied by another individual. This was in violation of Rocketdyne procedure and California state law. The individual's exposure was calculated to be approximately 5 mrem. Rockwell recommended that operating personnel be reminded to inspect the cell area thoroughly prior to activation of an X-ray system (Report No. A0220).[2]

Current Use: Building 4100 is standing in 2011 and is used for office, laboratory, storage, and support activities. Small amounts of radioactive materials in samples and check sources are used in Building 4100.[3]

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): A chronology of radiological investigations at this building is as follows:

- In 1980, Rockwell conducted a radiation survey to terminate facility license CX-17. All measured levels were below 1980 acceptable levels of 20 dpm/cm^2 for alpha radiation and 50 dpm/cm^2 for beta-gamma radiation.[1]

[1] Saba, V. B., Rockwell Internal Letter to Radiation Protection and Health Physics Services, re: *Radiological Safety Report, Contaminated Respirator Laboratory Washer*, December 17, 1991.
[2] Barnes, J., Rockwell Internal Letter to Distribution, re: *CAT Scanner Operation with Individual in Cell*, October 23, 1992.
[3] Rockwell International letter from R. J. Tuttle to R. Vaille, U.S. Environmental Protection Agency, dated October 2, 1989, p. 10.

- In 1980, the NRC conducted a radiation survey inside Building 4100 and confirmed Rockwell's findings.[2] No soil sampling outside Building 4100 was conducted.

- In 1988, Rockwell performed a gamma survey of the Building 4100 storage yard and concluded that the storage yard met 1988 unrestricted release criteria of less than 5 micro roentgen per hour above background.[3]

- In 1999, Rockwell performed instrument surveys and soil sampling in the trench area. All measured levels were below 1999 acceptable level of 9.2 picocuries per gram for Cs-137.

- In 2001, the EPA conducted a verification survey for alpha, beta, beta-gamma, and gamma radiation in accordance with the Multi-Agency Radiation Surveys and Site Investigation Manual (MARSSIM) guidance. Rooms 112, 113, and 114 were used for storage of radioactive materials at the time and were not surveyed. The contaminants of concern were mixed fission products, uranium, thorium, transuranic compounds, and activation and corrosion products on the floors, walls, and ceilings. Concrete core samples were also collected and analyzed for photon-emitting isotopes. No radionuclides were found above 2001 acceptable limits. Acceptable removable surface contamination levels ranged from 20 to 1,000 dpm/100 cm^2 depending on the radionuclide.[4] No soil samples were collected and analyzed during this survey.

- In 2001, Boeing removed the Building 4100 septic tank and leach field.[5] All instrument surveys and wipe tests of the tank and piping were non-detectable with respect to 2001 limits. Cs-137 was not detected in soil samples in 2001. No additional information has been located to date.

Radiological Use Authorizations: A chronology of radiological use authorizations at this building is as follows:[6]

- Use authorization No. 033, permitted the calibration of fixed and portable radioactive systems, including Cs-137 source calibrations in Building 4100.

- Use authorization No. 054, permitted the operation of the Faxitron 804 cabinet X-ray system in Building 4100.

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[1] Rockwell International, *Report of Radiation Survey of the FCEL Reactor Facility in Support of Request to Terminate Facility License CX-17 and to Release the Facility for Unrestricted Use*, Docket No. 50-147, April 30, 1980.
[2] Letter from Reid, R.W., NRC, to Remley, M.E. re Docket No. 50-147, dated October 1, 1980.
[3] Chapman, J. A., *Radiological Survey of the T056 Landfill, Area from 23rd Street to Building T100; and an Area across from Building T011*, Energy Technology Energy Center Report GEN-ZR-0011, August 26, 1988, pp. 24-25, 81.
[4] Tetra Tech EM Inc., *Final Oversight Verification and Confirmation Radiological Survey Report for Buildings T-011, T-019, T-055, and T-100*, December 20, 2002, pp. 11, 25-26.
[5] The Boeing Company Radiation Safety Records Management System (File Drawer 133-B), B/4100 Septic Tank, 2001.
[6] The Boeing Company, Radiation Safety Records Management System.

- Use authorization No. 070, permitted the storage and use of Pu calibration sources in Building 4100.

- Use authorization No. 099, permitted the calibration of radiation survey meters in Building 4100.

- Use authorization No. 124, permitted the use of radioactive materials for HP operations in Building 4100.

- Use authorization No. 125, permitted the storage and disposal of radioactive materials in Building 4100.

- Use authorization No. 127, permitted the storage of a gamma ray level detector in Building 4100.

- Use authorization No. 136, permitted analytical chemistry in Building 4100.

- Use authorization No. 154, permitted shielded room X-ray radiography for computerized tomography in Building 4100.

- Use authorization No. 160, permitted calibration sources for radiation instrumentation services in Building 4100.

Former Radiological Burial or Disposal Locations: A sanitary leach field and a trench were associated with Building 4100. Photographs from 1960 show the presence of debris and drums in a trench located near the intersection of F and 24th Streets. This trench was 80 ft. long by 20 ft. wide and used by contractors for burning and disposal of construction debris and possible hazardous substances. The trench was cleaned out and backfilled in the late 1960s to early 1970s. The trench location is now covered by the paving of 24th Street.[1] The sanitary leach field was removed in 2001.

Aerial Photographs: Aerial photographs show undeveloped land until the 1965 photograph when a rectangular-shaped building is identified as Building 4100. Building 4100 is observed in 1967, 1972, 1978, 1980, 1983, 1988, 1995, 2005, and 2009 aerial photographs. In 1965 and 1967 photographs, a stained area is identified on undeveloped land located east of Building 4100. In the 1967, 1972, and 1978 photographs, mounded material is observed on the undeveloped land located east of Building 4100. In the 1978 photograph, disturbed ground and a possible vertical tank are identified on the east side of Building 4100. In the 1983 through 1995 photographs, an open storage area is identified on the undeveloped land located on the east side of Building 4100.[2]

Radionuclides of Concern: The Atomic Energy Commission issued in October 1960, Facility License No. CX-17 for Building 4100 and subsequently amended it to permit the use of U-233,

[1] Chapman, J. A., *Radiological Survey of the T056 Landfill, Area from 23rd Street to Building T100; and an Area across from Building T011*, Energy Technology Energy Center Report GEN-ZR-0011, August 26, 1988, pp. 24-25, 81.
[2] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.

U-234, U-235, U-236, U-238, Th-232, Np-237, Pu-238, Pu-239, Pu-240, and Pu-241 in the AETR and in January 1972 for use in the FCEL. Decay products would include Th-228, Ra-228, Th-230, Ra-226, Pb-210, Pa-231, and Ac-227. All radionuclides of concern listed are included in the August 2010 Final Field Sampling Plan for soil sampling in Area IV.[1] Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: A drainage channel surrounds all four sides of Building 4100. This channel appears to connect to an intermittent stream that carries surface water north from the northwest corner of Building 4100 through the Northwest Buffer Zone to a stream that connects to the Los Angeles River. Based on general site topography, surface water may also flow south or east from the site to a storm drain that runs east to connect to an intermittent stream that flows southeast through Area III to a pond in Area II. Sanitary sewer lines are located on the eastern and southern sides of Building 4100.

Radiological Contamination Potential: Class 1 because of the former use of Building 4100.

Recommended Locations for Soil/Sediment Sampling:

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] U.S. Atomic Energy Commission, *Facility License No. CX-17, Amendment No. 2*, Washington, D.C., May 28, 1962.

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 the building areas within HSA-5C Group 4 are presented. HSA-5C Group 4 includes four building areas containing the Sodium Pump Test Facility, the Sodium Cleaning and Handling facility, and associated buildings.

2.4.1 Building 4461 Area

Site Description: The Building 4461 area comprised Building 4461 and the land surrounding it located on 22nd Street. Building 4461 was constructed in 1977 for electrical equipment that powered the motors in the Sodium Pump Test Facility (SPTF). Building 4461 was a 3,600-square-foot building constructed with a steel frame, siding and roof.[1,2,3] Figures 2.4.1a through 2.4.1b provide a current photograph and the best available building-specific drawing(s) that the research team could find. An alcohol drainage pond, sometimes liquid-filled, is located southwest of Building 4461. The alcohol was identified as ethanol in the 1998 Site Environmental Report.[4] Plate 1 presents a summary of all identified features for this site.

Building Features: Building 4461 contained sliding doors at its north and south ends, a partition forming two rooms, an evaporative cooler, and an exhaust fan. The floor plan and elevation for Building 4461 are presented in Figure 2.4.1b.

Former Use(s): Building 4461 was the SPTF Motor Generator Building.[1]

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: Building 4461 was demolished in 2007, but the concrete slab remains. In 2007, all utility connections were severed.[5]

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): The research team did not find evidence of previous radiological investigations, decontamination, or cleanups.

Radiological Use Authorizations: None found.

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[1] Energy Research and Development Administration, *Site Development Plan: 1977-1981*, LR-03026, Part 1, June 1975.
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[3] Energy Research and Development Administration, *Site Development Plan: 1977-1981*, LR-03026, Part 1, June 1975.
[4] The Boeing Corporation, *Site Environmental Report for Calendar Year 1998, DOE Operations at Rocketdyne Propulsion & Power*, RD99-115, dated September 22, 1999, p. 6-5.
[5] The Boeing Company, *Site Environment Report for Calendar Year 2007, DOE Operations at The Boeing Company Santa Susana Field Laboratory, Area IV*, September 2008, p. 2-7.

Former Radiological Burial or Disposal Locations: The research team did not find evidence of radiological waste burial or disposal in the Building 4461 area. However, open storage areas were located north, south, and in the location of Building 4461 (see below). The materials or equipment that was stored in these areas is unknown.

Aerial Photographs: Aerial photographs show undeveloped land until the 1972 photograph when probable open storage is identified north, south and in the location of future Building 4461. In the 1978 photograph, a square building is identified as Building 4461. This is seen in 1989, 1983, 1988, 1995, and 2005 photographs. Open storage is observed north and south of Building 4461 in the 1980, 1983, 198, and 1995 photographs. A dry impoundment located southwest of Building 4461 is observed in 1978, 1980, and 1983 photographs. A liquid-filled impoundment is seen in the same location in 1988 and 1995 photographs. A dry impoundment is observed in the 2005 photograph, while a liquid-filled impoundment is again observed in the 2009 photograph. The 2009 photograph indicates that only the foundation of Building 4461 remains.[1]

Radionuclides of Concern: The research team did not find evidence that radioactive materials were used or stored with the Building 4461 area. However, given its location within the ETEC, the presence of radioactive contamination cannot be ruled out. The Building 4461 area is located along a storm drain that receives storm water from the areas surrounding radiological Buildings 4009, 4020, and 4100; consequently, there is some potential that radionuclides associated with these buildings may have migrated to the Building 4461 area. Radionuclides used and generated in Buildings 4009, 4020, and 4100 include U-233, U-234, U-235, U-236, U-238, Th-232, Np-237, Pu-238, Pu-239, Pu-240, and Pu-241, and decay products including Th-228, Ra-228, Th-230, Ra-226, Pb-210, Pa-231, and Ac-227. All radionuclides of concern listed are included in the August 2010 Final Field Sampling Plan for soil sampling in Area IV.[2] Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Surface water from the site flows east and south to a storm drain that connects to an intermittent stream that flows southeast through Area III to a pond in Area II In 1965, the storm drain collected drainage from Buildings 4009, 4020, and 4100 where radioactive materials were used and radionuclides were generated.[3] A sanitary sewer line is located on the south side of the site.

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4461 area is Class 1, due to its location within ETEC and because of the proximity of Building 4461 to the storm drain that collected drainage from Buildings 4009, 4020, and 4100.

Recommended Locations for Soil/Sediment Sampling:

Plate 1 and Figure 2.4 provide a convenient reference for the following recommendations.

Previous characterization studies for the Building 4461 area were focused on delineating the extent of contamination to standards that were applicable at the time. Therefore, additional

[1] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[2] U.S. Atomic Energy Commission, *Facility License No. CX-17, Amendment No. 2*, Washington, D.C., May 28, 1962.
[3] Garcia, R. R. and Schwering, C. J., *Environmental Monitoring Semiannual Report, January 1, 1965 to June 30, 1965,* Atomics International, p. 12.

characterization is recommended for the Building 4461 area. This includes the following Building 4461 areas and appurtenances:

- The storm drain located east of the former building along 22nd Street and the storm drain located south of the former building. These storm drains collect storm water from the northern and western portions of Subarea HSA-5C. The storm drain along the southern portion of the site receives storm water from the areas surrounding radiological Buildings 4009, 4020, and 4100; consequently, there is some potential that radionuclides associated with these buildings may have migrated to the Building 4461.

- The sanitary sewer lines located along the southern side of the Building 4461. If radioactive materials were released into the building drains, residual contamination may exist in the materials surrounding the sewer lines.

- Open storage area that was observed in aerial photos.

2.4.2 Building 4462 Area

Site Description: The Building 4462 area comprises Building 4462, substation 4760, and the land surrounding these two buildings located on 22nd Street between F and G Streets. Building 4462 was constructed in approximately 1972 to test sodium pumps. It is 6,530 square feet in area, constructed with a steel frame, siding, and roof.[1, 2] Figures 2.4.2a through 2.4.2b provide a current photograph and the best available building-specific drawing(s) that the research team could find. An alcohol drainage pond, sometimes liquid-filled, is located southwest of Building 4462. The alcohol was identified as ethanol in the 1998 Site Environmental Report.[3] Plate 1 presents a summary of all identified features for this site.

Building Features: Building 4462 is a multistory building with an elevator shaft and an outside staircase to access the elevator. Building 4462 was designed to test 14,000 to 6,000 gallon-per-minute pumps at temperatures up to 1050 °F and discharge pressures up to 245 pounds per square inch. The system consisted primarily of an 18-inch diameter sodium pipe test loop. The test pump was supported in a structural steel tower located at one end of the loop. A test control building housing control equipment, a data acquisition system, switch gear, and office space was attached to the test building.[4] The floor plan and elevation for Building 4462 are presented in Figure 2.4.2b.

Former Use(s): Building 4462 was the Sodium Pump Test Facility Building.[2]

Information from Interviewees: None to date.

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[1] Energy Research and Development Administration, *Site Development Plan: 1977-1981, L*R-03026, Part 1, June 1975.
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[3] The Boeing Corporation, *Site Environmental Report for Calendar Year 1998, DOE Operations at Rocketdyne Propulsion & Power*, RD99-115, dated September 22, 1999, p. 6-5.
[4] Argonne National Laboratory, *Liquid Metal Fast Breeder Reactor Program, Facilities Profile*, ERDA-68, December 1975, p. 65.

Radiological Incident Reports: There has been one incident associated with Building 4462 that could have resulted in a release to the environment. The following table provides information presented in an incidents database provided by Boeing. A summary of the incident report is provided following the table.

Building 4462 Incident Report Summary

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A0688	09/28/1998	CONTROL ROOM		ELECTRICIANS RECEIVED HAND CONTAMINATION FROM RADIOACTIVE SOURCES IN SMOKE DETECTORS

*Isotopes are written as they are presented in the incident database.

- On September 28, 1998, two fire alarm electricians cleaned and replaced smoke detector heads in the control room in Building 4462. These devices contained 80 µCi of Am-241in several electroplated components. The electricians disassembled the devices and cleaned them with isopropyl alcohol. Radioactive contamination was detected on one of the wipes and on the hands of the electricians. The electricians were decontaminated at the Radioactive Material Handling Facility. A follow-up survey found no additional contamination (Report No. A0688).[1]

Current Use: Building 4462 is standing in 2010 awaiting demolition. In 2007, all utility connections were severed.[2]

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): The research team did not find evidence of previous radiological investigations, decontamination, or cleanups.

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Locations: An alcohol drainage pond, sometimes liquid-filled is located southwest of Building 4462. The research team did not find evidence that radionuclides were released to the drainage pond; however, historical records describing discharges to the pond are incomplete.

Aerial Photographs: Aerial photographs show undeveloped land until the 1972 photograph when an irregularly shaped building is identified as Building 4462. Storage tanks and a crane near Building 4462 are observed in 1978, 1980, 1983, and 1988 photographs. Storage tanks, a crane, an overhead pipe, and crates are observed in the 1995 photograph. A dry impoundment located southwest of Building 4462 is observed in 1978, 1980, and 1983 photographs. A liquid-filled impoundment is seen in the same location in 1988 and 1995 photographs. A dry impoundment is observed in the 2005 photograph, while a liquid-filled impoundment is again

[1] Barnes, C., Rockwell Incident Report, re: *SSFL T462 Control Room*, September 28, 1998.
[2] The Boeing Company, *Site Environment Report for Calendar Year 2007, DOE Operations at The Boeing Company Santa Susana Field Laboratory, Area IV*, September 2008, p. 2-7.

observed in the 2009 photograph. A large area of stained soil was observed in the 1965 aerial photo. Building 4462 is present in the 2005 and 2009 aerial photographs.[1]

Radionuclides of Concern: The research team did not find evidence that radioactive materials were used or stored with the Building 4462 area. However, given its location within the ETEC, the presence of radioactive contamination cannot be ruled out. The Building 4462 area is located relatively close to radiological test Buildings 4009, 4020, and 4100; consequently, there is some potential that radionuclides associated with these buildings may have migrated to the Building 4462 area. Radionuclides used and generated in Buildings 4009, 4020, and 4100 include U-233, U-234, U-235, U-236, U-238, Th-232, Np-237, Pu-238, Pu-239, Pu-240, and Pu-241, and decay products including Th-228, Ra-228, Th-230, Ra-226, Pb-210, Pa-231, and Ac-227. All radionuclides of concern listed are included in the August 2010 Final Field Sampling Plan for soil sampling in Area IV.[2] Table 3.3 presents a summary of contaminants of concern.
Drainage Pathways: Based on general site topography, surface water from the site likely flows east to a storm drain that connects to an intermittent stream that flows southeast through Area III to a pond in Area II. Storm drains are located northeast and west of Building 4462. The storm drain along south of the site receives storm water from Buildings 4009, 4020, and 4100 where radioactive materials were used and radionuclides were generated.[3] Sanitary sewer lines are located on the north side of the site.

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4462 area is Class 1, due to its location within ETEC and because of the proximity of Building 4462 to the storm drain that collected drainage from Buildings 4009, 4020, and 4100.

Recommended Locations for Soil/Sediment Sampling:

Plate 1 and Figure 2.4 provide a convenient reference for the following recommendations.

Previous characterization studies for the Building 4462 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 4462 area. This includes the following Building 4462 areas and appurtenances:

- The storm drains located northeast and south of Building 4462. These storm drains collect storm water from the northern and western portions of Subarea HSA-5C. The storm drain located south of 4462 receives storm water from the areas surrounding radiological Buildings 4009, 4020, and 4100; consequently, there is some potential that radionuclides associated with these buildings may have been transported to the area south of Building 4462.

- The sanitary sewer lines located along the northern side of the Building 4462. If radioactive materials were released into the building drains, residual contamination may exist in the materials surrounding the sewer lines.

[1] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[2] U.S. Atomic Energy Commission, *Facility License No. CX-17, Amendment No. 2*, Washington, D.C., May 28, 1962.
[3] Garcia, R. R. and Schwering, C. J., *Environmental Monitoring Semiannual Report, January 1, 1965 to June 30, 1965*, Atomics International, p. 12.

- Area of stained soil identified in the 1965 aerial photo. The cause of the stained soil is unknown. Additional investigation is recommended.

- Surface impoundment located southwest of Building 4462. Sampling is recommended to determine whether radiological waste may have been discharged into the pond.

2.4.3 Building 4463 Area

Site Description: The Building 4463 area comprises Building 4463, substation Building 4780, and the land surrounding these two buildings located on F Street. Building 4463 was constructed in 1974 to clean pumps and other mechanical parts of the Sodium Pump Test Facility (STPF). It is 6,635 square feet in area and 70 feet high. It was constructed with a steel frame, siding, and roof.[1, 2] Figures 2.4.3a through 2.4.3d provide a current photograph and the best available building-specific drawing(s) that the research team could find. An alcohol drainage pond, sometimes liquid-filled, is located south of Building 4463. Plate 1 presents a summary of all identified features for this site.

Building Features: Building 4463 has a 20-foot wide by 25-foot high roll-up door and houses 15-, 60-, and 100-ton cranes. Building 4463 is a steel frame structure 60 feet by 80 feet by 67 feet high. The building contained a structural steel framework for assembling and disassembling large reactor plant components. The cleaning system was designed to remove residual sodium from components by chemical reaction with Dowanol or ethanol. Cleaning was accomplished by immersing the test component in a vessel sized to accept articles up to 7 feet in diameter and 40 feet long. A solvent circulation loop connected to the vessel provided a cleaning fluid flow rate of 75 gallons per minute with a maximum fluid temperature of 180 °F. The cleaned components were rinsed with demineralized water and dried with nitrogen gas.[3] A floor plan and elevation for Building 4463 are presented in Figure 2.4.3b. A plot plan of the site is presented in Figure 2.4.3c. The alcohol used to clean the test components was identified as ethanol in the 1998 Site Environmental Report.[4] The alcohol drainage system is presented in Figure 2.4.3d.

Former Use(s): Building 4463 was the Sodium Cleaning and Handling Facility Building where pumps and other parts were assembled, disassembled, and cleaned.

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: Building 4463 was standing in 2010 awaiting demolition. In 2007, all utility connections were severed.[5]

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[1] Energy Research and Development Administration, *Site Development Plan: 1977-1981, LR*-03026, Part 1, June 1975.
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962-November 1992.
[3] Argonne National Laboratory, *Liquid Metal Fast Breeder Reactor Program, Facilities Profile*, ERDA-68, December 1975, p. 56.
[4] The Boeing Corporation, *Site Environmental Report for Calendar Year 1998, DOE Operations at Rocketdyne Propulsion & Power*, RD99-115, dated September 22, 1999, p. 6-5.
[5] The Boeing Company, *Site Environment Report for Calendar Year 2007, DOE Operations at The Boeing Company Santa Susana Field Laboratory, Area IV*, September 2008, p. 2-7.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): The research team did not find evidence of previous radiological investigations, decontamination, or cleanups.

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Locations: An alcohol drainage pond, sometimes liquid-filled is located south of Building 4463. This pond is discussed in the section of this TM describing Building 4462.

Aerial Photographs: Aerial photographs show undeveloped land until the 1965 photograph when disturbed ground is seen in the northwest area of the site. This is also observed in the 1967 photograph. Less disturbed ground is seen in the 1972 photograph, while the 1978 photograph shows an irregularly shaped building that is identified as Building 4463. A surface impoundment and area of soil staining is observed in aerial photos. These features are described in the section that discusses Building 4462.

Radionuclides of Concern: The research team did not find evidence that radioactive materials were used or stored with the Building 4463 area. However, given its location within the ETEC, the presence of radioactive contamination cannot be ruled out. The Building 4463 area is located relatively close to radiological test Buildings 4009, 4020, and 4100; consequently, there is some potential that radionuclides associated with these buildings may have migrated to the Building 4462 area. Radionuclides used and generated in nearby Buildings 4009, 4020, and 4100 include U-233, U-234, U-235, U-236, U-238, Th-232, Np-237, Pu-238, Pu-239, Pu-240, and Pu-241, and decay products including Th-228, Ra-228, Th-230, Ra-226, Pb-210, Pa-231, and Ac-227. All radionuclides of concern listed are included in the August 2010 Final Field Sampling Plan for soil sampling in Area IV.[1] Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Based on general site topography, surface water from the site likely flows west and south to storm drains that are connected to an intermittent stream that flows southeast through Area III to a pond in Area II. The storm drain located south of Building 4463 receives storm water from Buildings 4009, 4020, and 4100 where radioactive materials were used and radionuclides were generated.[2] Sanitary sewer lines are located on the northern and southern sides of the site.

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4463 area is Class 1, due to its location within ETEC and because of the proximity of Building 4463 to the storm drain that collected drainage from Buildings 4009, 4020, and 4100.

Recommended Locations for Soil/Sediment Sampling:

Plate 1 and Figure 2.4 provide a convenient reference for the following recommendations.

[1] U.S. Atomic Energy Commission, *Facility License No. CX-17, Amendment No. 2*, Washington, D.C., May 28, 1962.
[2] Garcia, R. R. and Schwering, C. J., *Environmental Monitoring Semiannual Report, January 1, 1965 to June 30, 1965*, Atomics International, p. 12.

Building 4463 is located adjacent to Building 4462. The recommended sampling locations are the same as the sampling locations that are recommended for Building 4462. These are discussed in Section 2.4.4.

2.4.4 Site 4662 Area

Site Description: The Site 4662 area comprises Site 4662 and the land surrounding it on 23rd Street. Site 4662 was constructed in approximately 1978 as a concrete pad with a roof.[1] 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: Concrete Pad 4662 was 36 feet long by 12 feet wide. It had a 13-foot high roof covering 21 feet of length and concrete sloped ramps at each end. Figure 2.4.4b presents a foundation plan, and Figure 2.4.4c presents an elevation view.

Former Use(s): Site 4662 was a small parts concrete cleaning pad. It was used for cleaning sodium off mechanical parts in support of the Sodium Pump Test Facility (SPTF), Building 4462.

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: Concrete Pad 4662 was demolished. Based on available information, the dimensions of the excavation made during pad demolition are unknown.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): None found.

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Locations: An alcohol drainage pond, sometimes liquid-filled is located southeast of Building 4662.

Aerial Photographs: Aerial photographs show undeveloped land until the 1978 photograph when a rectangular structure is observed that is identified as Site 4662. This concrete pad is located northwest of a dry impoundment through the 1983 photograph. The impoundment appears liquid filled in the 1988 and 1995 photographs, is dry again in the 2005 photograph, and is liquid filled in the 2009 aerial photograph. Concrete Pad 4662 appears to have been removed after the 1995 aerial photograph was taken. A vegetated area is seen in this location in the 2005 and 2009 photographs.[2]

Radionuclides of Concern: Radionuclides used and generated in nearby Buildings 4009, 4020, and 4100. These include U-233, U-234, U-235, U-236, U-238, Th-232, Np-237, Pu-238, Pu-

[1] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[2] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.

239, Pu-240, and Pu-241, and decay products including Th-228, Ra-228, Th-230, Ra-226, Pb-210, Pa-231, and Ac-227. All radionuclides of concern listed are included in the August 2010 Final Field Sampling Plan for soil sampling in Area IV.[1] Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Based on general site topography, surface water from the site likely flows east to a storm drain that connects to an intermittent stream that flows southeast through Area III to a pond in Area II. A storm drain is located immediately east of Building 4662. In 1965, the storm drain collected drainage from Buildings 4009, 4020, and 4100 where radioactive materials were used and radionuclides were generated.[2] A sanitary sewer line is located on the southern side of the site.

Radiological Contamination Potential: Class 1 because of the proximity of Site 4662 to the storm drain that carried waste water from Buildings 4009, 4020, and 4100, and because Site 4662 is located northwest of a sometimes liquid-filled impoundment.

Recommended Locations for Soil/Sediment Sampling:

Plate 1 and Figure 2.4 provide a convenient reference for the following recommendations.

Previous characterization studies for the Building 4662 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 4662 area. This includes the following Building 4662 areas and appurtenances:

- The north-south storm drain immediately east of Building 4662 that leads to the main east-west storm drain line located south of Building 4662. Because of the north-south drain's proximity to Building 4662 it should be investigated. The main east-west storm drain line located south of 4662 receives storm water from the areas surrounding radiological Buildings 4009, 4020, and 4100; consequently, there is some potential that radionuclides associated with these buildings may have been transported to the area south of Building 4662.

- The sanitary sewer line located along the southern side of Building 4662. If radioactive materials were released into the building drains, residual contamination may exist in the materials surrounding the sewer lines.

- Surface impoundment located southeast of Building 4662. Sampling is recommended to determine whether radiological waste may have been discharged into the pond.

[1] U.S. Atomic Energy Commission, *Facility License No. CX-17, Amendment No. 2*, Washington, D.C., May 28, 1962.
[2] Garcia, R. R. and Schwering, C. J., *Environmental Monitoring Semiannual Report, January 1, 1965 to June 30, 1965*, Atomics International, p. 12.

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 the building areas within HSA-5C Group 5 are presented. HSA-5C Group 5 includes eight building areas containing a Sodium Instrumentation building and numerous office buildings and trailers.

2.5.1 Building 4383 Area

Site Description: The Building 4383 area comprises Building 4383, Tower 4393, and the land surrounding these two buildings located on G Street. Building 4383 was constructed in approximately 1957, as a sodium instrumentation building. It was 3,691 square feet in area and 10 feet in height, constructed on a concrete pad and had a steel frame, siding and roof.[1, 2] Figures 2.5.1a through 2.5.1b 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 4383 contained laboratories, and a sodium tower. It also had a septic tank and a leach field.[3]. A floor plan of Building 4383 is presented in Figure 2.5.1b.

Former Use(s): Building 4383 was the Sodium Instrumentation Building, which together with the Sodium Instrumentation Tower (Building 4393), were designed to function under the conditions required for sodium graphite reactors (SGRs). The SGR program involved the development of many specialized items of equipment. Within Building 4383, instruments were developed to determine liquid level, flow, pressure and oxide content in sodium systems. All systems were tested and calibrated in Building 4383 before installation in a SGR reactor. In approximately 1967, Building 4383 was used as the Liquid Metal Engineering Center (LMEC) Assembly and Test Building, and LMEC Construction Staging Building.[2]

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: Building 4383 was demolished in approximately 1980. 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): Rockwell included the Building 4383 area in the 1994-1995 Area IV Radiological Characterization Survey. Radionuclide levels were below 1995 acceptable limits of less than 5 µR/h above background. Background was set at 15.6 µR/h.[4]

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[1] Energy Technology Engineering Center, *Site Development and Facility Utilization Planning: FY 1984-FY 1989*, N-083E-A02-DV001, Rev. A, April 1984.
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[3] Montgomery Watson Harza, *DOE Leach Fields (Area IV AOC) RCRA Facility Investigation Report, Santa Susana Field Laboratory, Ventura County, California*, Draft, October 2003, p. 2-5.
[4] Rocketdyne, *Area IV Radiological Characterization Survey*, A4CM-ZR-0011, Rev. A, August 15, 1996.

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Locations: The Building 4383 leach field was located approximately 50 feet east of the current footprint of Building 4487. Field trenching identified three leach lines, each approximately 100 feet long at this site. The leach field was removed in 2000.[1] Documentation of radiological releases into the 4383 septic system was not found. However, if radionuclides were disposed through building drains, the soils surrounding the former leach field may contain elevated radionuclide concentrations.

Aerial Photographs: Aerial photographs show undeveloped land until the 1957 aerial photograph when a small rectangular building located parallel to G Street is seen amid disturbed ground. This is identified as Building 4383. In the 1959 photograph, the building has expanded to become L-shaped. This shape remains through 1962/63, 1965, 1967, 1972, and 1978 photographs. Building 4383 can no longer be seen in the 1980 photograph; instead the foundations of new Building 4487 are observed northwest of Building 4383. Undeveloped land is seen in the location of Building 4383 in 1988, 1995, 2005 and 2009 photographs.[2]

Radionuclides of Concern: The research team did not find evidence that radioactive materials were used or stored in Building 4383. However, given its location within Area IV, the presence of radioactive contamination cannot be ruled out. The Building 4383 area is located reasonably close to close to Buildings 4009, 4020, and 4100; consequently, there is some potential that radionuclides associated with these buildings may have migrated to the area surrounding Building 4383. Radionuclides used and generated in Buildings 4009, 4020, and 4100 include U-233, U-234, U-235, U-236, U-238, Th-232, Np-237, Pu-238, Pu-239, Pu-240, and Pu-241, and decay products including Th-228, Ra-228, Th-230, Ra-226, Pb-210, Pa-231, and Ac-227. All radionuclides of concern listed are included in the August 2010 Final Field Sampling Plan for soil sampling in Area IV.[3] Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Based on general site topography, surface water likely flows east or south to a storm drain located on the north side of G Street. This connects to an intermittent stream that flows southeast through Area III to a pond in Area II. The southern storm drain receives storm water from Buildings 4009, 4020, and 4100 where radioactive materials were used and radionuclides were generated.[4] A sanitary sewer line is located on the site and south of the former building.

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4383 area is Class 2. The building is located inside the ETEC boundary, but there is no evidence of radioactive material use, and some radiological characterization has been conducted. However, the former building is in proximity to a storm drain that carried storm water from Buildings 4009, 4020, and 4100.

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[1] Montgomery Watson Harza, *DOE Leach Fields (Area IV AOC) RCRA Facility Investigation Report, Santa Susana Field Laboratory, Ventura County, California*, Draft, October 2003, p. 2-5.
[2] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[3] U.S. Atomic Energy Commission, *Facility License No. CX-17, Amendment No. 2*, Washington, D.C., May 28, 1962.
[4] Garcia, R. R. and Schwering, C. J., *Environmental Monitoring Semiannual Report, January 1, 1965 to June 30, 1965,* Atomics International, p. 12.

Recommended Locations for Soil/Sediment Sampling:

Plate 1 and Figure 2.5 provide a convenient reference for the following recommendations.

Previous characterization studies for the Building 4383 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 4383 area. This includes the following Building 4383 areas and appurtenances:

- The storm drain located south of the building along G Street. This storm drain collects storm water from the Buildings 4009, 4020, and 4100. Consequently, this storm drain may provide a pathway for the migration of radionuclides originating from these radiological buildings.

- The soils surrounding the former leach field located approximately 75 feet northwest of Building 4383. There is no evidence of radioactive material usage in Building 4383. However, if radioactive materials were used, the soil surrounding the leach field excavation would be a logical place to detect past radionuclide releases.

2.5.2 Building 4482 Area

Site Description: The Building 4482 area comprised Building 4482 and the land surrounding it located on G Street. Building 4482 was constructed in 1968 as an office building.[1, 2] Figure 2.5.2a provides a current photograph. The research team was unable to find building-specific drawing(s) and no as-built drawings were located for Building 4482. Plate 1 presents a summary of all identified features for this site.

Building Features: Building 4482 was a 3,130-square-foot prefabricated trailer with a steel frame and wood siding, anchored to a concrete slab. It was located near the Building 4383 septic tank and leach field.[3] The building was modified at some point in time.

Former Use(s): Building 4482 was a Government Project Office.[1]

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: Building 4482 was transferred off site in 2000.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): Boeing and the Los Angeles County Health Department conducted radiation surveys and determined that the trailer was free of radiological contamination based on 2000 standards.[1, 2]

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[1] Energy Research and Development Administration, *Site Development Plan: 1977-1981, LR*-03026, Part 1, June 1975.

[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.

[3] Montgomery Watson Harza, *DOE Leach Fields (Area IV AOC) RCRA Facility Investigation Report, Santa Susana Field Laboratory, Ventura County, California*, Draft, October 2003, p. 2-5.

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Locations: The Building 4383 leach field was located between the southwest corner of the Building 4482 footprint and approximately 50 feet east of the Building 4487 footprint. Field trenching identified three leach lines, each approximately 100 feet long at this site. The leach field was removed in 2000.[3] Documentation of radiological releases into the 4383 septic system was not found. However, if radionuclides were disposed through building drains, the soils surrounding the former leach field may contain elevated radionuclide concentrations.

Aerial Photographs: Aerial photographs show undeveloped land until the 1967 photograph when a parking lot is seen in the location of Building 4482. An irregularly shaped building identified as Building 4482 can be seen in photographs from 1972, 1978, 1980, 1983, 1988, and 1995. In the 2005 photograph, bare ground and undeveloped land can be seen in the location of former Building 4482. Undeveloped land can be observed in the 2009 aerial photograph.[4]

Radionuclides of Concern: The research team did not find evidence that radioactive materials were used or stored in Building 4482. However, given its location within Area IV, the presence of radioactive contamination cannot be ruled out. The Building 4482 area is located reasonably close to close to Buildings 4009, 4020, and 4100; consequently, there is some potential that radionuclides associated with these buildings may have migrated to the area surrounding Building 4482. Radionuclides used and generated in Buildings 4009, 4020, and 4100 include U-233, U-234, U-235, U-236, U-238, Th-232, Np-237, Pu-238, Pu-239, Pu-240, and Pu-241, and decay products including Th-228, Ra-228, Th-230, Ra-226, Pb-210, Pa-231, and Ac-227. All radionuclides of concern listed are included in the August 2010 Final Field Sampling Plan for soil sampling in Area IV.[5] Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Based on general site topography, surface water from the site likely flows east and possibly south to two storm drains that connect to two intermittent streams that flow southeast through Area III to a pond in Area II. The southern storm drain receives storm water from Buildings 4009, 4020, and 4100 where radioactive materials were used and radionuclides were generated.[6] Sanitary sewer lines are located on the north and south sides of the site.

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4482 area (i.e., the area, not the trailer itself) is Class 2. It is located inside the ETEC boundary, but there is no evidence of radioactive material use, and some radiological characterization has been conducted. However, the former building is in close proximity to a storm drain that carried storm water from Buildings 4009, 4020, and 4100.

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[1] Correspondence from Bunn, D., Department of Health Services, Radiation Health Branch, to Sutherland, D., U.S. Department of Energy, *Reference: Complaint Concerning Rocketdyne Trailers*, dated February 14, 2000.
[2] The Boeing Company, *Radiological Survey of Donated Trailer Sections at the Wildlife Way Station*, February 16, 2000.
[3] Montgomery Watson Harza, *DOE Leach Fields (Area IV AOC) RCRA Facility Investigation Report, Santa Susana Field Laboratory, Ventura County, California*, Draft, October 2003, p. 2-5.
[4] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[5] U.S. Atomic Energy Commission, *Facility License No. CX-17, Amendment No. 2*, Washington, D.C., May 28, 1962.
[6] Garcia, R. R. and Schwering, C. J., *Environmental Monitoring Semiannual Report, January 1, 1965 to June 30, 1965*, Atomics International, p. 12.

Recommended Locations for Soil/Sediment Sampling:

Plate 1 and Figure 2.5 provide a convenient reference for the following recommendations.

Building 4482 is located close to Building 4383. The recommendations for soil sampling within the Building 4383 area is the same as Building 4482 and is discussed in Section 2.5.2 of this TM.

2.5.3 Building 4483 Area

Site Description: The Building 4483 area comprised Building 4483 and the land surrounding it located on 20th Street. Building 4483 was constructed in 1968 as an office building.[1, 2] Figure 2.5.3a provides a current photograph. The research team was unable to find building-specific drawing(s) and no as-built drawings were located for Building 4483. Plate 1 presents a summary of all identified features for this site.

Building Features: Building 4483 was a 6,000-square-foot prefabricated trailer with a steel frame and wood siding, anchored to a concrete slab.

Former Use(s): Building 4483 was a Liquid Metal Engineering Center (LMEC) Office Trailer.

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: Building 4483 was transferred off site in 2000.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): Boeing and the Los Angeles County Health Department conducted radiation surveys and determined that the trailer was free of radiological contamination based on 2000 standards.[3, 4]

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Locations: The research team did not find evidence of radiological waste burial or disposal in the Building 4483 area.

Aerial Photographs: Aerial photographs show undeveloped land until the 1967 photograph when a parking lot is seen in the location of Building 4483. A rectangular-shaped building identified as Building 4483 can be seen in photographs from 1972, 1978, 1980, 1983, 1988, and 1995. In the 1995 photograph, a probable stain was identified north of Building 4483. In the

[1] Energy Research and Development Administration, *Site Development Plan: 1977-1981, LR-03026*, Part 1, June 1975.
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[3] Correspondence from Bunn, D., Department of Health Services, Radiation Health Branch, to Sutherland, D., U.S. Department of Energy, *Reference: Complaint Concerning Rocketdyne Trailers*, dated February 14, 2000.
[4] The Boeing Company, *Radiological Survey of Donated Trailer Sections at the Wildlife Way Station*, February 16, 2000.

2005 photograph, undeveloped land can be seen in the location of former Building 4483. Undeveloped land can be observed in the 2009 aerial photograph.[1]

Radionuclides of Concern: Radiological contamination is not anticipated in this area.

Drainage Pathways: Based on general site topography, surface water from the site likely flows east to a storm drain that connects to an intermittent stream that flows southeast through Area III to a pond in Area II. Sanitary sewer lines are located on the south and east sides of the site.

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4483 area (i.e., the area, not the trailer itself) is Class 3. Based on the use of this building and surrounding structures, there is low probability of detecting radiological contamination in soil.

Recommended Locations for Soil/Sediment Sampling:

Plate 1 and Figure 2.5 provide a convenient reference for the following recommendations.

Radionuclide contamination is not expected in the area directly surrounding Building 4483. However, limited soil sampling is recommended to confirm this assumption. Specific sampling locations have not been identified for this area.

2.5.4 Building 4484 Area

Site Description: The Building 4484 area comprised Building 4484 and the land surrounding it located on the interior of the block between F and G Streets, 20th and 22nd Streets. Building 4484 was constructed in 1969 as a rest room associated with office space.[2, 3] Figure 2.5.4a provides a current photograph. The research team was unable to find building-specific drawing(s) and no as-built drawings were located for Building 4484. Plate 1 presents a summary of all identified features for this site.

Building Features: Building 4484 was a 520-square-foot prefabricated trailer with a steel frame and wood siding, anchored to a concrete slab.

Former Use(s): Building 4484 was a Rest Room Trailer.

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: Building 4484 was transferred off site in 2000.

[1] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[2] Energy Research and Development Administration, *Site Development Plan: 1977-1981,* LR-03026, Part 1, June 1975.
[3] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): Boeing and the Los Angeles County Health Department conducted radiation surveys and determined that the trailer was free of radiological contamination based on 2000 standards.[1, 2]

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Locations: None found.

Aerial Photographs: Aerial photographs show undeveloped land until the 1967 photograph when a parking lot is seen in the location of Building 4484. Building 4484 can be seen in photographs from 1972, 1978, 1980, 1983, 1988, and 1995. In the 2005 photograph, bare ground and undeveloped land can be seen in the location of former Building 4484. Undeveloped land can be observed in the 2009 aerial photograph.[3]

Radionuclides of Concern: Radiological contamination is not anticipated in this area.

Drainage Pathways: Surface water from the site flows east to a storm drain that connects to an intermittent stream that flows southeast through Area III to a pond in Area II. Sanitary sewer lines are located on the south and east sides of the site. A sanitary sewer line appears to emanate from the southwest corner of Building 4484.

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4483 area (i.e., the area, not the trailer itself) is Class 3. Based on the use of this building and surrounding structures, there is low probability of detecting radiological contamination in soil.

Recommended Locations for Soil/Sediment Sampling:

Plate 1 and Figure 2.5 provide a convenient reference for the following recommendations.

Radionuclide contamination is not expected in the area directly surrounding Building 4483. However, limited soil sampling is recommended to confirm this assumption. Specific sampling locations have not been identified for this area.

2.5.5 Building 4485 Area

Site Description: The Building 4485 area comprised Building 4485 and the land surrounding it located near the southeast corner of 22nd and F Streets. Building 4485 was constructed in 1968 as an office building.[4, 5] Figure 2.5.5a provides a current photograph. The research team was

[1] Correspondence from Bunn, D., Department of Health Services, Radiation Health Branch, to Sutherland, D., U.S. Department of Energy, *Reference: Complaint Concerning Rocketdyne Trailers*, dated February 14, 2000.
[2] The Boeing Company, *Radiological Survey of Donated Trailer Sections at the Wildlife Way Station*, February 16, 2000.
[3] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[4] Energy Research and Development Administration, *Site Development Plan: 1977-1981*, LR-03026, Part I, June 1975.
[5] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.

unable to building-specific drawing(s) and no as-built drawings were located for Building 4485. Plate 1 presents a summary of all identified features for this site.

Building Features: Building 4485 was a 3,000-square-foot prefabricated trailer with a steel frame and wood siding, anchored to a concrete slab.

Former Use(s): Building 4485 was a Liquid Metal Engineering Center (LMEC) Office Trailer.

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: Building 4485 was transferred off site in 2000.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): Boeing and the Los Angeles County Health Department conducted radiation surveys and determined that the trailer was free of radiological contamination based on 2000 standards.[1, 2]

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Locations: The research team did not find evidence of radiological waste burial or disposal in the Building 4485 area.

Aerial Photographs: Aerial photographs show undeveloped land until the 1967 photograph when a parking lot is seen in the location of Building 4485. An almost square-shaped building identified as Building 4485 can be seen in photographs from 1972, 1978, 1980, 1983, 1988, and 1995. In the 2005 photograph, bare ground can be seen in the location of former Building 4485. Undeveloped land can be observed in the 2009 aerial photograph.[3]

Radionuclides of Concern: Radiological contamination is not anticipated in this area.

Drainage Pathways: Based on general site topography, surface water from the site likely flows east to a storm drain that connects to an intermittent stream that flows southeast through Area III to a pond in Area II. Sanitary sewer lines are located north, east, and south of the site.

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4485 area (i.e., the area, not the trailer itself) is Class 3. Based on the use of this building and surrounding structures, there is low probability of detecting radiological contamination in soil.

Recommended Locations for Soil/Sediment Sampling:

Plate 1 and Figure 2.5 provide a convenient reference for the following recommendations.

[1] Correspondence from Bunn, D., Department of Health Services, Radiation Health Branch, to Sutherland, D., U.S. Department of Energy, *Reference: Complaint Concerning Rocketdyne Trailers*, dated February 14, 2000.
[2] The Boeing Company, *Radiological Survey of Donated Trailer Sections at the Wildlife Way Station*, February 16, 2000.
[3] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.

Radionuclide contamination is not expected in the area directly surrounding Building 4485. However, limited soil sampling is recommended to confirm this assumption. Specific sampling locations have not been identified for this area.

2.5.6 Building 4486 Area

Site Description: The Building 4486 area comprised Building 4486 and the land surrounding it located on F Street. Building 4486 was constructed in the late 1970s as an office building.[1, 2] Figure 2.5.6a provides a current photograph. The research team was unable to find building-specific drawing(s) and no as-built drawings were located for Building 4486. Plate 1 presents a summary of all identified features for this site.

Building Features: Building 4486 was a 6,000-square-foot prefabricated trailer with a steel frame and wood siding anchored to a concrete slab.

Former Use(s): Building 4486 was a Liquid Metal Engineering Center (LMEC) Office Trailer.

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: Building 4486 was transferred off site in 2000.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): Boeing and the Los Angeles County Health Department conducted radiation surveys and determined that the trailer was free of radiological contamination based on 2000 standards.[3, 4]

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Locations: The research team did not find evidence of radiological waste burial or disposal in the Building 4483 area.

Aerial Photographs: Aerial photographs show undeveloped land until the 1978 photograph when a rectangular building is identified as Building 4486. This building is seen in photographs from 1980, 1983, 1988, and 1995. In the 2005 photograph, bare ground can be seen in the location of former Building 4486. Undeveloped land can be observed in the 2009 aerial photograph.[5]

Radionuclides of Concern: Radiological contamination is not anticipated in this area.

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[1] Energy Research and Development Administration, *Site Development Plan: 1977-1981*, LR-03026, Part 1, June 1975.
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[3] Correspondence from Bunn, D., Department of Health Services, Radiation Health Branch, to Sutherland, D., U.S. Department of Energy, *Reference: Complaint Concerning Rocketdyne Trailers*, dated February 14, 2000.
[4] The Boeing Company, *Radiological Survey of Donated Trailer Sections at the Wildlife Way Station*, February 16, 2000.
[5] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.

Drainage Pathways: Based on general site topography, surface water from the site likely flows east to a storm drain that connects to an intermittent stream that flows southeast through Area III to a pond in Area II. Sanitary sewer lines are located south and east of the site.

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4486 area (i.e., the area, not the trailer itself) is Class 3. Based on the use of this building and surrounding structures, there is low probability of detecting radiological contamination in soil.

Recommended Locations for Soil/Sediment Sampling:

Plate 1 and Figure 2.5 provide a convenient reference for the following recommendations.

Radionuclide contamination is not expected in the area directly surrounding Building 4483. However, limited soil sampling is recommended to confirm this assumption. Specific sampling locations have not been identified for this area.

2.5.7 Building 4487 Area

Site Description: The Building 4487 area comprised Building 4487 and the land surrounding it located on 22nd Street. Building 4487 was constructed in 1981 as an office building. It was a prefabricated building with a wooden frame and stucco siding.[1, 2] Figures 2.5.7a through 2.5.7b 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 4487 contained air-conditioned offices, rest rooms, and a computer terminal room. It had a septic tank that was later excavated and removed. The floor plan for Building 4487 is presented in Figure 2.5.7b.

Former Use(s): Building 4487 was an Energy Technology Engineering Center (ETEC) Engineering Building, and Safety Health and Environmental Affairs (SHEA) Office.

Information from Interviewees: None to date.

Radiological Incident Reports: None found

Current Use: Building 4487 was demolished in 2004. 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): Boeing conducted periodic radiation surveys between December 2002 and 2004. No radiological contamination was detected above 2002, 2003, and 2004 designated background concentrations on those occasions.

[1] Energy Research and Development Administration, *Site Development Plan: 1977-1981*, LR-03026, Part 1, June 1975.
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Locations: The Building 4383 leach field was located approximately 50 feet east of the footprint of Building 4487. Field trenching identified three leach lines, each approximately 100 feet long at this site. The leach field was removed in 2000.[1] Documentation of radiological releases into the 4383 septic system was not found. However, if radionuclides were disposed through building drains, the soils surrounding the former leach field may contain elevated radionuclide concentrations.

Aerial Photographs: Aerial photographs show undeveloped land until the 1957 photograph when disturbed ground can be seen in the location of Building 4487. Disturbed ground is seen in 1959, 1962/63, and 1965 photographs. In the 1967 photograph, vegetation can be seen. In the 1980 photograph, the rectangular foundations of Building 4487 can be seen. Building 4487 is present in 1983 and 1988 photographs. Building 4487 can be seen in the 1995 photograph, but bare ground is observed in the 2005 photograph. Undeveloped land is seen in the 2009 aerial photograph.[2]

Radionuclides of Concern: The research team did not find evidence that radioactive materials were used or stored in Building 4487. However, given its location within Area IV, the presence of radioactive contamination cannot be ruled out. The Building 4487 area is located reasonably close to close to Buildings 4009, 4020, and 4100 and a storm drain that receives storm water from these radiological buildings; consequently, there is some potential that radionuclides associated with these buildings may have migrated to the area surrounding Building 4487. Radionuclides used and generated in Buildings 4009, 4020, and 4100 include U-233, U-234, U-235, U-236, U-238, Th-232, Np-237, Pu-238, Pu-239, Pu-240, and Pu-241, and decay products including Th-228, Ra-228, Th-230, Ra-226, Pb-210, Pa-231, and Ac-227. All radionuclides of concern listed are included in the August 2010 Final Field Sampling Plan for soil sampling in Area IV.[3] Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Based on general site topography, surface water likely flows east or south to a storm drain located on the north side of G Street. This connects to an intermittent stream that flows southeast through Area III to a pond in Area II. The storm drain collected drainage from Buildings 4009, 4020, and 4100 where radioactive materials were used and radionuclides were generated.[4] A sanitary sewer line is located on the site and south of the site.

Radiological Contamination Potential:
The preliminary MARSSIM Classification for the Building 4487 area is Class 2. It is located inside the ETEC boundary, but there is no evidence of radioactive material use, and some radiological characterization has been conducted. However, the former building is in close proximity to a storm drain that carried storm water from Buildings 4009, 4020, and 4100.

[1] Montgomery Watson Harza, *DOE Leach Fields (Area IV AOC) RCRA Facility Investigation Report, Santa Susana Field Laboratory, Ventura County, California*, Draft, October 2003, p. 2-5.
[2] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.

[4] Garcia, R. R. and Schwering, C. J., *Environmental Monitoring Semiannual Report, January 1, 1965 to June 30, 1965,* Atomics International, p. 12.

Recommended Locations for Soil/Sediment Sampling:

Plate 1 and Figure 2.5 provide a convenient reference for the following recommendations.

Previous characterization studies for the Building 4487 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 4487 area. This includes the following Building 4487 areas and appurtenances:

- The storm drain located south of the building along G Street. This storm drain collects storm water from the Buildings 4009, 4020, and 4100. Consequently, this storm drain may provide a pathway for the migration of radionuclides originating from these radiological buildings.

- The soils surrounding the former leach field located approximately 40 feet east of Building 4487. There is no evidence of radioactive material usage in this area. However, if radioactive materials were used, the soil surrounding the leach field excavation would be a logical place to detect past radionuclide releases.

2.5.8 Site 4538 Area

Site Description: The Site 4538 area comprised Parking Lot 4538 and the land surrounding it at the northwest corner of the intersection of 20th and G Streets.[1, 2] It was constructed in approximately 1966. Figures 2.5.8a through 2.5.8b 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: Site 4538 was a paved parking lot. A site layout map is presented in Figure 2.5.8b.

Former Use(s): Site 4538 was a parking lot for office Buildings 4482 through 4486. In 2000, Parking Lot 4538 was removed and the site was graded and seeded.

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: Site 4538 is undeveloped land.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): The research team did not find evidence of previous radiological investigations, decontamination, or cleanups.

Radiological Use Authorizations: None found.

[1] Boeing, *ETEC Closure, Landscaping of Old Trailer Parking Lot*, No date.
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.

Former Radiological Burial or Disposal Locations: The research team did not find evidence of radiological waste burial or disposal in this area

Aerial Photographs: Aerial photographs show undeveloped land until the 1965 photograph when disturbed ground is observed. The 1967 photograph shows a parking lot that is identified as Site 4538. The parking lot is also seen in 1972, 1978, 1980, 1983, 1988, and 1995 photographs. Undeveloped land is observed in 2005 and 2009 aerial photographs.[1]

Radionuclides of Concern: Radiological contamination is not anticipated in this area.

Drainage Pathways: Based on general site topography, surface water from the site likely flows east to a storm drain that connects to an intermittent stream that flows southeast through Area III to a pond in Area II. Sanitary sewer lines are located on the south, north, and east sides of the site.

Radiological Contamination Potential: The preliminary MARSSIM Classification for the former Parking Lot 4538 is Class 3. Based on the use of the surrounding structures, there is low probability of detecting radiological contamination in soil.

Recommended Locations for Soil/Sediment Sampling:

Plate 1 and Figure 2.5 provide a convenient reference for the following recommendations.

Radionuclide contamination is not expected in the area directly surrounding Parking Lot 4538. However, limited soil sampling is recommended to confirm this assumption. Specific sampling locations have not been identified for this area.

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 the building areas within HSA-5C Group 6 are presented. HSA-5C Group 6 includes one building area containing a warehouse building constructed over a former parking lot.

2.6.1 Building 4015 Area

Site Description: The Building 4015 area comprises Building 4015, substation Building 4707, and the land surrounding these two buildings located on the eastern side of 22nd Street. Building 4015 was constructed sometime after March 1975 on former unimproved Parking Lot 4573, which was constructed in 1956.[2, 3] Figure 2.6.1a provides a current photograph. The research team was unable to find building-specific drawing(s) and no as-built drawings were located for Building 4015. Building 4343, located south of Building 4015, served as the time clock building for Parking Lot 4573. Buildings 4373 and 4848 are located approximately 75 feet west of Building 4015, across 22nd Street. Building 4373 was a Systems for Nuclear Auxiliary Power (SNAP) criticality test facility, and radioactive materials were used in this building. A leach

[1] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[2] Energy Technology Engineering Center, *Site Development and Facility Utilization Planning: FY 1984-FY 1989*, N-083E-A02-DV001, Rev. A, April 1984.
[3] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.

field for Building 4373 that received flow from a septic tank was located approximately 75 feet south of the southeast corner of Building 4373. Field trenching identified two leach pits across 22nd Street from Building 4015.[1,2] The Building 4373 leach field was removed in 2000.[3] Plate 1 presents a summary of all identified features for this site.

Building Features: Building 4015 is a warehouse with 13-foot ceilings, a steel frame, sheet metal siding and a sheet metal roof.

Former Use(s): Building 4015 was used to store construction materials. Substation Building 4707 supplied power to Building 4015.[1]

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: Building 4015 is standing in 2011 and is used for storage. Substation 4707 was demolished in August 2003.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): The research team did not find any evidence of previous radiological investigations or remediation associated with the Building 4015 area.

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Locations: The research team did not find evidence of radiological burial or disposal in the Building 4015 area. A debris disposal area was identified in the northeast region of the Building 4015 area, south of the intermittent stream. The Building 4373 leach field is a potential source of radiological contamination that may have migrated onto the Building 4015 site.

Aerial Photographs: Aerial photographs show undeveloped land until the 1957 photograph when Parking Lot 4573 can be seen. This parking lot is observed in 1959 and 1962/63 photographs. Disturbed ground can be seen around the edges of the parking lot in 1965, 1967, and 1972 photographs. Building 4015 is observed in 1995, 2005, and 2009 aerial photographs.[3] An area that was interpreted by the EPIC aerial photograph analysis as being "probable leakage" is observed in the 1972 photograph. In the 1988 photograph, a probable stain is identified at the southwest corner of Building 4015. A debris field, located approximately 140 feet from Building 4015, was identified in the aerial photo analysis. Based on the aerial photo analysis, it appears that debris was disposed in this area after 1983, and the disposal was discontinued prior to 1986. A "fill area," located east of Building 4015, was also identified in the aerial photo analysis. This area was identified in the 1988 through 2005 aerial photos. It is unclear if this is an area of historic dumping.

[1] Montgomery Watson Harza, *DOE Leach Fields (Area IV AOC) RCRA Facility Investigation Report, Santa Susana Field Laboratory, Ventura County, California*, October 2003, p. 2-5.
[2] Map located at: *www.dtsc-ssfl.com/files/maps/SSFL%20-%20Western%20Half.pdf.*
[3] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.

Radionuclides of Concern: The research team did not find evidence that radioactive materials were used or stored within the Building 4015 area. However, given its location within the ETEC, the presence of radioactive contamination cannot be ruled out. The Building 4015 area is located close to Building 4373; consequently, there is some potential that radionuclides associated with Building 4373 may have migrated to the area surrounding Building 4015. Highly enriched uranium was used in Building 4373 with a hydrogen moderator and beryllium and graphite reflectors. Activation foils were used for flux mapping.[1] The drainage ditch north of Building 4015 receives storm water from the area surrounding Building 4100. If radioactive materials were released from Building 4100, they could have migrated to the 4015 area through the storm water drainage system. Radionuclides associated with Building 4373 will be discussed in TM HSA-5D. Table 3.3 presents a summary of contaminants of concern for buildings within HSA-5C.

Drainage Pathways: Surface water flow near Building 4015 is expected to be generally from the northwest to southeast. A storm drain network carries storm water from the north and east to the intermittent drainage ditches located north and south of Building 4015. As discussed above, these drainage ditches carry storm water from Building 4100 and 4373, which were both radiological test facilities. The northern and southern drainage ditches merge approximately 550 feet west of Building 4015, and ultimately discharges into a pond in Area II.[2]

Radiological Contamination Potential: The preliminary MARSSIM Classification for Building 4015 is Class 1, due to its location within ETEC and its proximity to SNAP facility Building 4373. Storm drains, originating from the area surrounding Building 4373, carry storm water to the drainage ditch south of Building 4015. In addition, the drainage ditch located directly north of Building 4015 receives storm water from Building 4100. Both 4373 and 4100 were radiological test facilities. If there were radiological releases from these buildings, radionuclides may have migrated to the Building 4015 area.

Recommended Locations for Soil/Sediment Sampling:

Plate 1 and Figure 2.6 provide a convenient reference for the following recommendations.

Previous characterization studies for the Building 4015 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 4015 area. This includes the following Building 4015 areas and appurtenances:

- The debris field located northeast of Building 4015. This is a former dump site area that could have received radioactive waste materials.

- The fill area located west of Building 4015. The fill area could represent a former disposal area.

- The storm drains located on the western side of the site. These storm drains received water from radiological test facilities located with the ETEC.

[1] Chapman, J.A., Tuttle, R.J., and Stafford, K.T., *Radiological Survey of Buildings T373, T374, and T375*, Rocketdyne Division, Rockwell International Report GEN-ZR-0012, August 26, 1988, pp. 17-23.
[2] Map located at: *www.dtsc-ssfl.com/files/maps/SSFL%20-%20Western%20Half.pdf.*

- The drainage ditch located at the southern side of the site. These storm drains and drainage ditch receives storm water from Building 4373. Building 4373 was a radiological facility that contained a septic tank and leach field. If a radiological release occurred at Building 4373, radioactive materials could have migrated to Building 4015.

- The drainage ditch located at the northern side of the site. This drainage ditch receives storm water from the northern Building 4015 area and sites north of this area. The drainage system receives water from the Building 4100 area. If a radiological release occurred at Building 4100, radioactive materials could have migrated to Building 4015.

- The area identified as "dark toned material" located along the southeastern portion of Building 4015.

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 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 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-5C area.

3.2 U.S. Atomic Energy Commission Critical Experiments Facility License

On October 3, 1960, the AEC authorized AI, 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). AI 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 covered the use and possession of radioactive materials in Building 4100 that housed a calibration laboratory, a counting laboratory, and used company owned calibration sources. 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. Up until August 27, 2010, there had been 110 amendments to this license.

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: Na-22, Fe-55, Sb-125, Cs-134, Ce-144, and Po-210. 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-5C Sites
Potential 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

Table 3.3 (continued)
Summary of Subarea HSA-5C Sites
Potential Contaminants of Concern

Site No.	Use(s)	Current Status	Potential Radiological Contaminants of Concern	Preliminary MARSSIM Class
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
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

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4.0 REACTOR/CRITICALITY FACILITIES/SIGNIFICANT SITES WORKS CITED

4.1 BUILDING 4059

Facility Name	Building No.	Period of Operation	Notes
S8DR	4059	5/1968 to 12/1969	SNAP development reactor facility

Building 4059 Cited Documents

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4.2 BUILDING 4100

Facility Name	Building No.	Period of Operation	Notes
Fast Critical Experiment Laboratory (FCEL)	4100	1961 to 1972	Started as Advanced Epithermal Thorium Reactor (AETR)

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FIGURES

PARTIALLY SCANNED
OVERSIZE ITEM(S)

See document # 2266488
for partially scanned image(s).

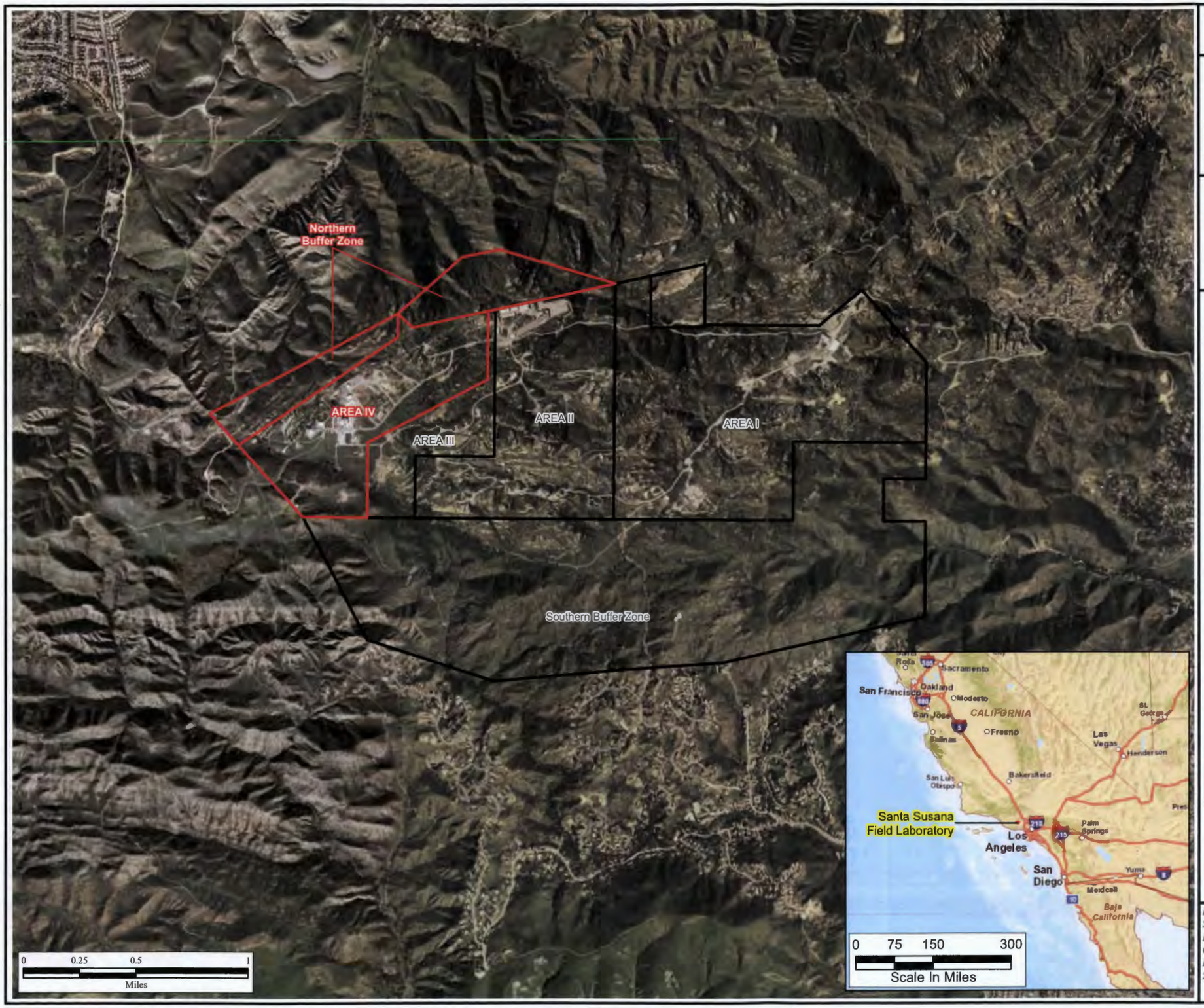
PLATE 1
SUBAREA HSA - 5C

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

Historical Site Assessment
Final Technical Memorandum - HSA-5C

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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Created: CLimoges
Revised: 08/23/2010 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_6\(1-02)site_layout.mxd
Project: EP9038
Created: CLimoges
Revised: 08/23/2010 TJ
Sorce: Boeing Company, 2008
CIRGIS, 2007

HGL

Redacted

Figure 1.3
Subarea HSA-5C
Santa Susana Field Laboratory

U.S. EPA Region 9

Legend

Buildings

- Existing
- Removed

N

0 50 100 200
Scale In Feet

Filepath:Y:/Santa_Susana/EP9038/TM/HSA_5C/(1-03)subarea_RFI_5C.mxd
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Edited: 08/23/210 TJ
Source:Boeing Company, 2008
CIRGIS, 2007

HGL HydroGeoLogic, Inc.

Redacted

Figure 2.1
Area IV Subarea 5C-1
Santa Susana Field Laboratory

U.S. EPA Region 9

Legend

- Sub-Area 5C-1 Boundary
- Primary Roads
- Secondary Roads
- Tertiary Roads
- Underground Storage Tank
- Unknown Tank Type
- French Drain Holding Tank
- Sump
- Dry Well
- Tank Footprint
- Above ground Storage Tank
- Demolished Bldg.
- Existing Bldg.
- Parking Lots
- Drainage
- Drainage Ditch
- Interview Line
- Offsite Seeps and Springs
- Onsite Seeps and Springs
- Drain
- Well

Aerial Photo Features
- Priority 1
- Priority 2
- Processing Area (Priority 1)
- Excavation

Historical Data
- Chemical Use Area / Debris Field
- Excavation
- Leach Field / Septic Tank
- Open Storage

Surface Water
- Intermittent Stream
- Permanent Stream
- Surface Water
- Lined Channel
- French Drain
- Drainage
- Leach Field
- Septic System

Aerial Photo Descriptors

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
VT	Vertical Tank
WDA	Waste Disposal Area

Utilities
- Channel
- Drain
- Drain
- Drainage Divide
- Gutter
- Tank
- Tank
- Vault
- Well
- Water (Removed)
- Water (Removed)
- Pipes (Unknown Type)
- Pipes (Unknown Type)
- G Gas
- SD Storm Drain
- SS Sanitary Sewer
- W Water

Surface Water Flow (From Boeing Database, 2008)

N

0 25 50 100
Scale In Feet

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Revised: 08/23/2010 TJ
Sorce: Boeing Company, 2008
CIRGIS, 2007

HGL HydroGeoLogic, Inc.

Redacted

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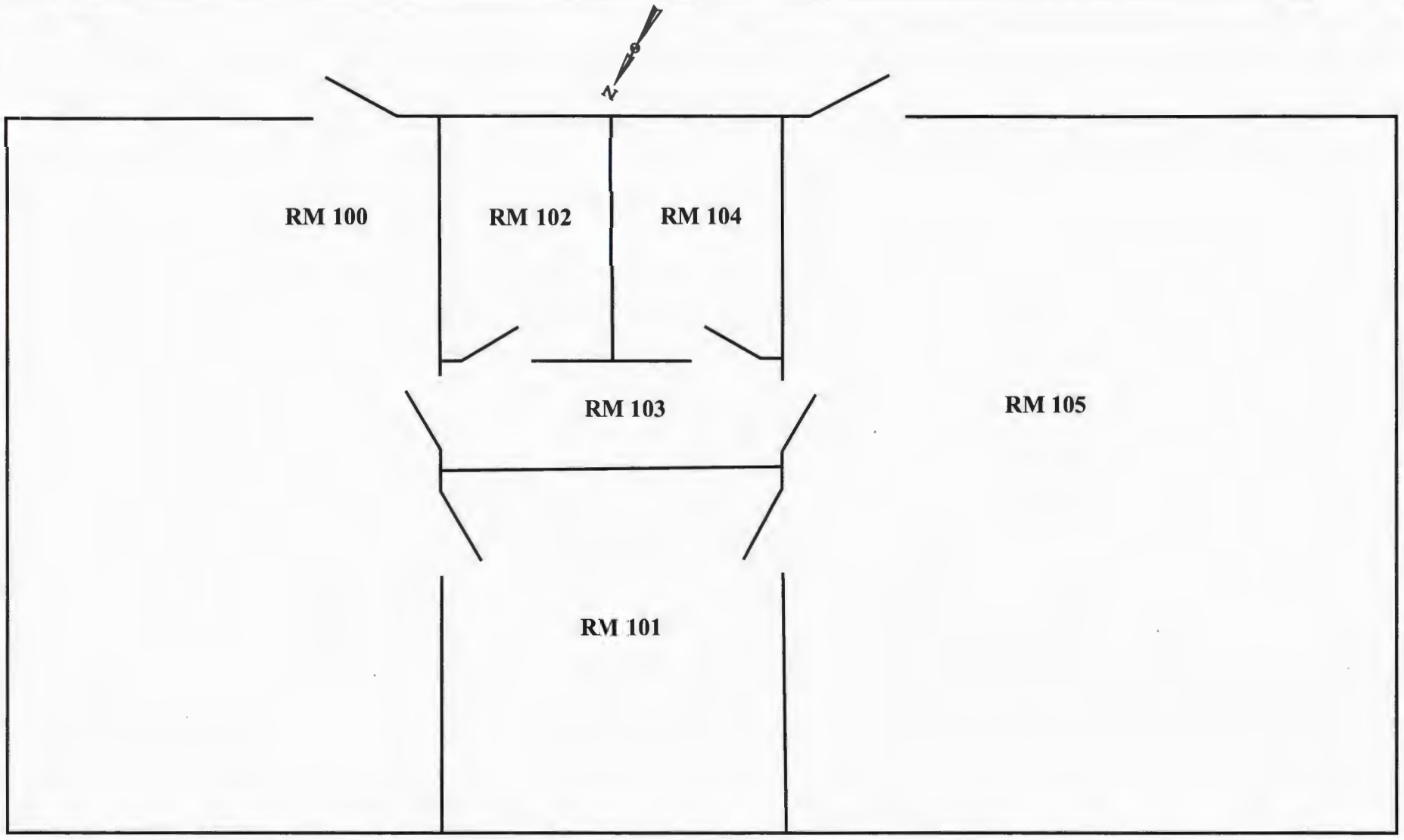
Revised: 08/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.1a
Building 4039
Site Photograph

Redacted



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Revised: 07/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.1b
Building 4039
Floor Plan

Y:/Santa_Susana/EP9038/TM/HSA_5C (2-11)bldg_4059.cdr
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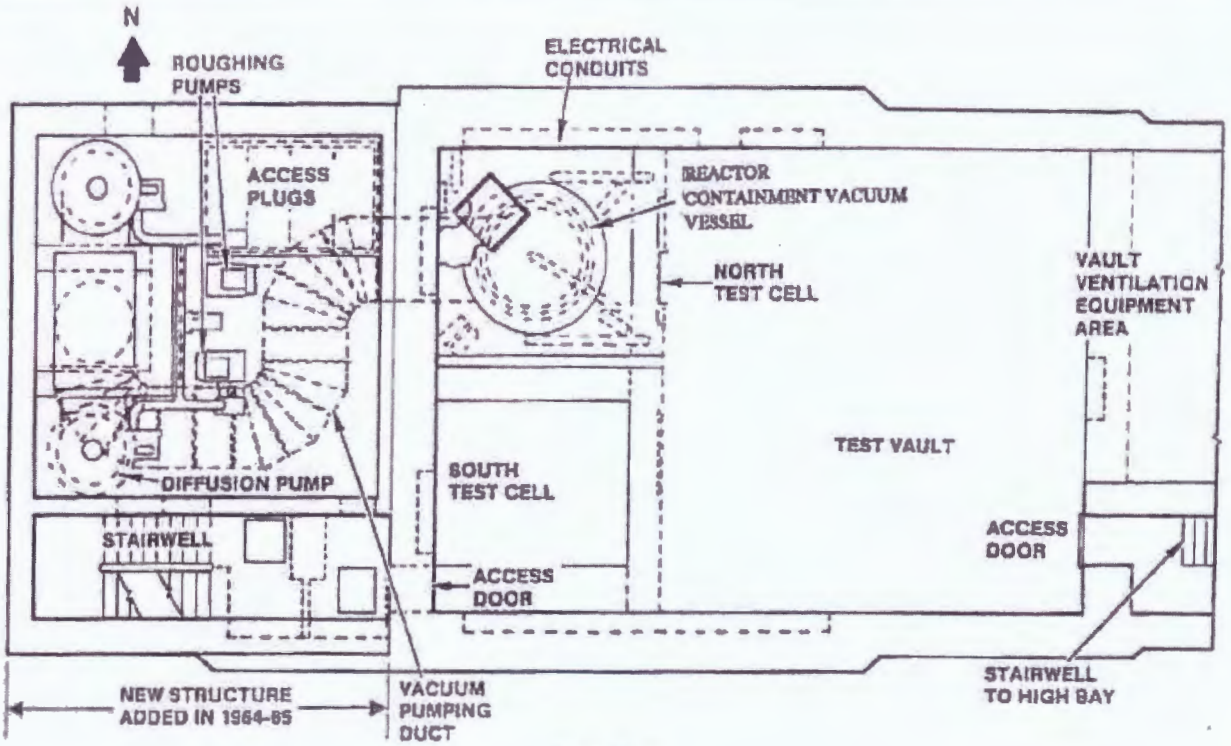
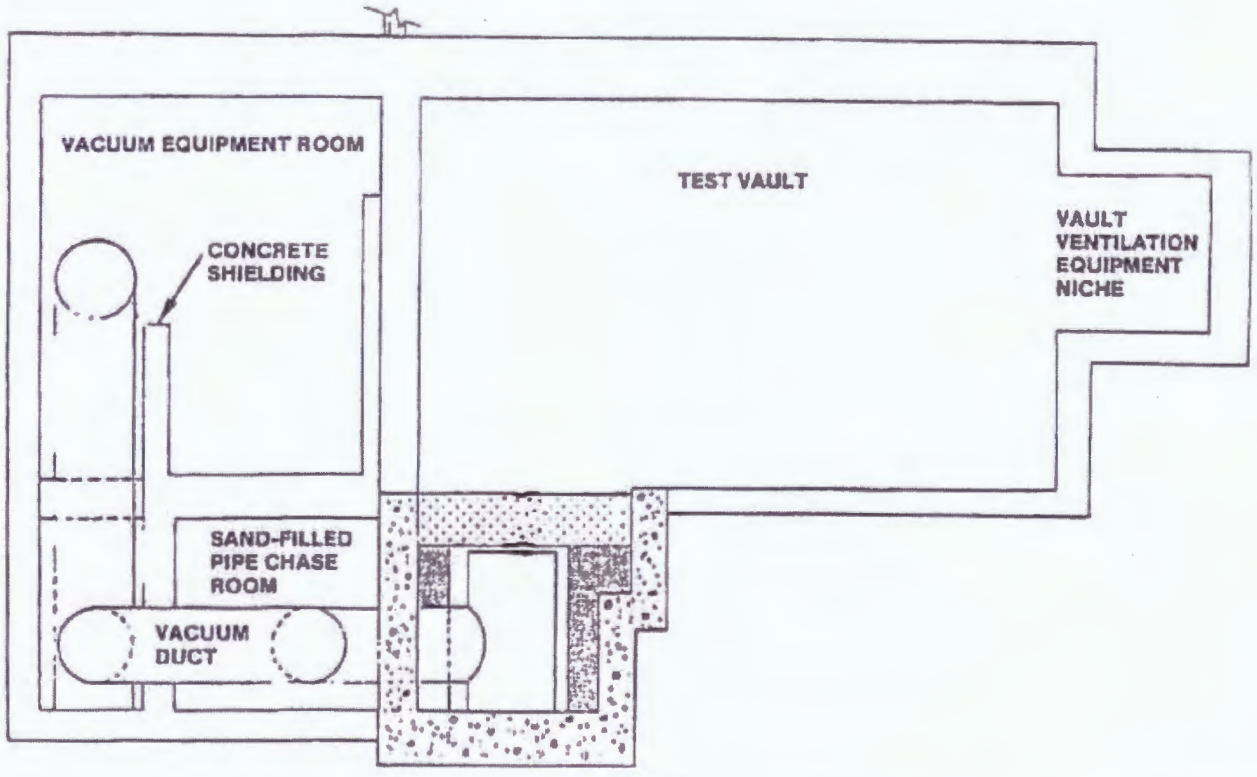
Revised: 08/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.2a
Building 4059
Site Photograph



Plan View



Elevation View

Figure not to Scale

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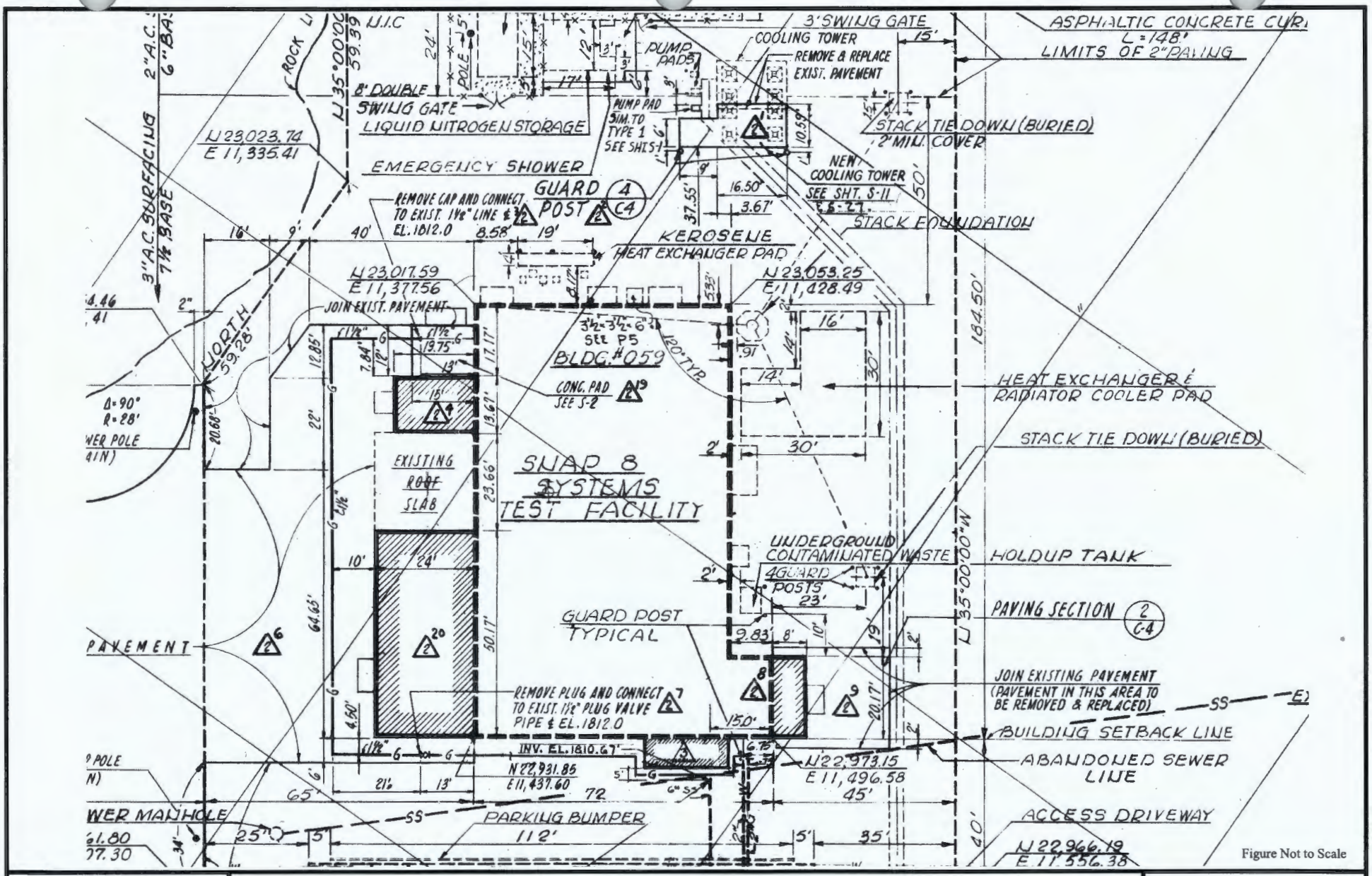
Revised: 08/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

ORDINARY CONCRETE $\rho = 2.3$ g/cm^3
ORDINARY CONCRETE 1% BORON
HIGH DENSITY CONCRETE $\rho = 3.2$ g/cm^3 0.25% BORON
HIGH DENSITY CONCRETE 0.5% BORON

Figure 2.1.2b
Building 4059
Floor Plan

Redacted



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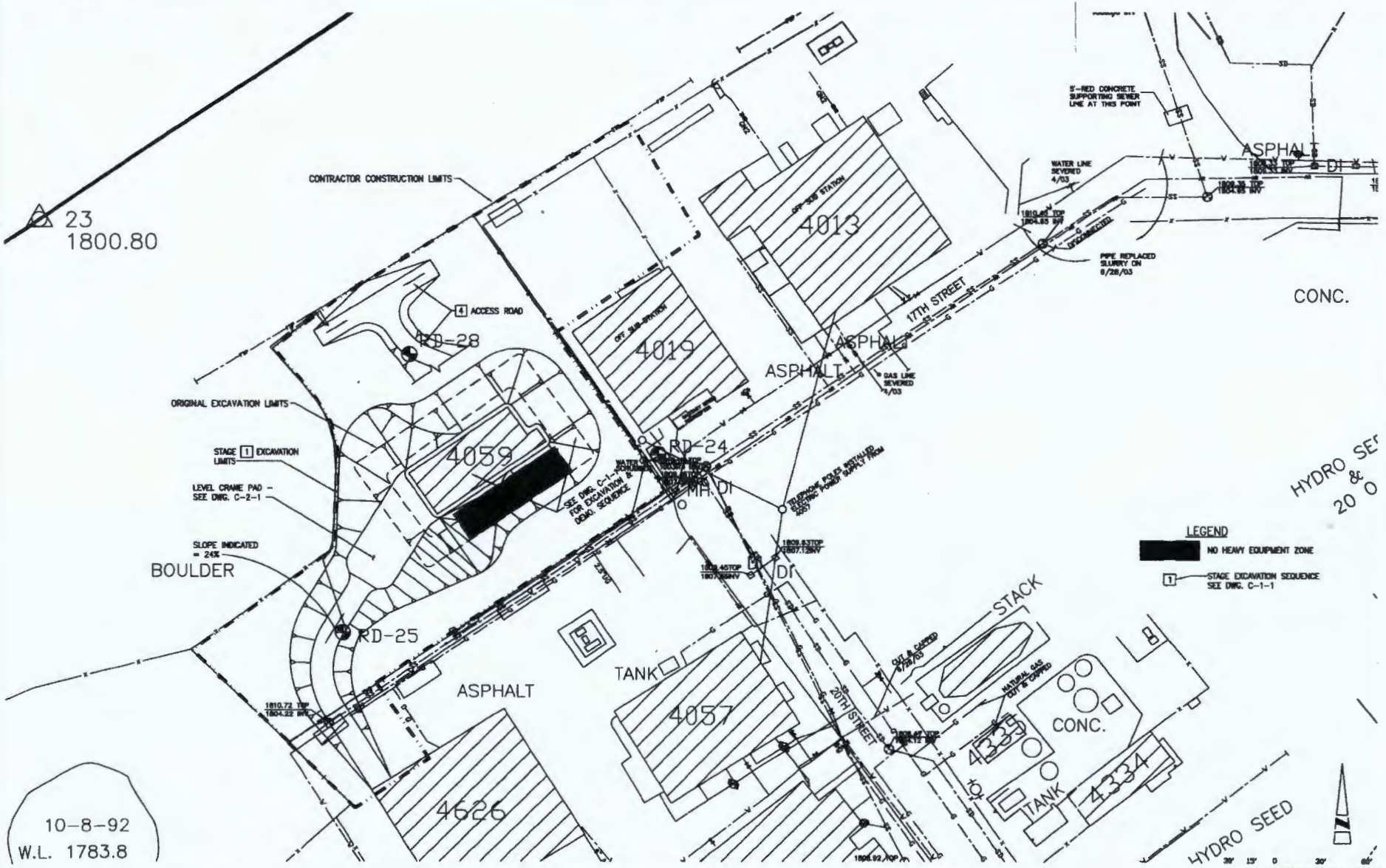
U.S. EPA Region 9

Figure 2.1.2c
Building 4059
Utility Plan

Redacted



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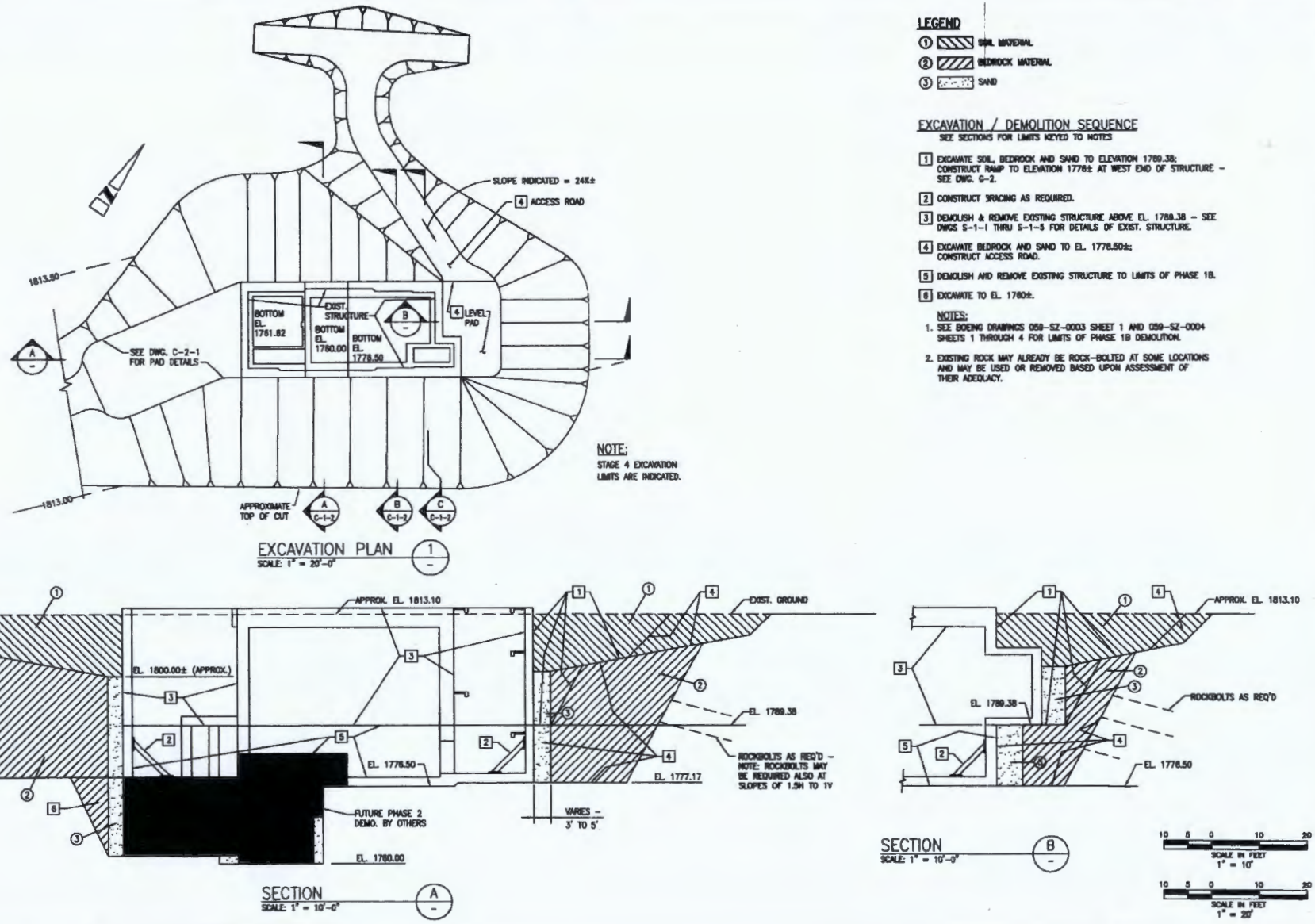
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.2d
Building 4059
Excavation Plan



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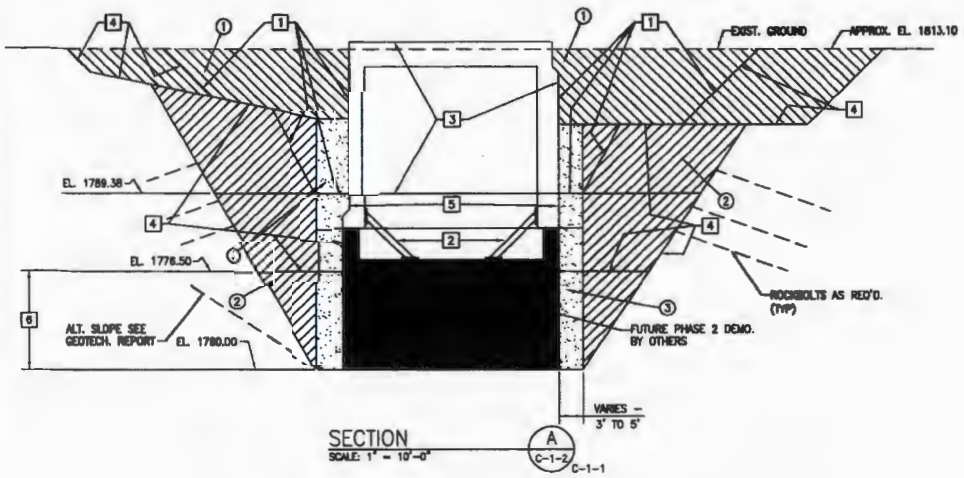
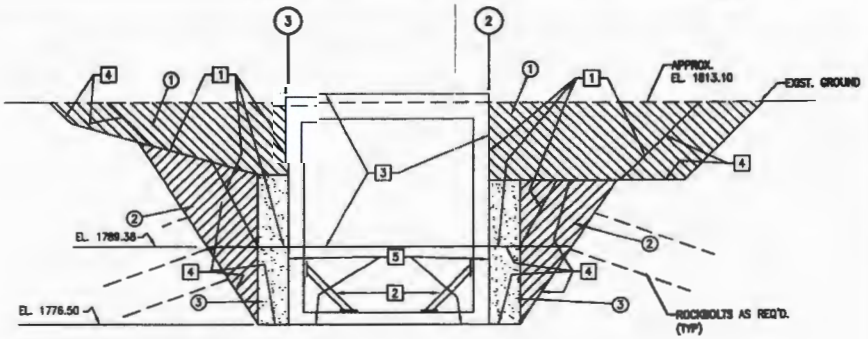
Source: Boeing Company, 2008

U.S. EPA Region 9

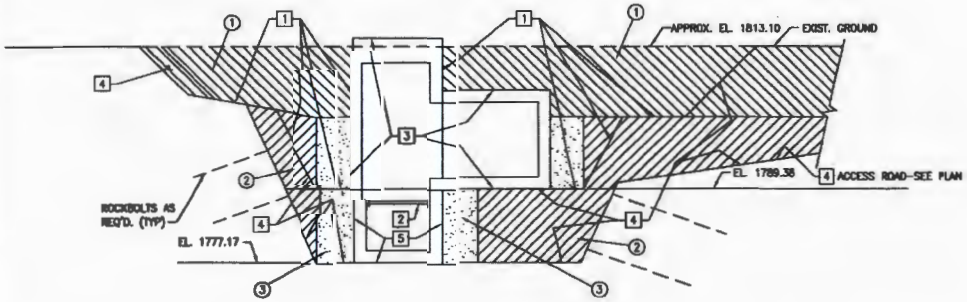
Figure 2.1.2e
Building 4059
Excavation Plan



SECTION A
SCALE: 1" = 10'-0"
C-1-2
C-1-1



SECTION B
SCALE: 1" = 10'-0"
C-1-2
C-1-1



SECTION C
SCALE: 1" = 10'-0"
C-1-2
C-1-1

NOTE:
SEE DWG. C-1-1 FOR LEGEND AND SEQUENCE.

10 5 0 10 20
SCALE IN FEET

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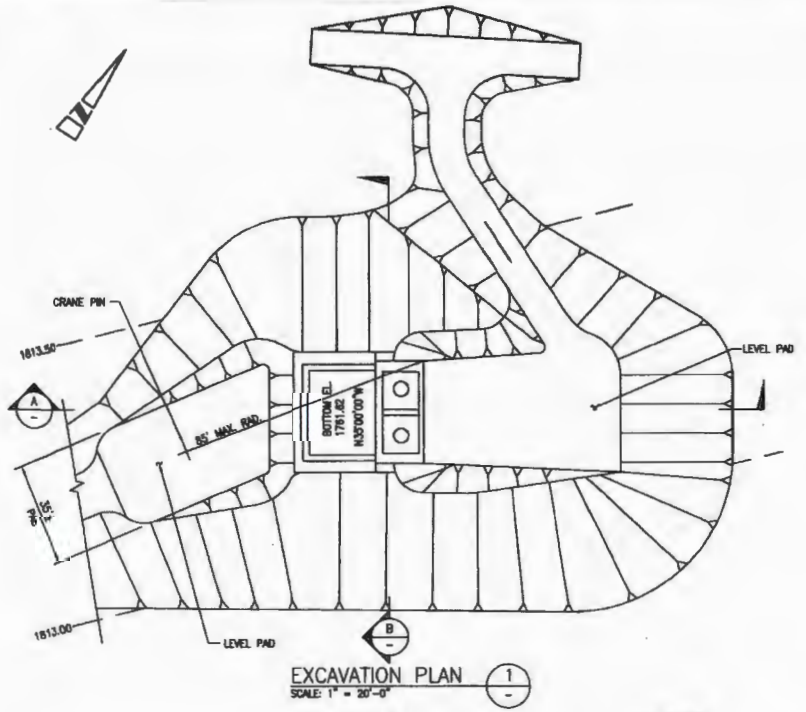
Project:EP9038
Revised: 08/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

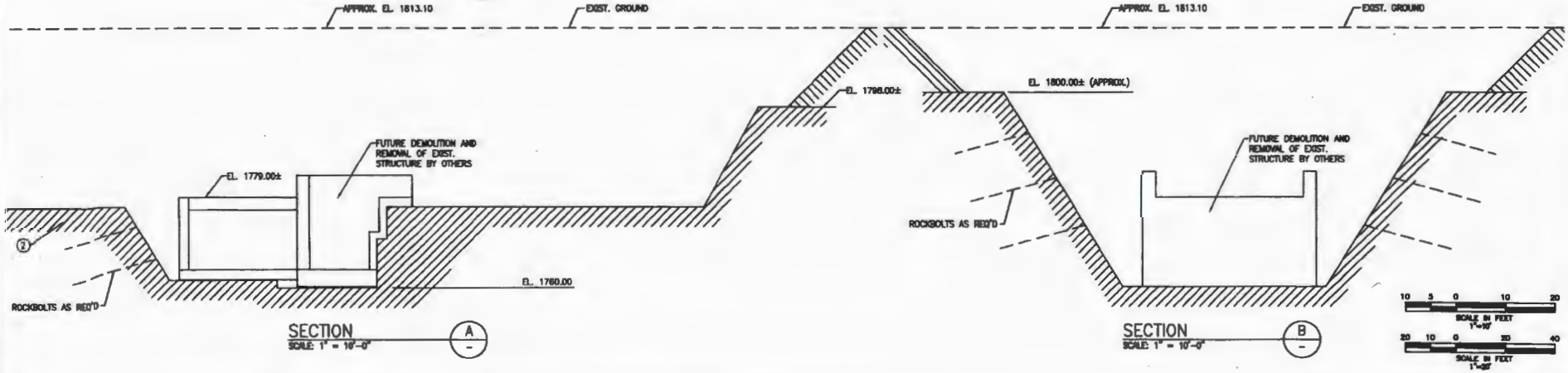
Figure 2.1.2f
Building 4059
Excavation Plan



EXCAVATION PLAN
SCALE: 1" = 20'-0"

NOTES:

1. SEE DWG. C-1-1 FOR LEGEND
2. SEE DWGS. S-1-1 THRU S-1-5 FOR DETAILED DWGS. OF EXIST. STRUCTURE.
3. SEE BOEING DWGS. 059-SZ-0004 SHTS. 1 THRU 4 FOR LIMITS OF PHASE 1B DEMOLITION.



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Revised: 08/23/2010 TJ
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Figure 2.1.2g
Building 4059
Excavation Plan

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Project:EP9038
Revised: 08/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.3a
Building 4459
Site Photograph

Figure 2.2
Area IV Subarea 5C-2
Santa Susana Field Laboratory

U.S. EPA Region 9

French Drain Associated with Building 59

Holding Tank for French Drain System

The two roads next to this pit area were part of a general dumping area around the pit (not just IN the pit) by construction maintenance personnel. Along the sides of the roads. Dark stains were common.

Look here for contamination (Interview 71)

Legend

- Sub-Area 5C-2 Boundary
- Primary Roads
- Secondary Roads
- Tertiary Roads
- Underground Storage Tank
- Unknown Tank Type
- French Drain Holding Tank
- Sump
- Dry Well
- Tank Footprint
- Above ground Storage Tank
- Demolished Bldg.
- Existing Bldg.
- Parking Lots
- Drainage
- Drainage Ditch
- Interview Line
- Offsite Seeps and Springs
- Onsite Seeps and Springs
- Drain
- Well

Aerial Photo Features
- Priority 1
- Priority 2
- Processing Area (Priority 1)
- Excavation

Historical Data
- Chemical Use Area / Debris Field
- Excavation
- Leach Field / Septic Tank
- Open Storage

Surface Water
- Intermittent Stream
- Permanent Stream
- Surface Water
- Lined Channel
- French Drain
- Drainage
- Leach Field
- Septic System

Aerial Photo Descriptors

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
VT	Vertical Tank
WDA	Waste Disposal Area

Utilities
- Channel
- Drain
- Drain
- Drainage Divide
- Gutter
- Tank
- Tank
- Vault
- Well
- Water (Removed)
- Water (Removed)
- Pipes (Unknown Type)
- Pipes (Unknown Type)
- Gas
- Storm Drain
- Sanitary Sewer
- Water

Surface Water Flow (From Boeing Database, 2008)

N

0 25 50 100
Scale In Feet

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CIRGIS, 2007

HGL HydroGeoLogic, Inc.

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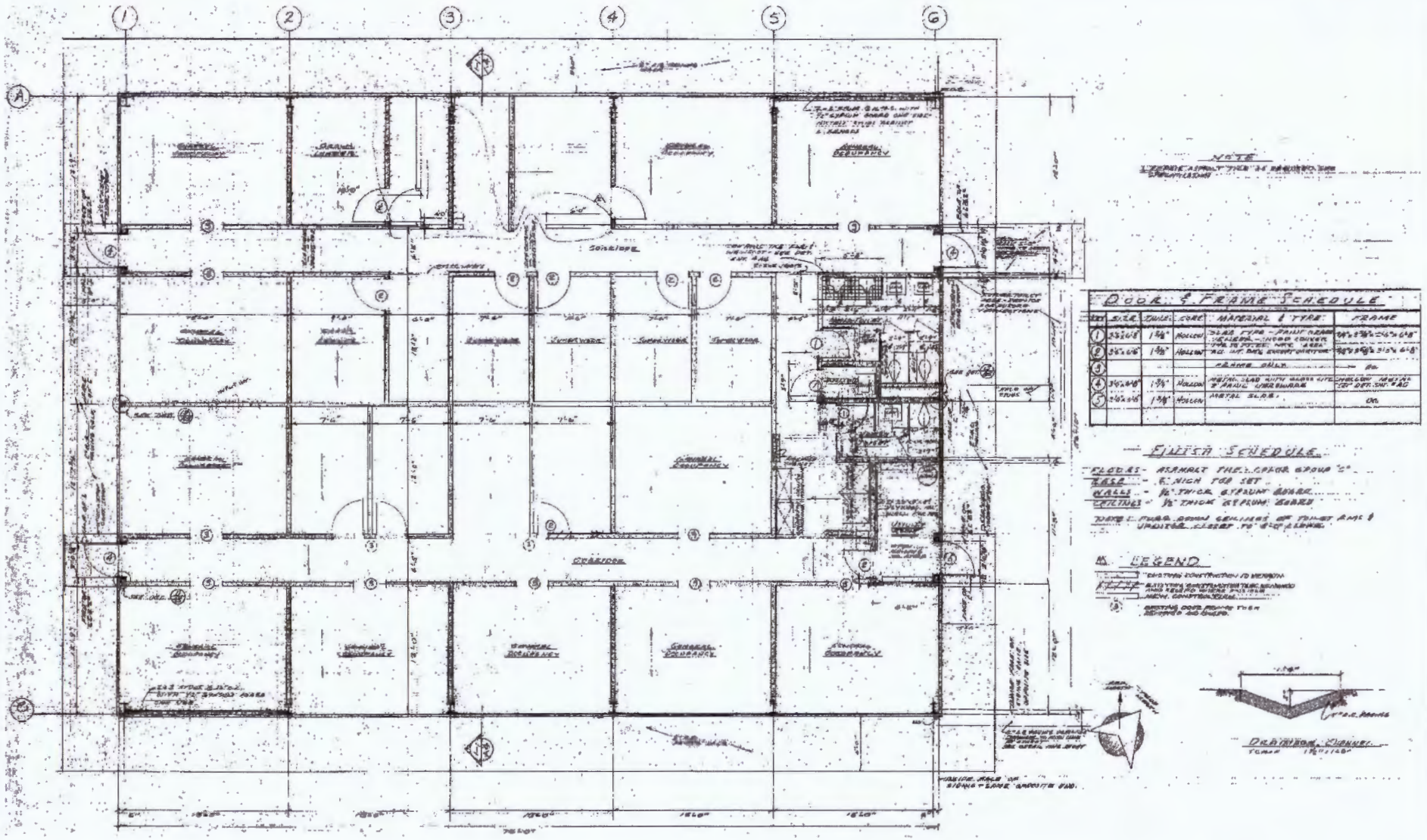
U.S. EPA Region 9

Figure 2.2.1a
Building 4038
Site Photograph



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U.S. EPA Region 9

Figure 2.2.1b
Building 4038
Floor Plan

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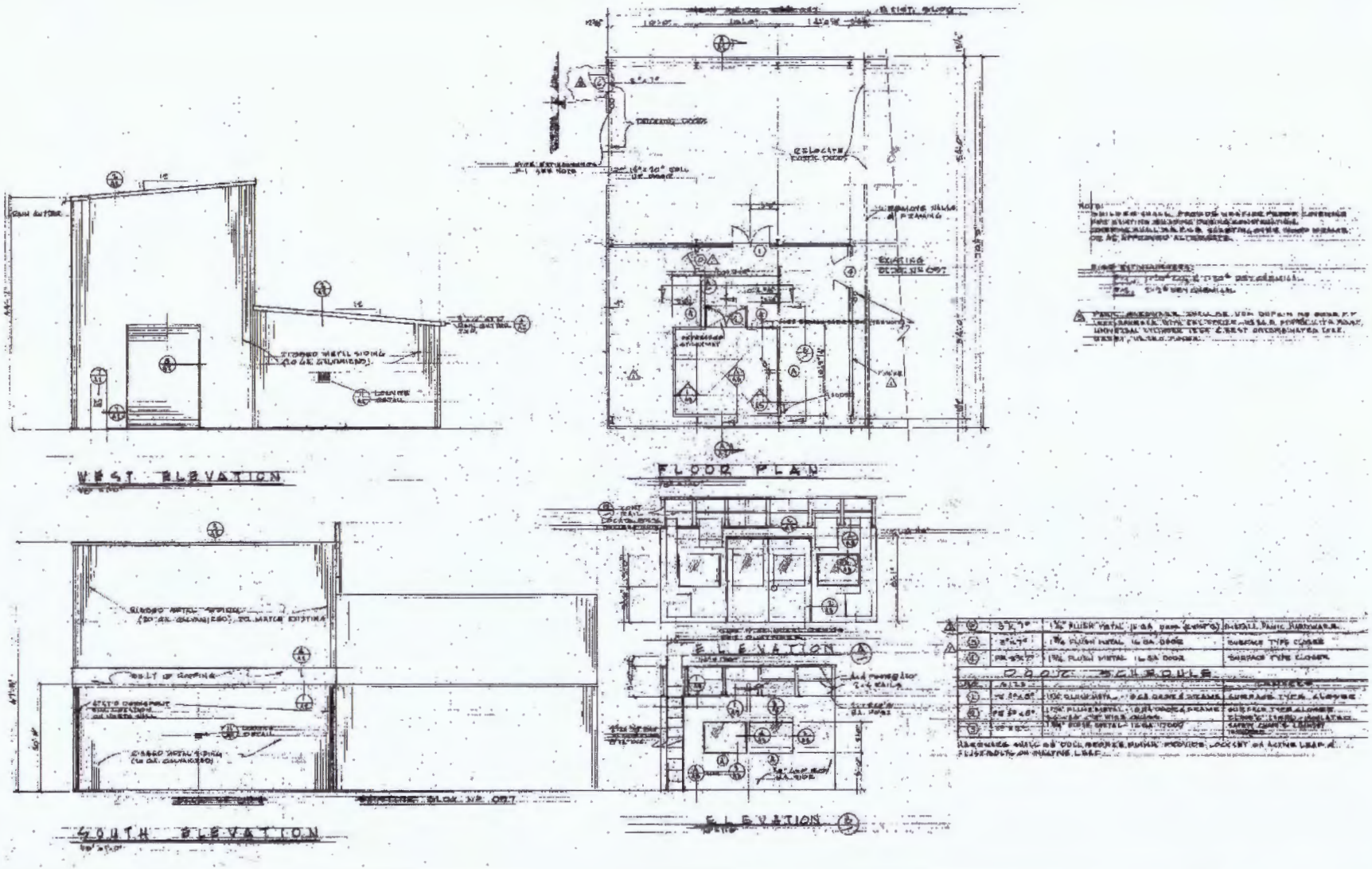
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.2.2a
Building 4057
Site Photograph



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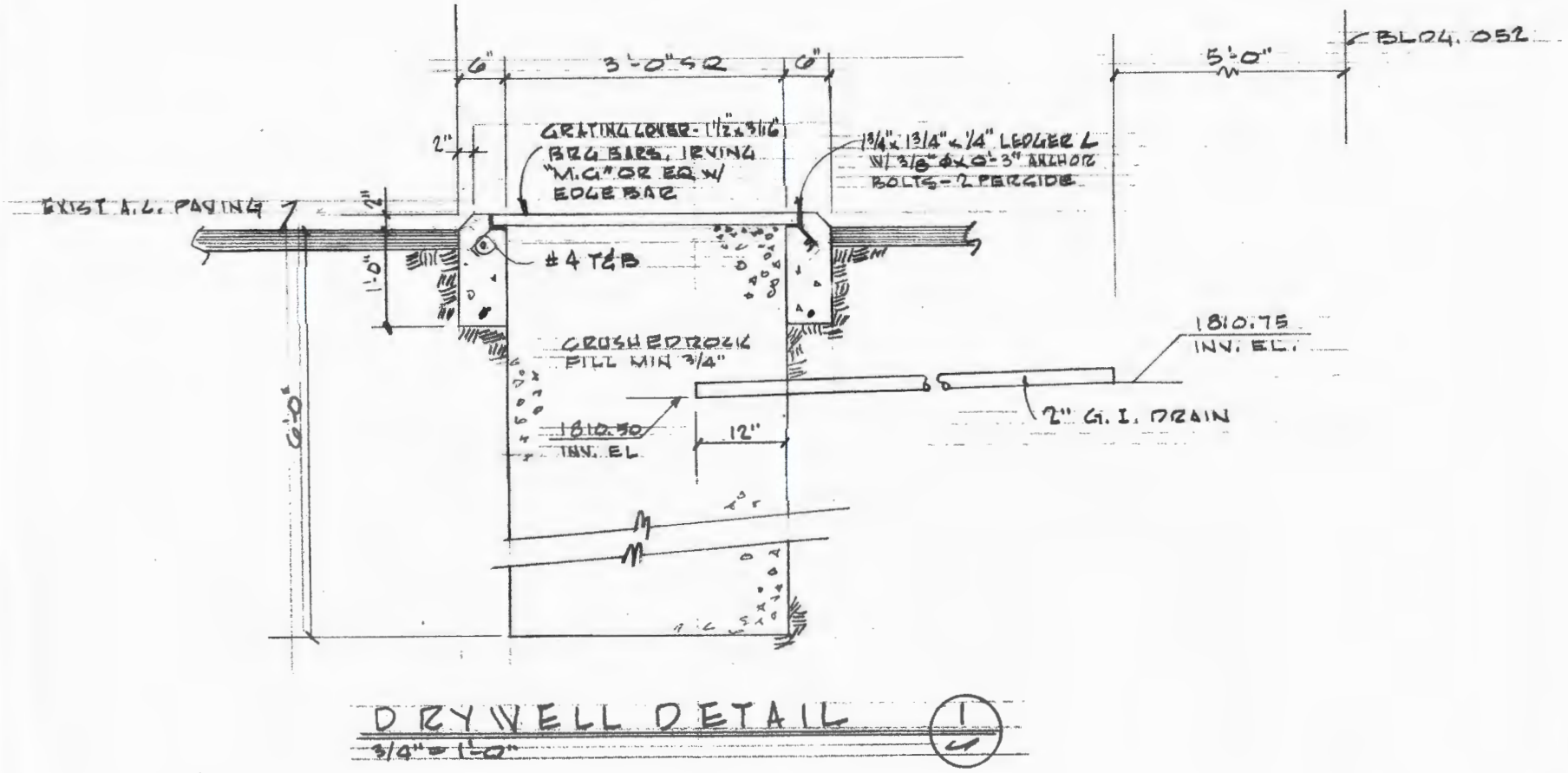
U.S. EPA Region 9

Figure 2.2.2b
Building 4057
Floor Plan



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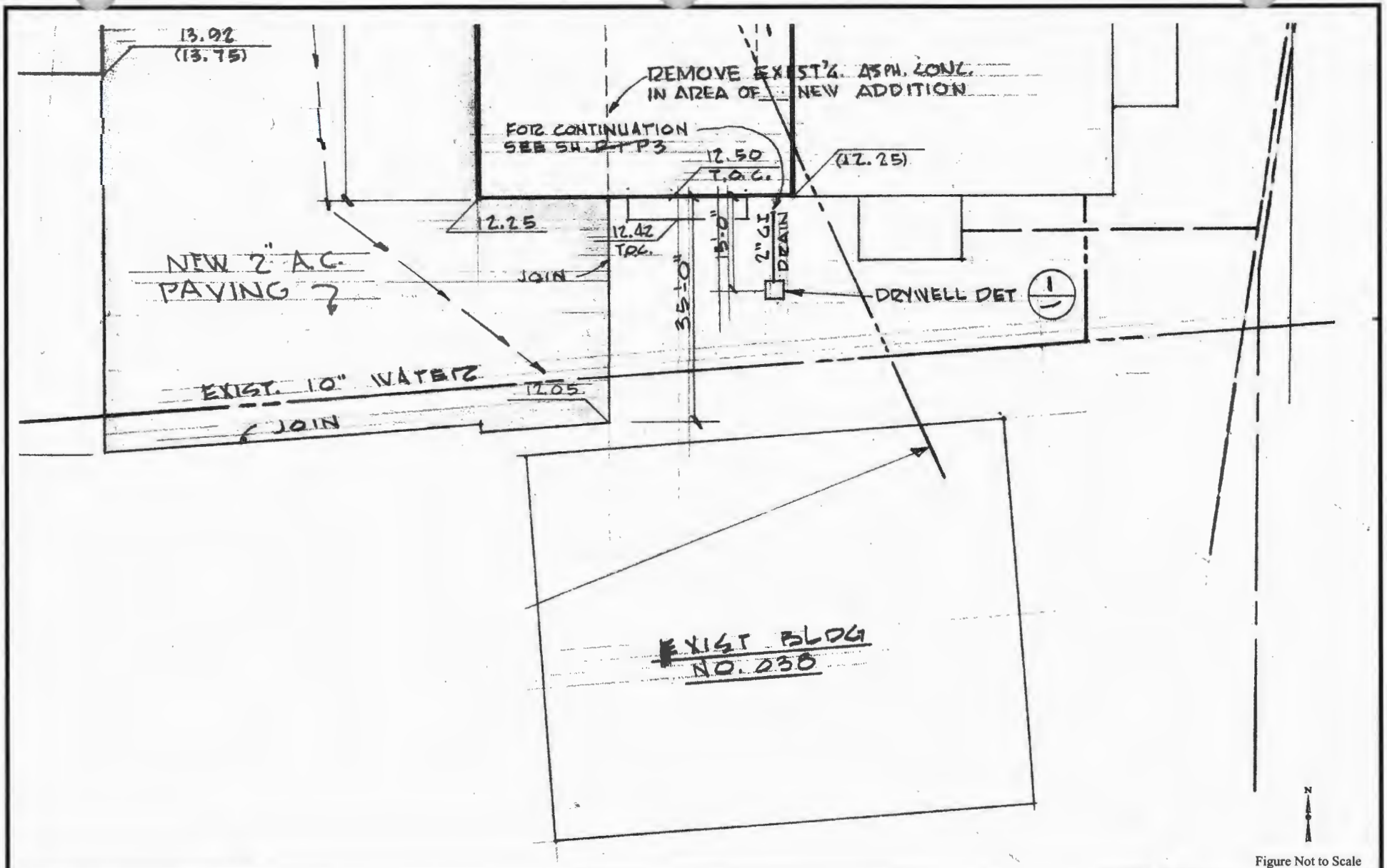
U.S. EPA Region 9

Figure 2.2.2c
Building 4057
Dry Well



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Revised: 08/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.2.2d
Building 4057
Dry Well

Redacted

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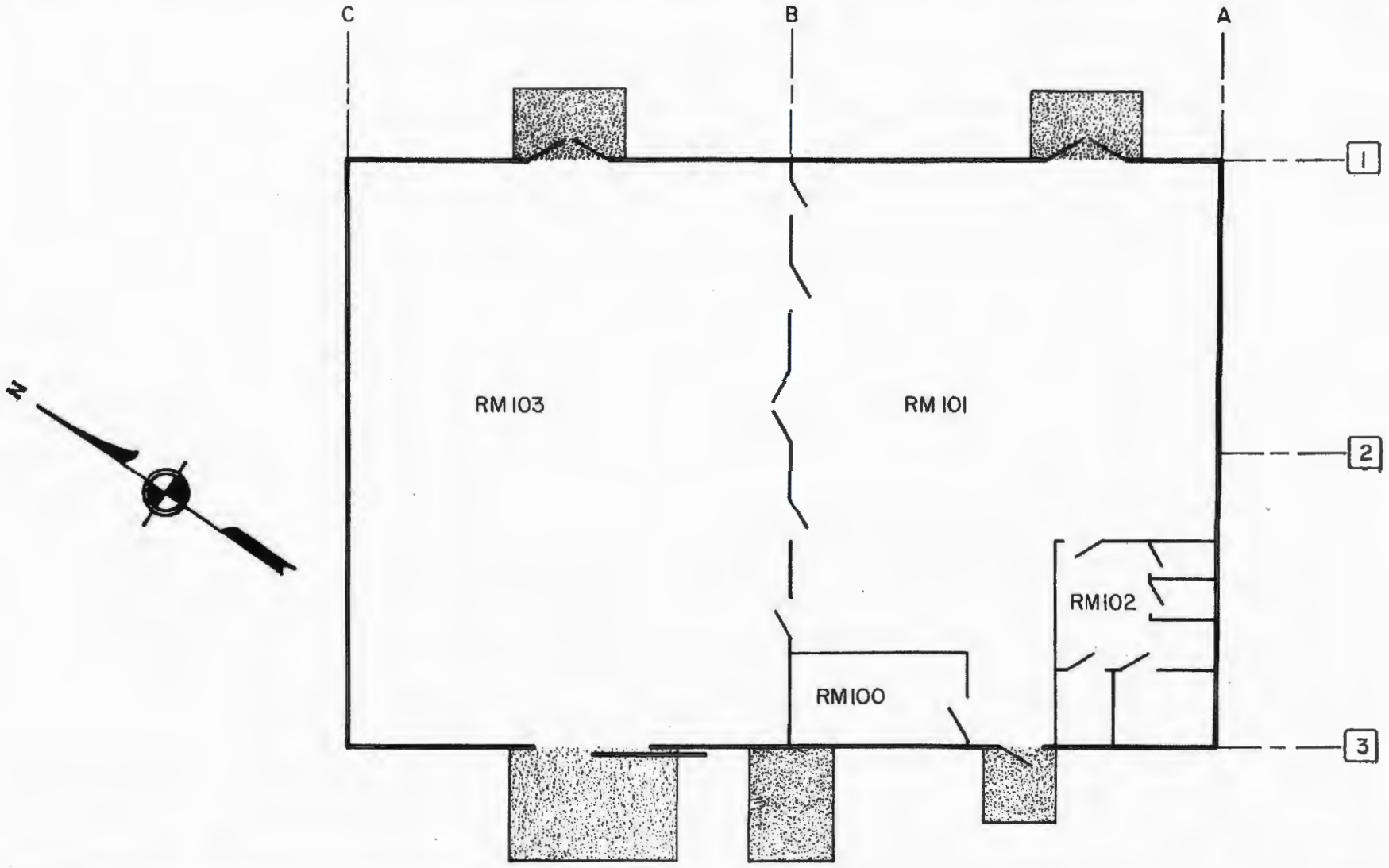
Revised: 08/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.2.3a
Building 4062
Site Photograph



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Project:EP9038
Revised: 08/23/2010 TJ
Source: Boeing Company, 2008

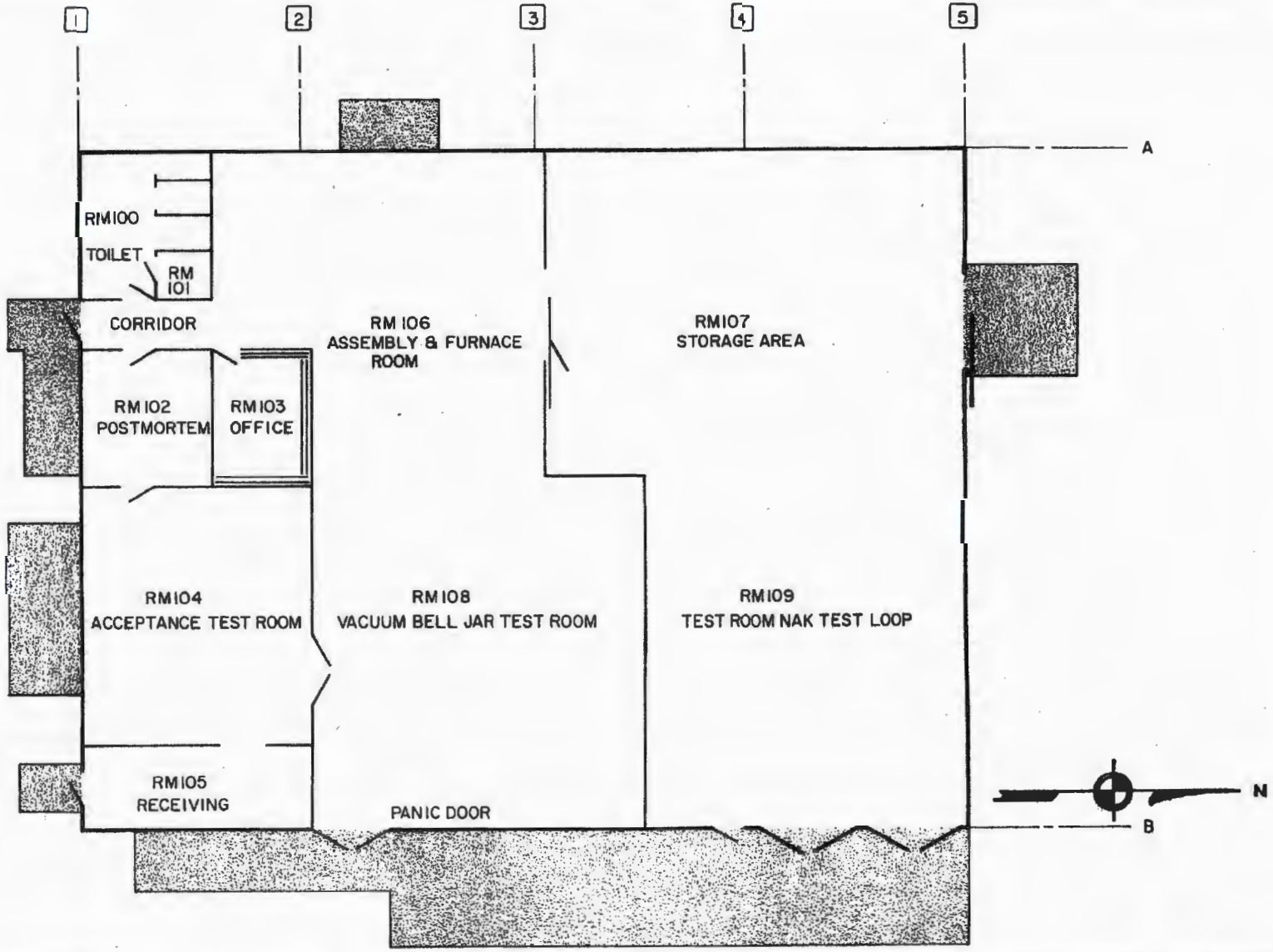
U.S. EPA Region 9

Figure 2.2.3b
Building 4062
Floor Plan

Y:/Santa_Susana/EP9038/TM/HSA_5C (2-07)bldg_4065.cdr
Project:EP9038
Revised: 08/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.2.4a
Building 4065
Site Photograph



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Source: Boeing Company, 2008

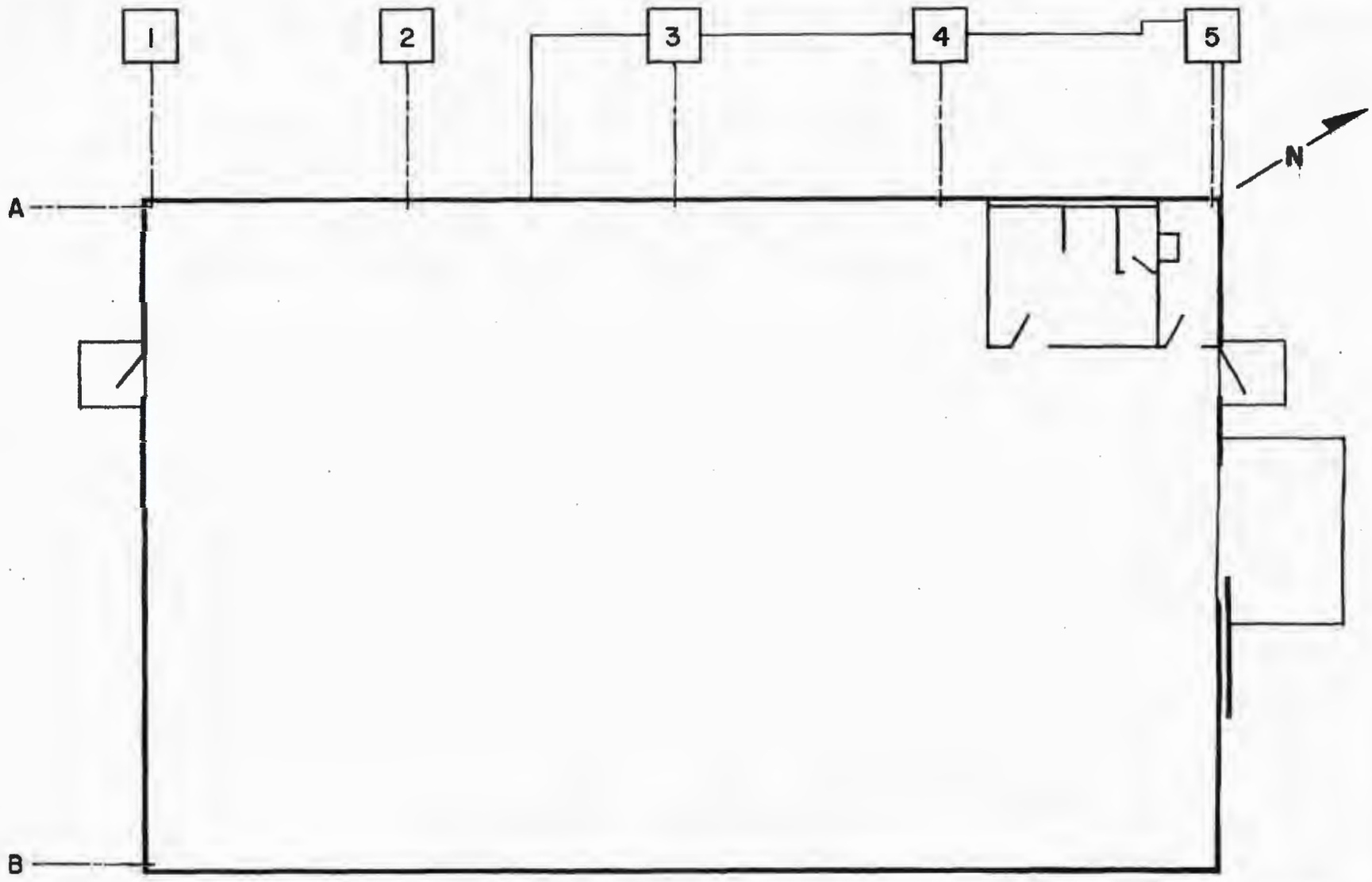
U.S. EPA Region 9

Figure 2.2.4b
Building 4065
Floor Plan

Y:/Santa_Susana/EP9038/TM/HSA_5C (2-08)bldg_4066.cdr
Project:EP9038
Revised: 08/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.2.5a
Building 4066
Site Photograph



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Revised: 08/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.2.5b
Building 4066
Floor Plan

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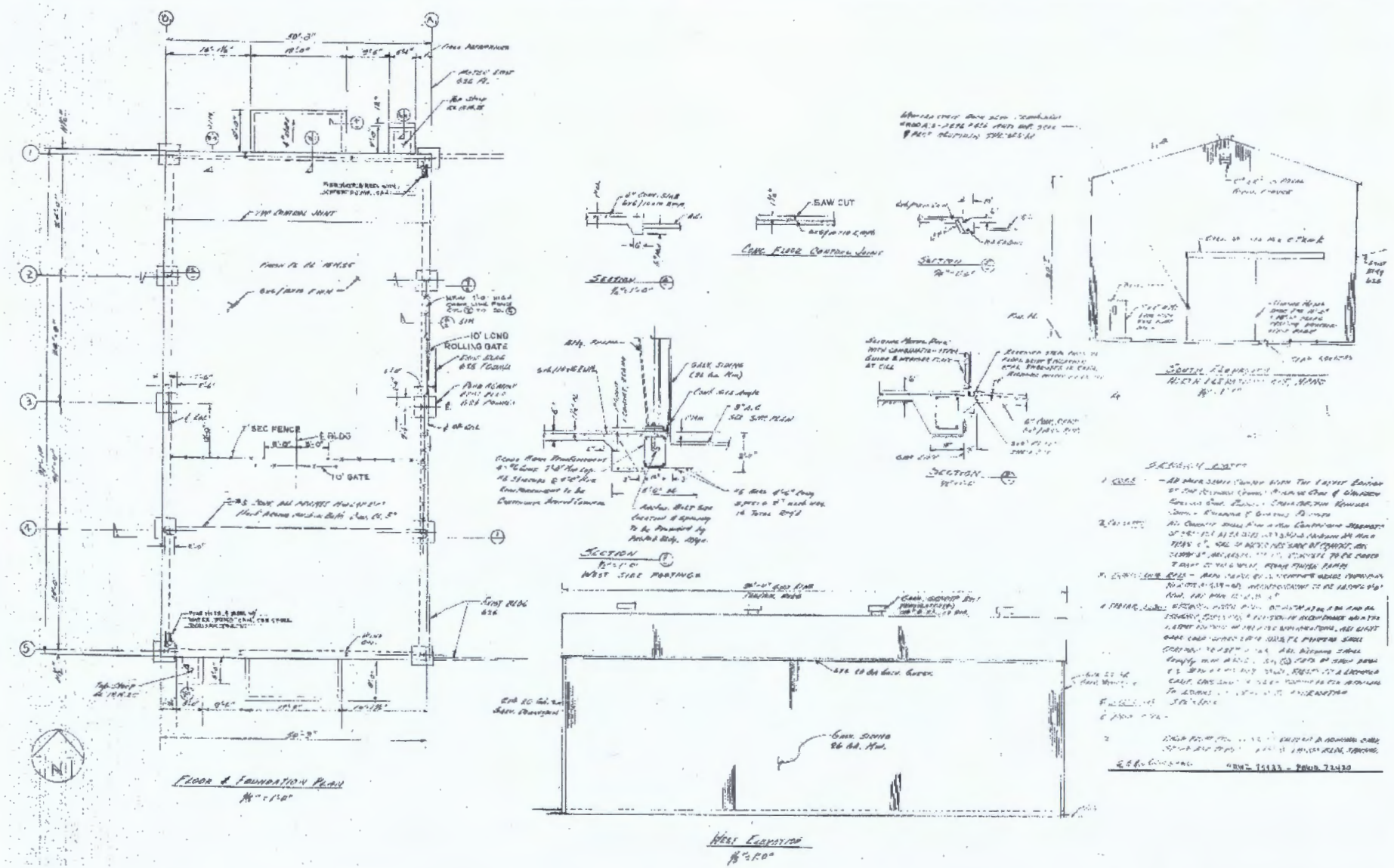
Revised: 08/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.2.6a
Building 4626
Site Photograph



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Revised: 08/23/2010 TJ
Source: Boeing Company, 2008

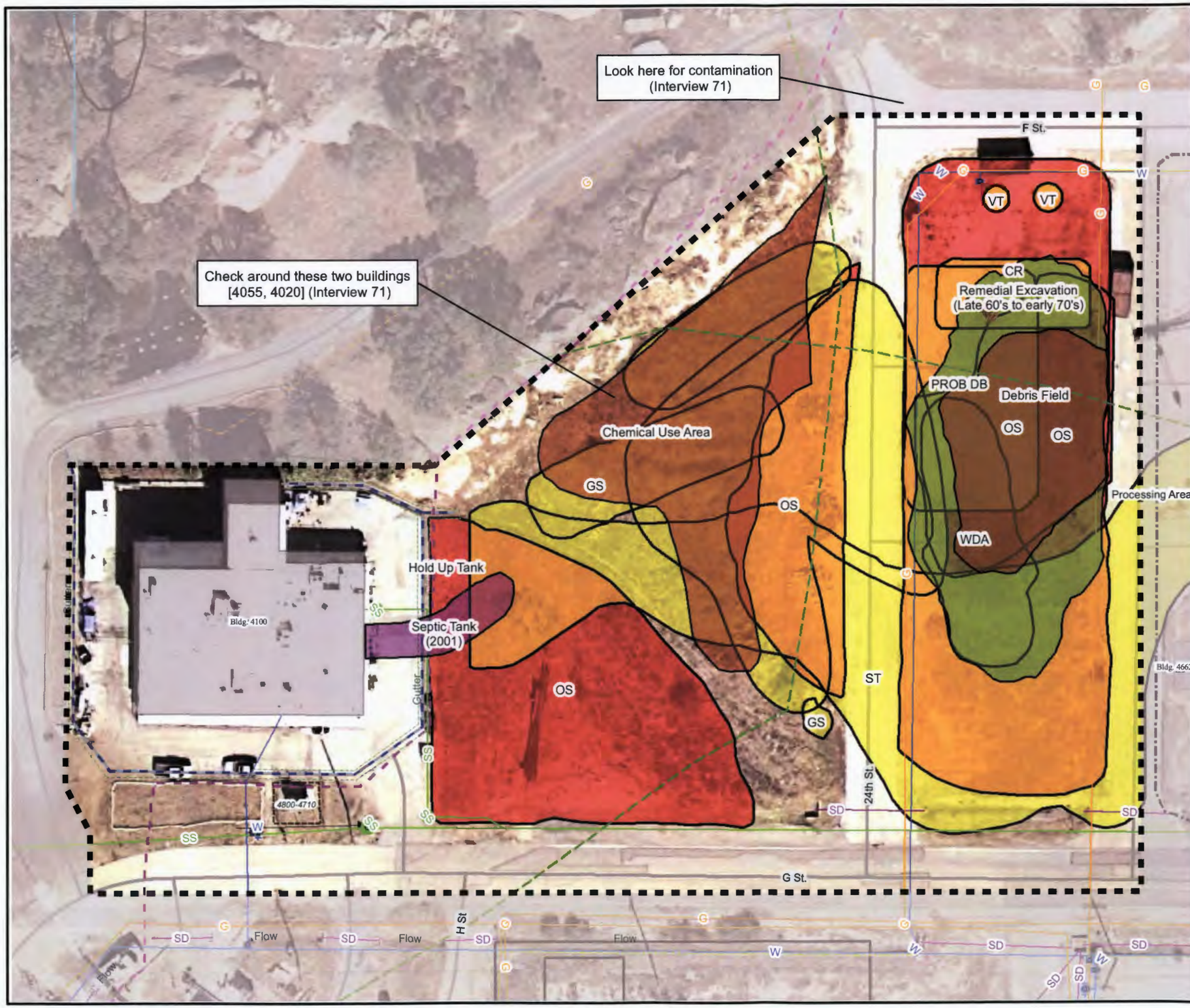
U.S. EPA Region 9

Figure 2.2.6b
Building 4626
Floor Plan

Y:/Santa_Susana/EP9038/TM/HSA_5C (2-09)bldg_4100.cdr
Project:EP9038
Revised: 08/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.3.1a
Building 4100
Site Photograph



Historical Site Assessment
Final Technical Memorandum - HSA-5C

Figure 2.3
Area IV Subarea 5C-3
Santa Susana Field Laboratory

U.S. EPA Region 9

Legend

- Sub-Area 5C-3 Boundary
- Primary Roads
- Secondary Roads
- Tertiary Roads
- Underground Storage Tank
- Unknown Tank Type
- French Drain Holding Tank
- Sump
- Dry Well
- Tank Footprint
- Above ground Storage Tank
- Demolished Bldg.
- Existing Bldg.
- Parking Lots
- Drainage
- Drainage Ditch
- Interview Line
- Offsite Seeps and Springs
- Onsite Seeps and Springs
- Drain
- Well

Aerial Photo Features
- Priority 1
- Priority 2
- Processing Area (Priority 1)
- Excavation

Historical Data
- Chemical Use Area / Debris Field
- Excavation
- Leach Field / Septic Tank
- Open Storage

Surface Water
- Intermittent Stream
- Permanent Stream
- Surface Water
- Lined Channel
- French Drain
- Drainage
- Leach Field
- Septic System

Aerial Photo Descriptors

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
VT	Vertical Tank
WDA	Waste Disposal Area

Utilities
- Channel
- Drain
- Drain
- Drainage Divide
- Gutter
- Tank
- Tank
- Vault
- Well
- Water (Removed)
- Water (Removed)
- Pipes (Unknown Type)
- Pipes (Unknown Type)
- Gas
- Storm Drain
- Sanitary Sewer
- Water

Surface Water Flow (From Boeing Database, 2008)

N

0 25 50 100
Scale In Feet

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Revised: 08/23/2010 TJ
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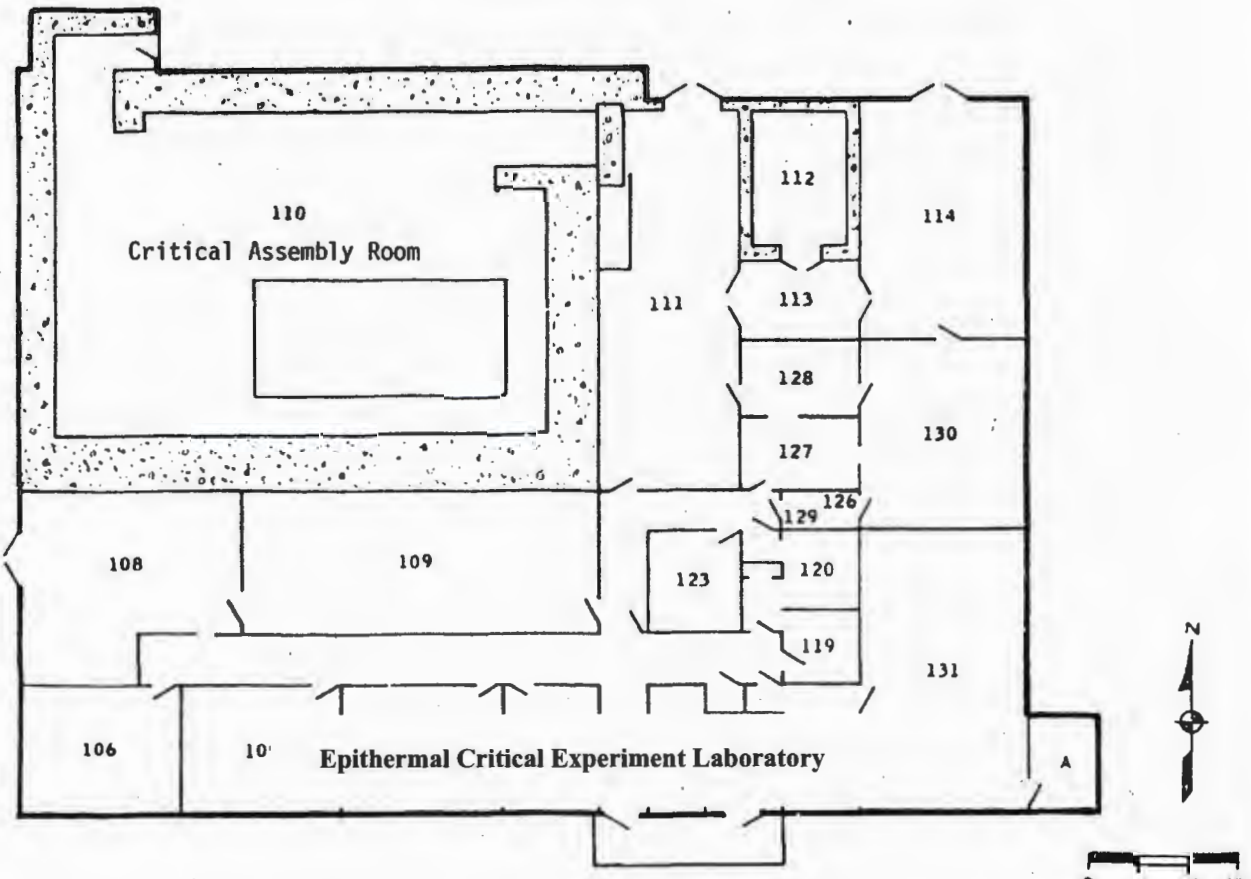
CIRGIS, 2007

HGL HydroGeoLogic, Inc

Redacted



EPITHERMAL CRITICAL EXPERIMENT LABORATORY
BUILDING 100

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Project:EP9038
Revised: 08/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.3.1b
Building 4100
Floor Plan

Y:/Santa_Susana/EP9038/TM/HSA_5C (2-12)bldg_4461.cdr
Project:EP9038
Revised: 08/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.4.1a
Building 4461
Site Photograph

Figure 2.4
Area IV Subarea 5C-4
Santa Susana Field Laboratory

U.S. EPA Region 9

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

Legend

- Sub-Area 5C-4 Boundary
- Primary Roads
- Secondary Roads
- Tertiary Roads
- Underground Storage Tank
- Unknown Tank Type
- French Drain Holding Tank
- Sump
- Dry Well
- Tank Footprint
- Above ground Storage Tank
- Demolished Bldg.
- Existing Bldg.
- Parking Lots
- Drainage
- Drainage Ditch
- Interview Line
- Offsite Seeps and Springs
- Onsite Seeps and Springs
- Drain
- Well

Aerial Photo Features
- Priority 1
- Priority 2
- Processing Area (Priority 1)
- Excavation

Historical Data
- Chemical Use Area / Debris Field
- Excavation
- Leach Field / Septic Tank
- Open Storage

Surface Water
- Intermittent Stream
- Permanent Stream
- Surface Water
- Lined Channel
- French Drain
- Drainage
- Leach Field
- Septic System

Aerial Photo Descriptors

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
VT	Vertical Tank
WDA	Waste Disposal Area

Utilities
- Channel
- Drain
- Drain
- Drainage Divide
- Gutter
- Tank
- Tank
- Vault
- Well
- Water (Removed)
- Water (Removed)
- Pipes (Unknown Type)
- Pipes (Unknown Type)
- G Gas
- SD Storm Drain
- SS Sanitary Sewer
- W Water

Surface Water Flow (From Boeing Database, 2008)

N

0 25 50 100

Scale In Feet

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Revised: 08/23/2010 TJ
Sorce: Boeing Company, 2008
CIRGIS, 2007

HGL HydroGeoLogic, Inc.

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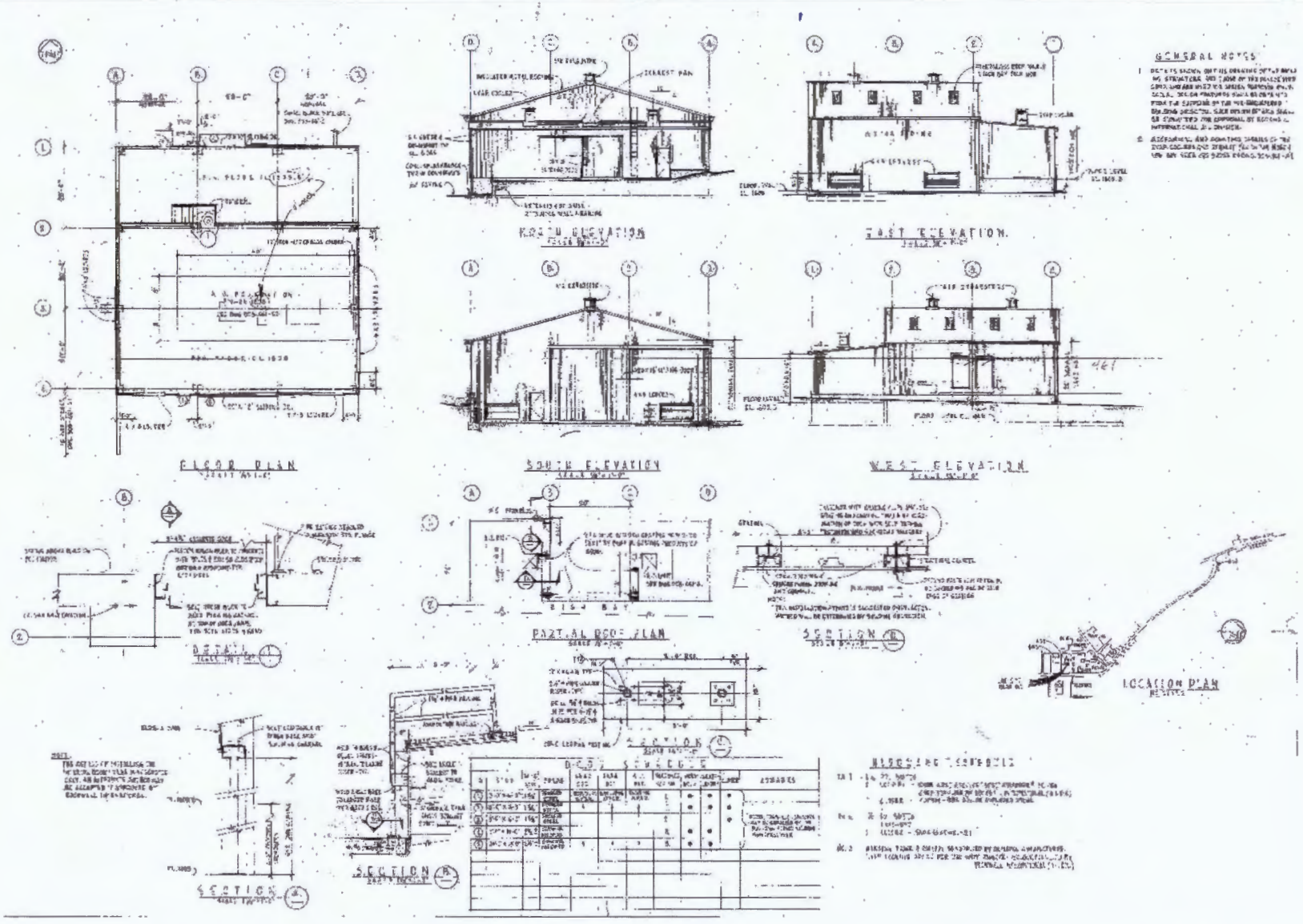

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Revised: 08/23/2010 TJ
Source: Boeing Company, 2008

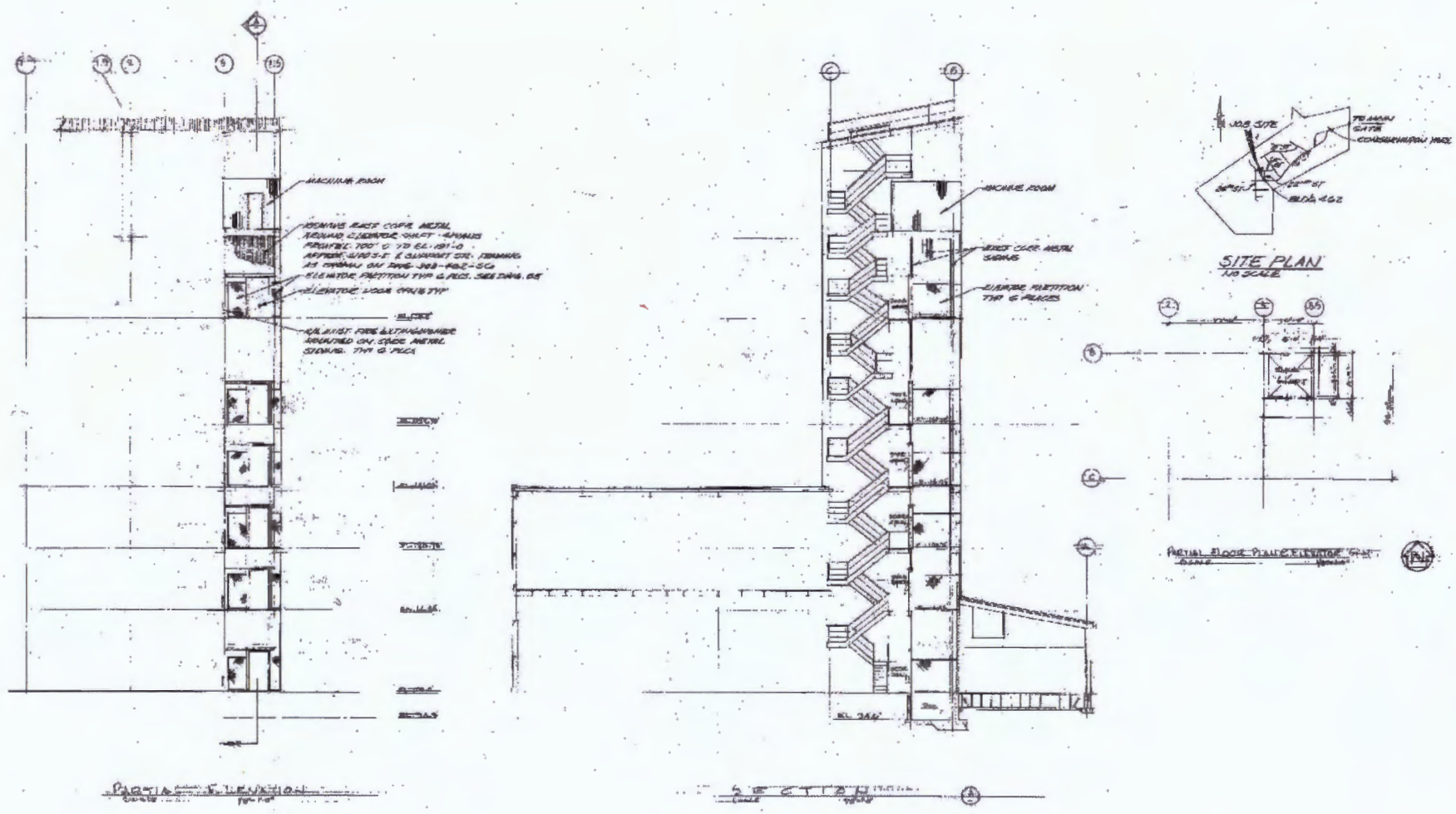
U.S. EPA Region 9

Figure 2.4.1b
Building 4461
Floor Plan

Y:/Santa_Susana/EP9038/TM/HSA_5C (2-13)bldg_4462.cdr
Project:EP9038
Revised: 08/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.4.2a
Building 4462
Site Photograph



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Revised: 08/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.4.2b
Building 4462
Floor Plan

Y:/Santa_Susana/EP9038/TM/HSA_5C (2-14)bldg_4463.cdr
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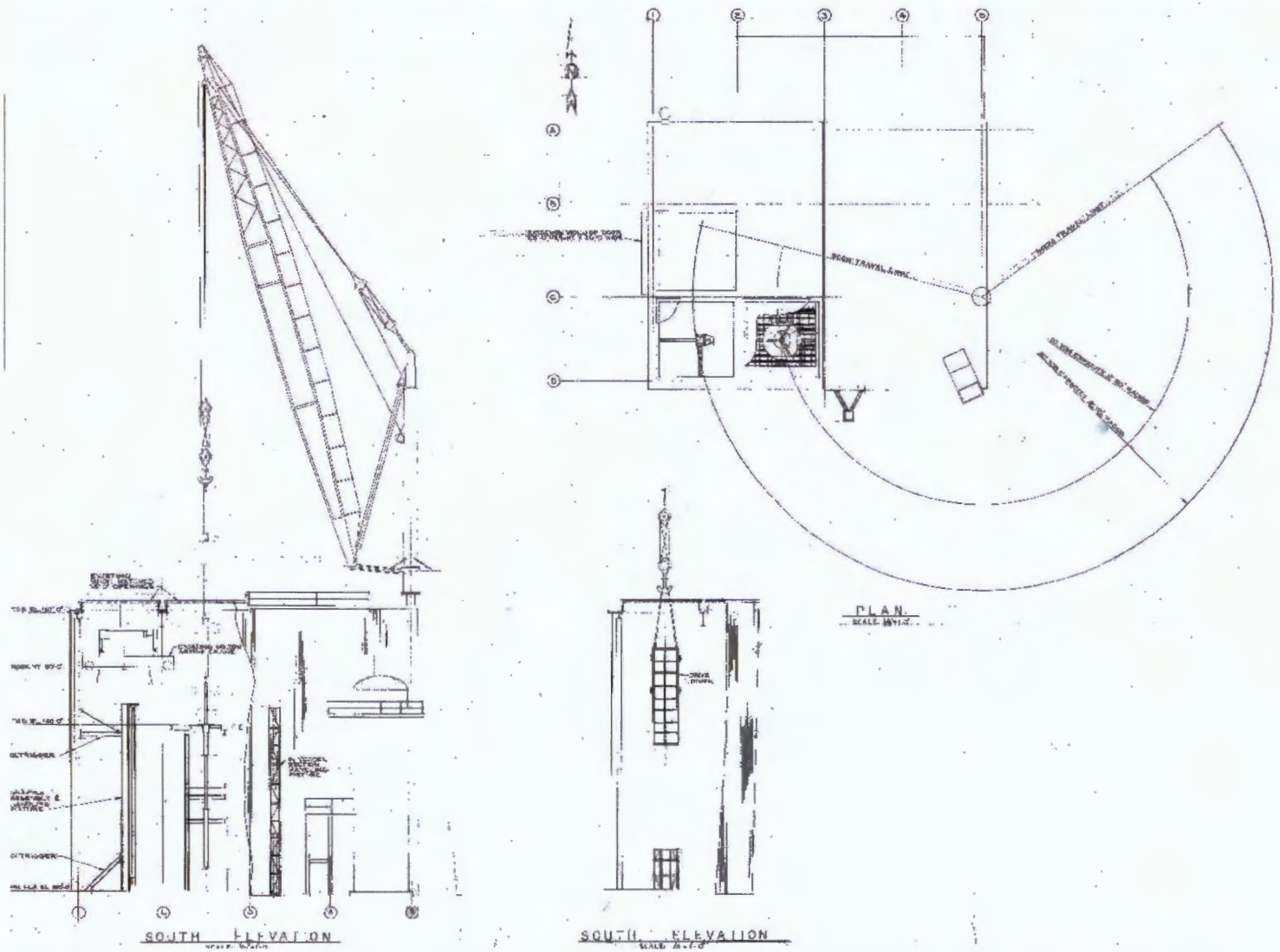
Revised: 08/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.4.3a
Building 4463
Site Photograph



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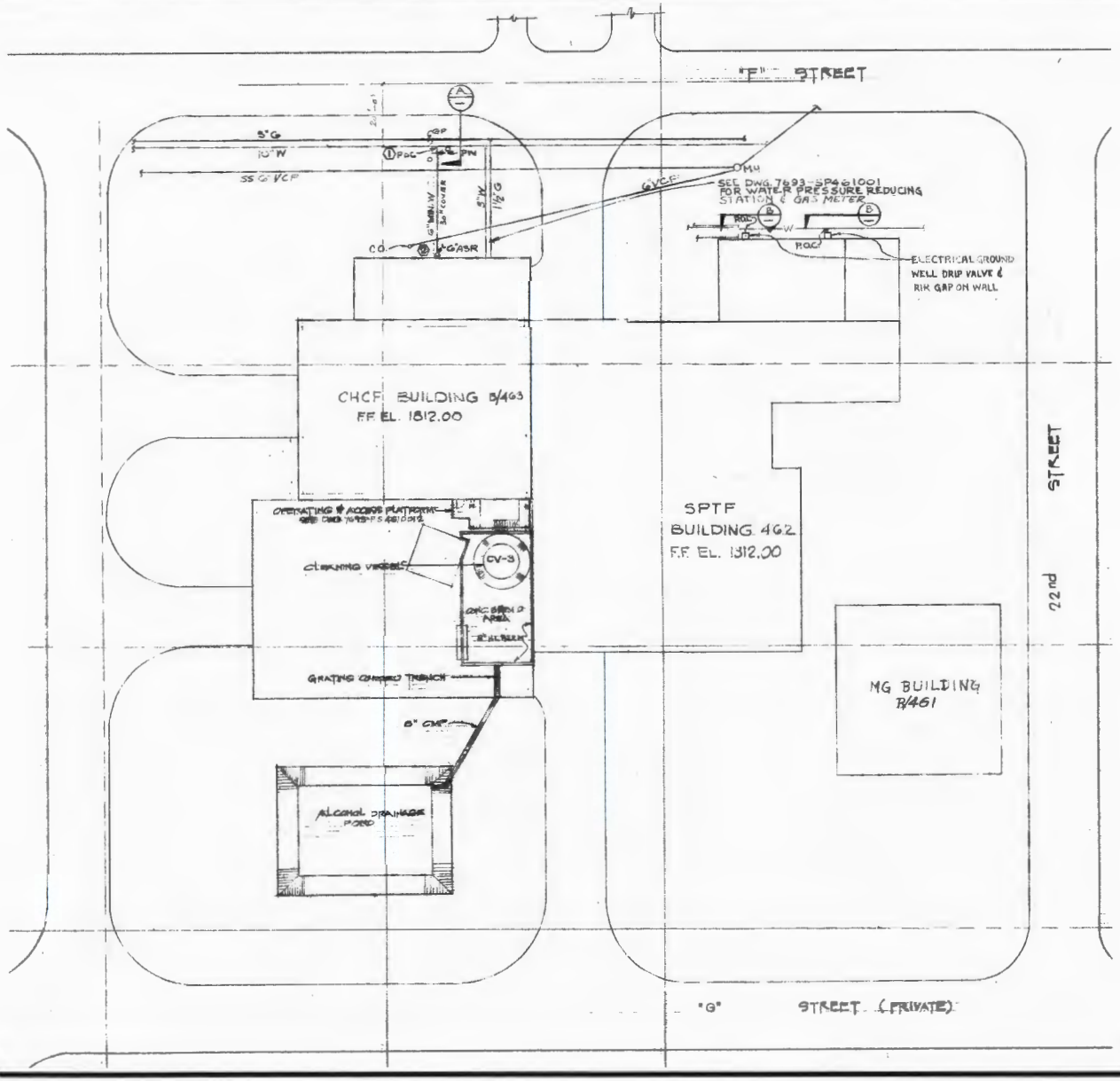
Revised: 08/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.4.3b
Building 4463
Floor Plan



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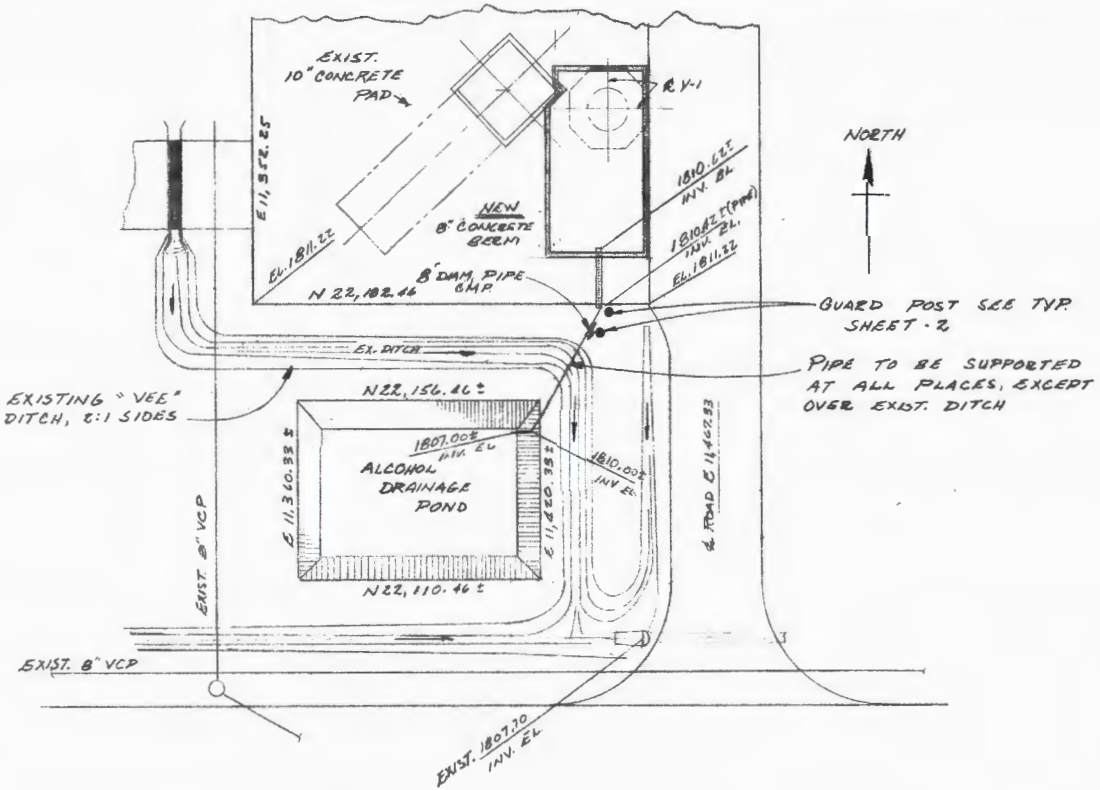
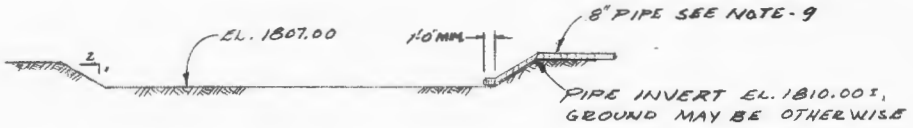
Project:EP9038
Revised: 08/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.4.3c
Building 4463
Plot Plan



PLAN VIEW - ALCOHOL DRAINAGE POND
SCALE - 1" = 20'-0"



ELEVATION - ALCOHOL DRAINAGE POND
SCALE - 1" = 10'

Figure Not to Scale

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Revised: 08/23/2010 TJ
Source: Boeing Company, 2008

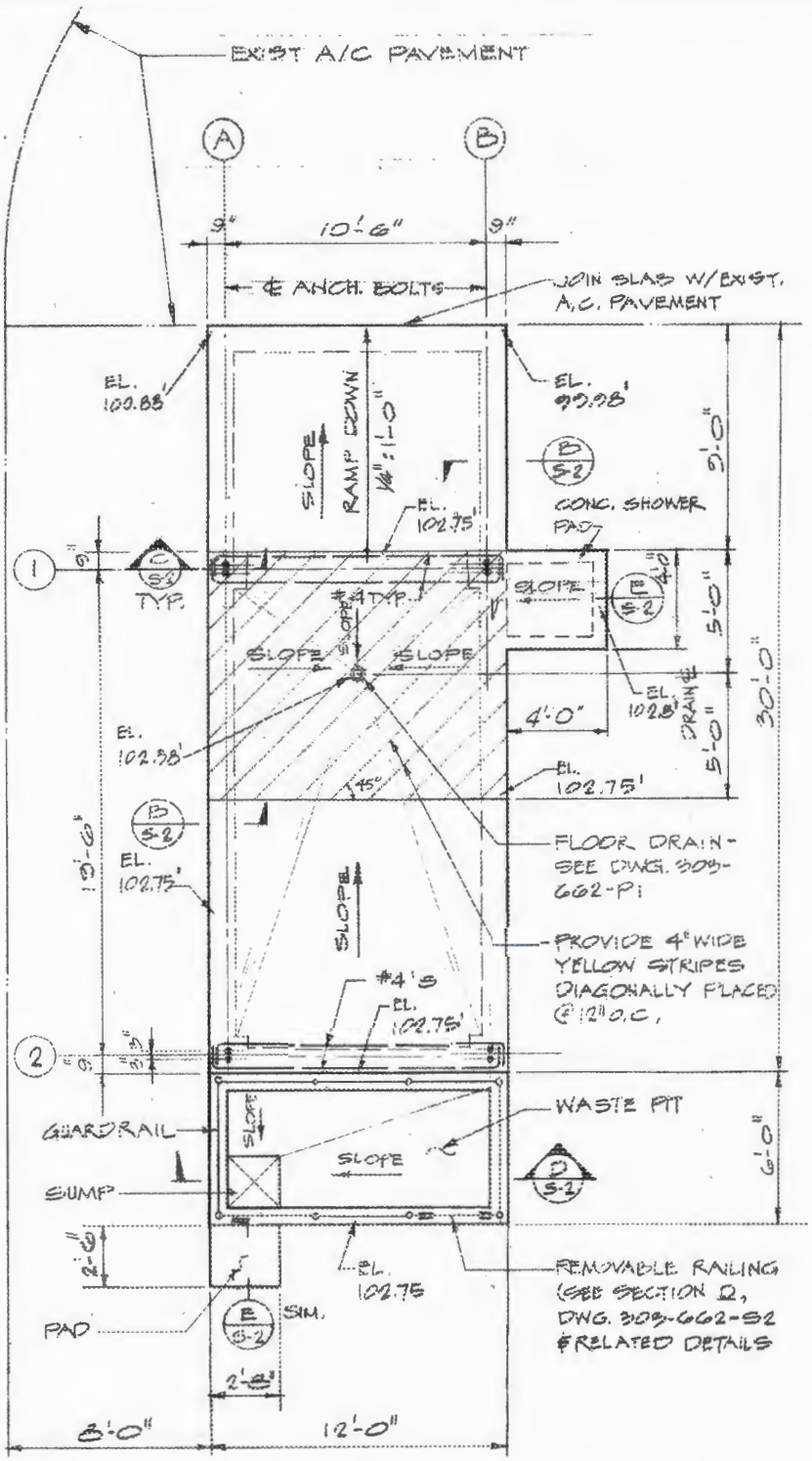
U.S. EPA Region 9

Figure 2.4.3d
Building 4463
Drainage System

Y:/Santa_Susana/EP9038/TM/HSA_5C (2-24)concretepad_4662.cdr
Project:EP9038
Revised: 08/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.4.4a
Concrete Pad 4662
Site Photograph



FOUNDATION PLAN

1/4" = 1'-0"

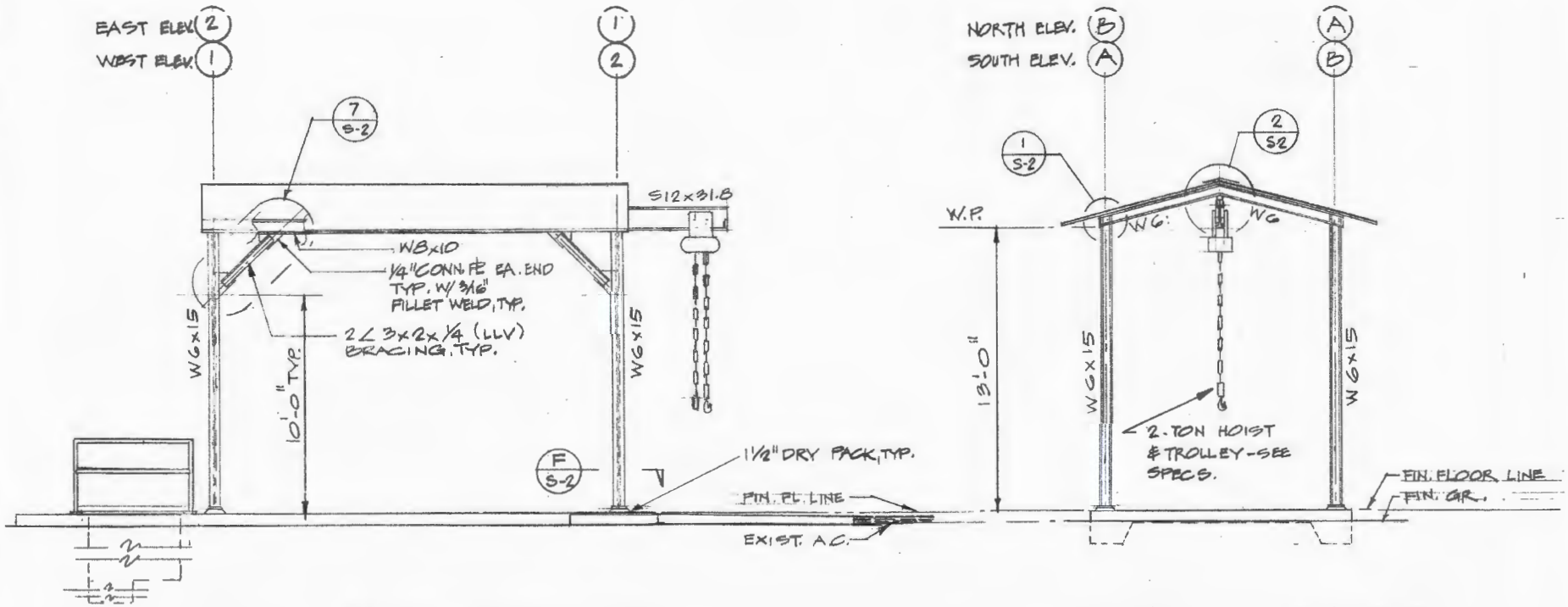
N

Figure Not to Scale

Y:/Santa_Susana/EP9038/TM/HSA_5C/(2-24)bldg662FP_Portrait.cdr
Project:EP9038
Revised: 08/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.4.4b
Building 4662
Foundation Plan



EAST ELEVATION; WEST ELEVATION SIM. & OPP. HAND

1/4" = 1'-0"

NORTH ELEVATION SOUTH ELEVATION SIM.

1/4" = 1'-0"

N

Figure Not to Scale

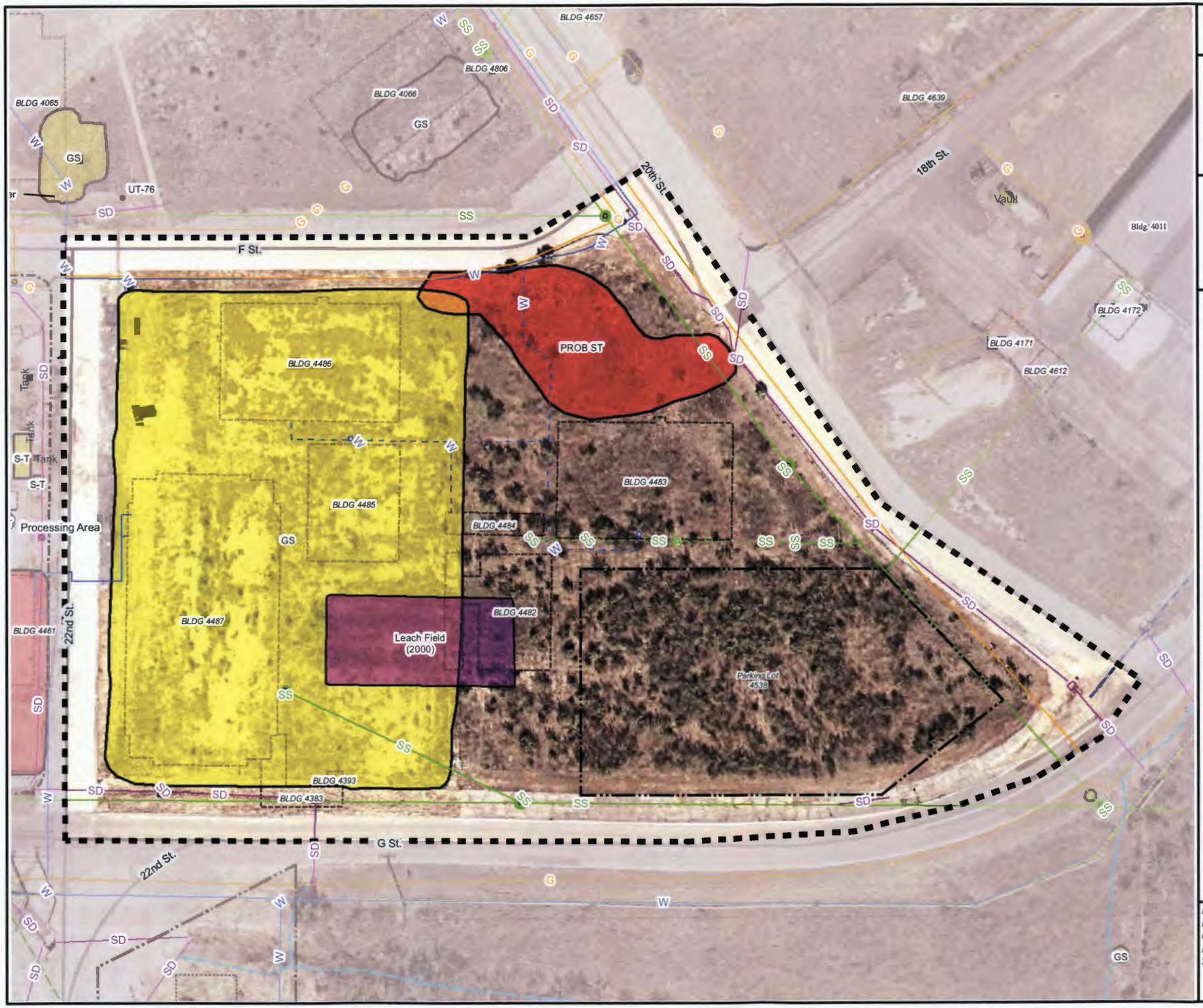
Y:/Santa_Susana/EP9038/TM/HSA_5C (2-24)bldg4662EV_LS.cdr
Project:EP9038
Revised: 08/23/2010
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.4.4c
Pad 4662
Elevation View

Figure 2.5
Area IV Subarea 5C-5
Santa Susana Field Laboratory

U.S. EPA Region 9



Legend

- Sub-Area 5C-5 Boundary
- Primary Roads
- Secondary Roads
- Tertiary Roads
- Underground Storage Tank
- Unknown Tank Type
- French Drain Holding Tank
- Sump
- Dry Well
- Tank Footprint
- Above ground Storage Tank
- Demolished Bldg.
- Existing Bldg.
- Parking Lots
- Drainage
- Drainage Ditch
- Interview Line
- Offsite Seeps and Springs
- Onsite Seeps and Springs
- Drain
- Well

Aerial Photo Features

- Priority 1
- Priority 2
- Processing Area (Priority 1)
- Excavation

Historical Data

- Chemical Use Area / Debris Field
- Excavation
- Leach Field / Septic Tank
- Open Storage

Surface Water

- Intermittent Stream
- Permanent Stream
- Surface Water
- Lined Channel
- French Drain
- Drainage
- Leach Field
- Septic System

Aerial Photo Descriptors

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
VT	Vertical Tank
WDA	Waste Disposal Area

Utilities

- Channel
- Drain
- Drain
- Drainage Divide
- Gutter
- Tank
- Tank
- Vault
- Well
- Water (Removed)
- Water (Removed)
- Pipes (Unknown Type)
- Pipes (Unknown Type)
- Gas
- Storm Drain
- Sanitary Sewer
- Water

Surface Water Flow
(From Boeing Database, 2008)

N

0 25 50 100
Scale In Feet

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Revised: 08/23/2010 TJ
Sorce: Boeing Company, 2008
CIRGIS, 2007

HGL HydroGeoLogic, Inc.

Redacted

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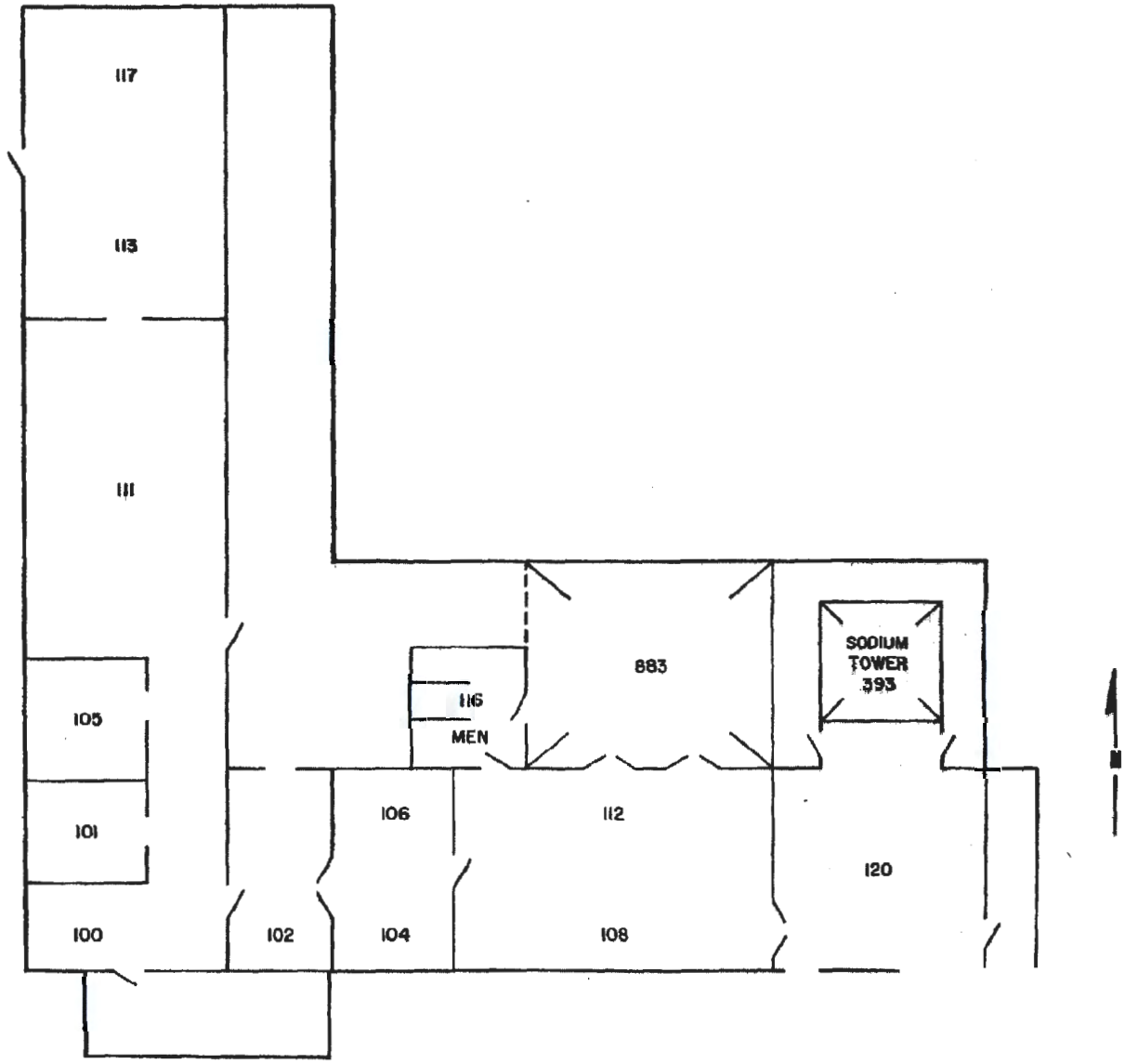
Project:EP9038
Revised: 08/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.5.1a
Building 4383
Site Photograph



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Revised: 08/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.5.1b
Building 4383
Floor Plan

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Project:EP9038
Revised: 08/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.5.2a
Building 4482
Site Photograph

Y:/Santa_Susana/EP9038/TM/HSA_5C (2-16)bldg_4483.cdr
Project:EP9038
Revised: 08/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.5.3a
Building 4483
Site Photograph

Y:/Santa_Susana/EP9038/TM/HSA_5C (2-17)bldg_4484.cdr
Project:EP9038
Revised: 08/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.5.4a
Building 4484
Site Photograph

Y:/Santa_Susana/EP9038/TM/HSA_5C (2-18)bldg_4485.cdr
Project:EP9038
Revised: 08/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.5.5a
Building 4485
Site Photograph

Y:/Santa_Susana/EP9038/TM/HSA_5C (2-19)bldg_4486.cdr
Project:EP9038
Revised: 08/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.5.6a
Building 4486
Site Photograph

Y:/Santa_Susana/EP9038/TM/HSA_5C (2-20)bldg_4487.cdr
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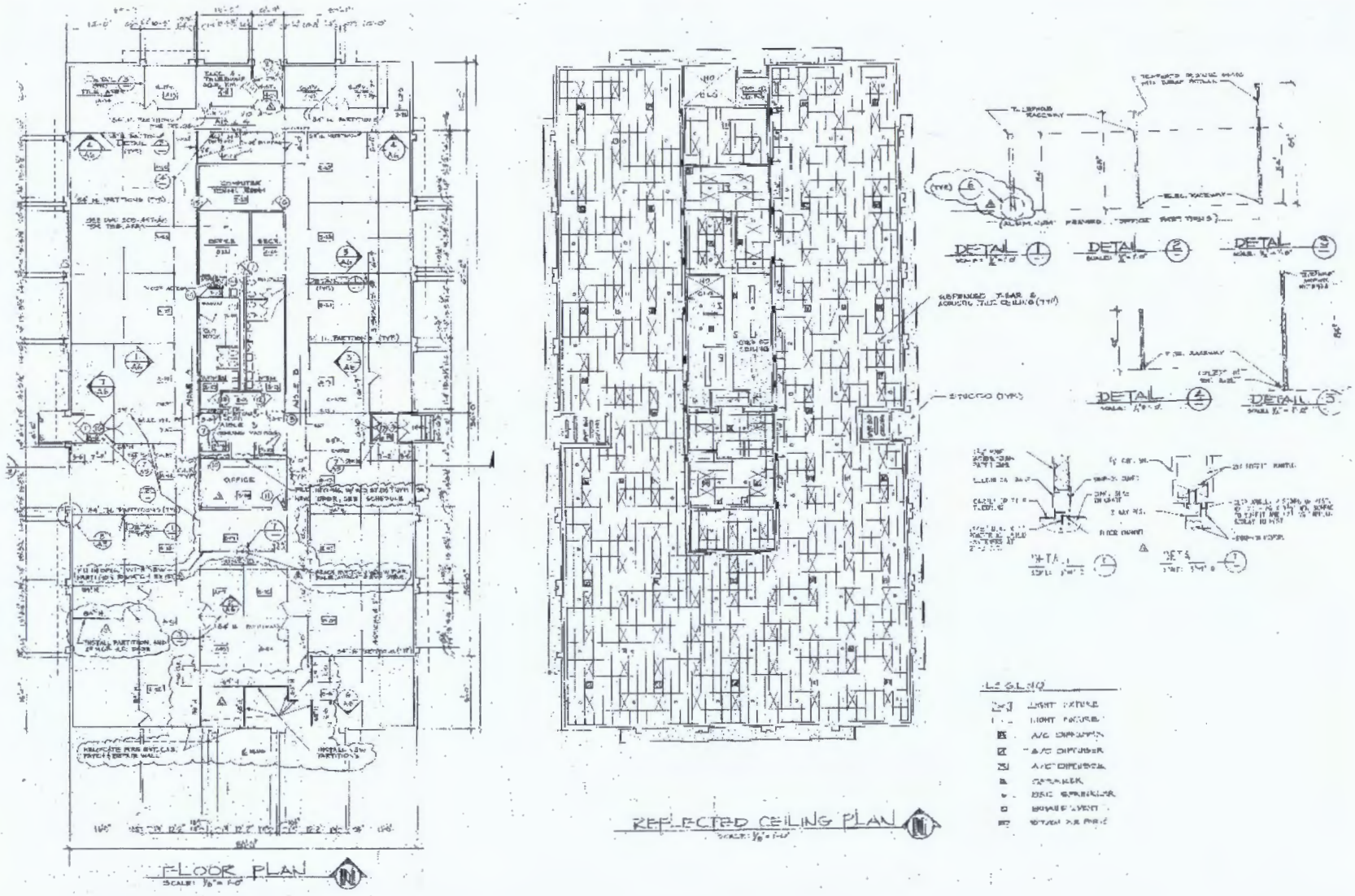
Revised: 08/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.5.7a
Building 4487
Site Photograph



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Revised: 08/20/2010 TJ
Source: Boeing Company, 2008

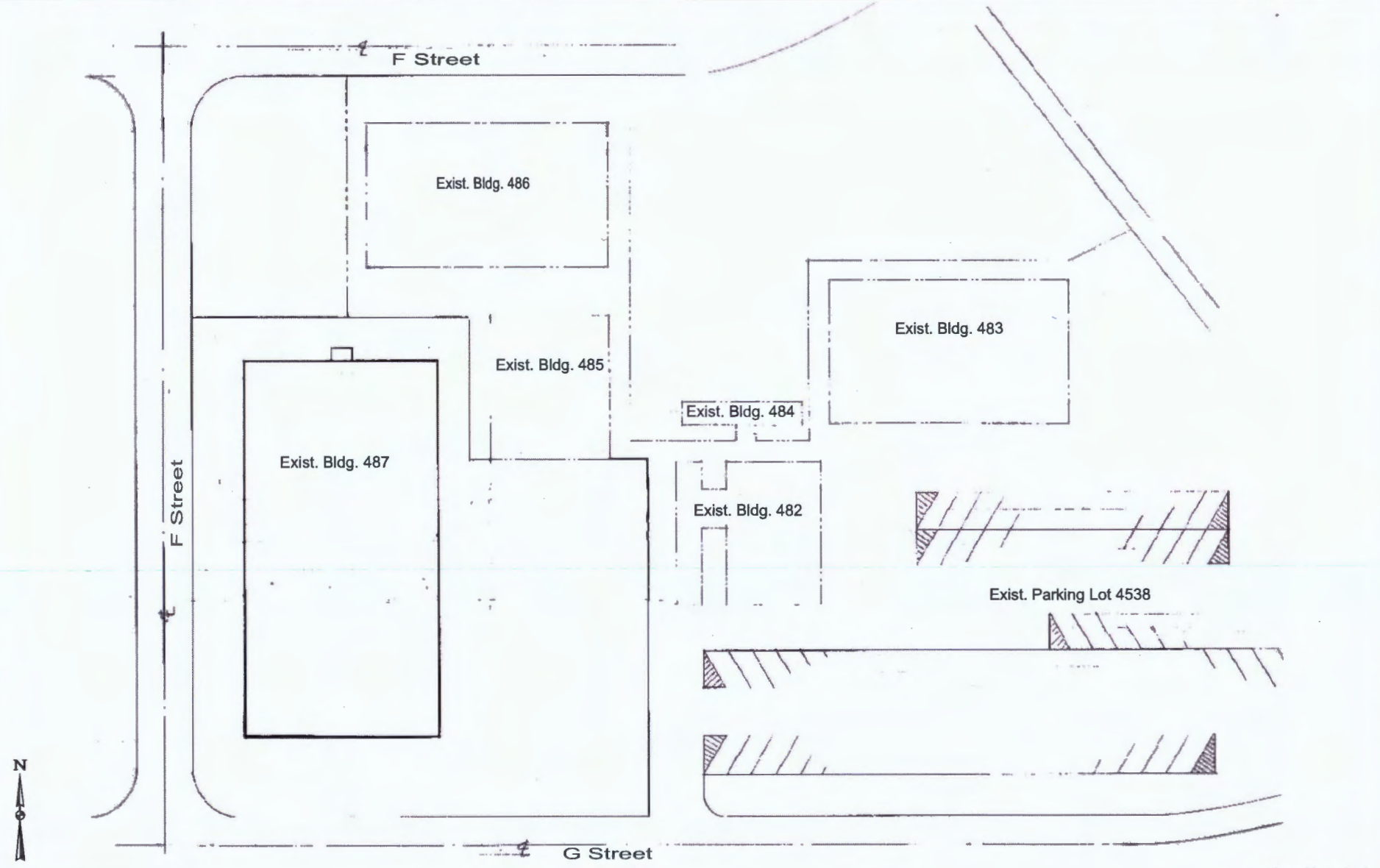
U.S. EPA Region 9

Figure 2.5.7b
Building 4487
Floor Plan

Y:/Santa_Susana/EP9038/TM/HSA_5C (2-21)bldg_4538.cdr
Project:EP9038
Revised: 08/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.5.8a
Parking Lot 4538
Site Photograph



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Project:EP9038
Revised: 08/23/2010
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.5.8b
Parking Lot 4538

Figure 2.6
Area IV Subarea 5C-6
Santa Susana Field Laboratory

U.S. EPA Region 9

Legend

- Sub-Area 5C-6 Boundary
- Primary Roads
- Secondary Roads
- Tertiary Roads
- Underground Storage Tank
- Unknown Tank Type
- French Drain Holding Tank
- Sump
- Dry Well
- Tank Footprint
- Above ground Storage Tank
- Demolished Bldg.
- Existing Bldg.
- Parking Lots
- Drainage
- Drainage Ditch
- Interview Line
- Offsite Seeps and Springs
- Onsite Seeps and Springs
- Drain
- Well

Aerial Photo Features
- Priority 1
- Priority 2
- Processing Area (Priority 1)
- Excavation

Historical Data
- Chemical Use Area / Debris Field
- Excavation
- Leach Field / Septic Tank
- Open Storage

Surface Water
- Intermittent Stream
- Permanent Stream
- Surface Water
- Lined Channel
- French Drain
- Drainage
- Leach Field
- Septic System

Aerial Photo Descriptors

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
VT	Vertical Tank
WDA	Waste Disposal Area

Utilities
- Channel
- Drain
- Drain
- Drainage Divide
- Gutter
- Tank
- Tank
- Vault
- Well
- Water (Removed)
- Water (Removed)
- Pipes (Unknown Type)
- Pipes (Unknown Type)
- Gas
- Storm Drain
- Sanitary Sewer
- Water

Surface Water Flow (From Boeing Database, 2008)

N

0 25 50 100
Scale In Feet

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CIRGIS, 2007

HGL HydroGeoLogic, Inc.

Redacted

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Project:EP9038
Revised: 08/23/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.6.1a
Parking Lot 4573
Site Photograph

RESPONSE TO COMMENTS

Summary of Stakeholder Comments on Revised Draft HSA-5C Technical Memoranda Issued on August 25, 2010
Historical Site Assessment, Santa Susana Field Laboratory Site
Area IV Radiological Study, Ventura County, California

Item	Comment	Response
6	Page 3, Paragraph 1 - The use of the MARSSIM DCGLw to define and distinguish between MARSSIM Class 1, 2, or 3 areas is only meaningful when DCGLws of similar or greater than background concentrations are used. Post SB 990, the DCGLw 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, • Location within the ETEC boundary • Proximity to SNAP building 4059 • Proximity to storm water channels leading from 4059, 4100, 4009, 4020 or 4373 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.

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7	Page 7, 1st Paragraph. Change "California Department of Public Health and Environment (CDPHE)" to "California Department of Public Health (CDPH)" Correct all subsequent references to CDPHE.	Agreed. This change will be made on subsequent TMs.
8	Page 7, 2nd Paragraph. Change "August 31" to "August 20". Add after third sentence "On June 11, 2010, Boeing provided to EPA a complete set of all RFI Group reports that had previously been made available to the public on the DTSC web site."	Agreed. This change will be made on subsequent TMs.
9	Page 7, Last Paragraph. Boeing alone has provided almost 87,000 documents, of which over 84,000 were provided on August 20, 2009. EPA refers to screening only 30,000. When is Appendix A available?	Agreed. This typographical error will be correct on subsequent TMs. Appendices were provided on CD-ROM at the HSA-5C technical breakout session. Appendices for other TMs will be made available on the EPA SharePoint website.
10	Page 8, 1st Paragraph. When is Appendix B available?	Agreed. Appendices were provided on CD-ROM at the HSA-5C technical breakout session. Appendices for other TMs will be made available on the EPA SharePoint website.

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11	Page 8, Section "Previous Rad Investigations" 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" 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 in this passage will be deleted from future TMs. The DTSC/DOE Administrative Order on Consent (AOC) will be referenced as the effective reference regarding determination of cleanup levels in SSFL Area IV and the Northern Buffer Zone.
12	Page 18, 1st Bullet. The values quoted for H-3 and Ni-63 are Boeing data not ORISE data. The 2004 ORISE verification report did not report any ORISE data for Ni-63. The highest ORISE H-3 data was reported at 5.1 pCi/g.	Agreed. The revised text for the first bullet on Page 18 will be replaced with the following: "In October 2004, ORISE conducted an independent verification survey and found that other than naturally occurring radionuclides, only H-3 was present. The maximum concentration found was 5.1 pCi/g wet weight, which is less than the 7 pCi/g minimum detectable concentration."

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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13	Page 20, Paragraph 5. The reactor core was not removed in 2004. The core was removed in early 1970 following completion of S8DR testing in December 1969. The building shell and concrete cells and foundations were removed in 2004.	Agreed. The revised text for the third sentence in Paragraph 5 on Page 20 will be replaced with the following: "The building shell and concrete cells and foundations were removed in 2004 after which the large excavation area was backfilled with soils that had been removed from the excavation."
14	Page 40, Paragraph 4. The Computer Aided Tomography operations were conducted during the period from the late 1980s and 2008. I made this same comment in the first draft.	Agreed. The revised text for the penultimate sentence in Paragraph 4 on Page 40 should be replaced with the following: "From the late 1980s until 2008, the high bay was used for high energy Computer Aided Tomography (CAT)."
15	Page 45, Section, Radiological Contamination Potential. Change "waste water" to "storm water"	Agreed. The section "Radiological Contamination Potential" on Page 45 will be replaced with the following: "The preliminary MARSSIM Classification for the Building 4461 area is Class 1, due to its location within ETEC and because of the proximity of Building 4461 to the storm drain that collected drainage from Buildings 4009, 4020, and 4100."
16	Page 48, Section, Radiological Contamination Potential. Change "waste water" to "storm water"	Agreed. The section "Radiological Contamination Potential" on Page 45 will be replaced with the following: "The preliminary MARSSIM Classification for the Building 4462 area is Class 1, due to its location within ETEC and because of the proximity of Building 4462 to the storm drain that collected drainage from Buildings 4009, 4020, and 4100."

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17	Page 53, Section, Radiological Contamination Potential. Change "waste water" to "storm water"	Agreed. The section "Radiological Contamination Potential" on Page 53 will be replaced with the following: "The preliminary MARSSIM Classification for the Site 4662 area is Class 1, due to its location within ETEC, because of the proximity of Site 4662 to the storm drain that collected drainage from Buildings 4009, 4020, and 4100, and because Site 4662 is located northwest of a sometimes liquid-filled impoundment."
18	Page 74, Paragraph 1. 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 building 4059 was not included in the SNM-21 license because building 4059 was owned by the federal government, not by NAA or Rockwell. The critical facilities in building 4100 (which was owned by (NAA and Rockwell) was not included in the SNM-21 license because they were required to have a separate reactor license, namely CX-17 (as discussed in section 3.2). Therefore SNM-21 is not relevant to the nuclear facilities discussed in subarea 5C, 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. Subsection 3.1 will be deleted because it does not apply to HSA-5C.

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19	Page 75, Last Paragraph. 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. The only building within subarea 5C that was, and is, on the California Radioactive Materials License is the company owned Building 4100 that housed a calibration lab., a counting lab., and used company owned calibration sources.	Agreed. The last paragraph on Page 75 will be replaced with the following: "This license covered the use and possession of radioactive materials in Building 4100 that housed the calibration laboratory, a counting laboratory, and used company owned calibration sources. 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."
20	Page 76, 1st Paragraph. License 0015-70 was renumbered to 0015-19 on December 5, 1996. As of August 27, 2010 there have been a total of 110 amendments.	Agreed. The first paragraph on Page 76 will be replaced with the following: "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 a total of 110 amendments to this license."
21	Page 76, Section 3.4. Promethium-147 was on the original list of analytes. Was it dropped? The 669 pCi/g Ag PRG should be relatively easy to detect by the laboratory.	Agreed. Promethium-147 is listed in Table 2-4 of the Master Soil FSP as an analyte that will be requested at specific facility locations such as the HOT Lab (Building 4028) and the Former Sodium Disposal Facility.

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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22	Please include my original comments from May 7th, 2010 on HSA 5-C as I feel many were not considered in the REVISED DRAFT of August 2010, most notably, we need to see more historical photography, photos of an overgrown field are no help in understanding the operations of the past. This document can be found here...http://www.acmela.org/images/ACME_Comments_on_the_EPA_Technical_HSA_Memo_May_7_of_2010.pdf	Agreed. Additional historical photographs and maps/drawings, including utilities such as sanitary and storm drainages, were added as available to subsequent TMs in response to the original comments.
23	Starting with Figure 2.4.4b of the HSA-5C Revised Tech Memo (RTM) that features the SSFL AREA IV Building 4662 Foundation Plan includes an area that is referred to as "Waste Pit" with a Sump located within the pit, this should be investigated in more detail. Where does this drain into, is there a schematic of any said pipelines and are there any documentation found about such waste releases? Answering these questions would help in the identification of potential radiological or chemical contamination.	Agreed. The waste pit is located at the south end of the concrete slab and was used to collect the sodium-contaminated effluent however, it is not clear where the effluent was transferred to for disposal nor have records such as incident reports been found that describe spills. A single targeted sample location was placed in the soil immediately south of the waste pit to investigate potential past spills in this area. In addition, the waste pit is located within a complex that is planned for demolition, which will be followed by a soil verification sampling effort, in accordance with the December 2010 AOC, to ensure that chemical and radiological contamination in soil above site cleanup level is not left behind.

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24	Figure 2.4.3d of HSA-5C RTM features the Building 4463 Drainage System and in the past, comments have been made regarding this Alcohol Drainage Pond. The concern is/was, that it has never been properly characterized. Core-hole drilling should be completed with instruments lowered into the borings to monitor the amounts of radiation that could have potentially leached out of this pond. Another concern in Figure 2.4.3d is the area labeled "VEE" Ditch as it describes "Pipe to be supported at all places except over existing ditch" this area should be treated of an Area of Concern (AOC) as it could have been a potential source of leakage. This pipe should be included in Figure 2.4 of HSA-5C RTM as currently it is not.	Agreed. The response to this comment is similar to Comment 21 above in the sense that the pond and the "vee" ditch are located within a facility that is planned for future D&D. It is EPA's understanding that the pond and the ditch will be completely removed at that time and the soil underneath these units will be sampled and analyzed for chemical and radiological constituents to verify that levels above corresponding background values are not left behind.
25	Figure 2.1.2c of HSA-5C RTM, the Utility Plan of Building 4059, there is an area that reads "Remove Plug and Connect to Exist 1! Plug Valve" Since this removal is noted, the area should be scanned for potential contamination. There is an Emergency Shower near the Liquid Nitrogen Storage as well that needs to be addressed, as typically employees were washed down after personal contamination. As all maps, North should be noted in this drawing, as currently it is not. We need to see more photos of the Building 4059 Demolition as it could give us answers to sources of storage and stockpiling during D & D and this could give EPA a better idea on where to investigate potential spillage.	Agreed. The "North" arrow will be placed in this figure. Most if not all of the soil excavated at this location during D&D was staged temporarily north of Buildings 4012 and 4013 and then placed back into the excavation. The footprint of the excavation area is being characterized by EPA by collecting surface and subsurface soil samples.

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26	There is a Dry Well located between Buildings 4057 and 4038 and an excavation needs to be performed under strict supervision, as this is a highly probable source of contamination. The same care needs to be taken in all former sink and restroom areas as many employees interviewed said it was common practice to dispose of, or rinse off contaminated items in these areas. Recommendation would be to tent these areas before excavation occurs, as airborne particles could be a potential health threat to the surrounding communities. (See Inflatable Version Below)	Agreed. This dry well served Building 4057 and is located 12 feet from the facility south wall. It is approximately 3 feet in diameter and 6 feet deep with a surface asphalt flush mount installation for access. This dry well will be removed during the D&D of this facility at a future date. Verification sampling of the remaining soil and excavation will be conducted both during and after the facility D&D by EPA and DTSC to ensure that impacted soils are not left behind. Potential contamination currently below facility structures, if encountered, will be removed during facility D&D.
27	The Rocks to the West of building 59 should be looked into and screened as the Building 59 smokestack was at the same height as these rocks and could have left an imprint of radiation. It should be noted that on February 12th of 1970 in the Building 59 Test Vault during the D & D of the SNAP 8 DR a Vacuum Filter ruptured contaminating various areas. This contamination in a typical scenario would have been vented, validating my concern.	Agreed. Surface radiological contamination (if any) in this rock area west of this building will be evaluated as part of the gamma survey for Subareas 7, 8N, and NBZ-NW.
28	Again, I think it is critical that EPA understands that ALL the Sewers run from the HSA 5-C reporting area, connect to the AREA III Sewage Treatment Plant and contamination should be followed as per the Multi-Agency Radiation Survey & Site Investigation Manual (MARSSIM). See Below Map for Reference.	Agreed. The scope of the soil investigation described in the Subarea 5C Addendum to the FSP for Soil Sampling includes 18 drainage samples to be collected over the storm runoff network of conveyances within Subarea 5C.

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29	The EPA presentation at the last technical meeting regarding contacting former employees had said that the return rate had been very low. I would suggest that the Oil, Chemical & Atomic Workers International Union be contacted and request that their files be looked into for current contact information on former SSFL workers. http://www.webshells.com/ocaw/ The National Institute for Occupational Safety and Health (NIOSH) should be contacted as well, and their employee accident files that are submitted by claimants should also be investigated. http://www.cdc.gov/niosh/	Noted. EPA interviewed approximately 50 former employees and DOE interviewed over 100 former employees. Information from both interview programs are being integrated into EPA's HSA TMs. EPA believes that this interview program has been quite thorough and helpful during EPA's Round 1 soil sampling program. No further interviews are anticipated at this time.
30	The above 1959 Article in the Simi Valley Enterprise, printed before the Sodium Reactor Experiment incident needs to be investigated as per which area was contaminated with Radioactive Tritium. An employee retained an attorney against North American Aviation & Atomics International seeking $150,000 in damages. By further investigation the EPA can identify the location and building number(s) alleged in this suit as Tritium is a problem at the SSFL. Many sources of Tritium have been disputed over the years, a special investigation needs to be put in motion.	Agreed. Potential tritium source areas are being identified via EPA's HSA TMs. Tritium will be tested for in soils at the SRE, Buildings 4010, 4059, 4028, and 4024, and at the land overlying the tritium groundwater plume.
31	On page 12 of the HSA-5C RTM, Section 2.1.1, Building 4039 area, under current use it states "In 2009, a trailer appears to be located at the side of Building 4039. (Above Photo – Right, taken in 2007) The use of this trailer is unknown" This was not 1959, this is 2009, there should, for sure, be clear documentation of this trailers use. Behind the said trailer, EPA should have an investigation of the possible impacts from the Tent-like structure (Above Left Photo, taken in 2007) located behind this said trailer. Something this current should not be an "Unknown" unless the Responsible Parties do not want it to be known.	Agreed. The trailer noted in the HSA TM and by the commenter has been used for the past several years as a facility for copying documents contained in Building 4057. According to The Boeing Company, the "tent-like" structure has been used as portable storage in support of operations at Buildings 4024 and 4059.

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32	The Above Facilities, the Sodium Instrumentation Building (Building 4383) and the Sodium Instrumentation Tower (Building 4393 Shown Above) were designed to function under the conditions required for Sodium Graphite Reactors (SGR). The SGR program involved the development of many specialized items of equipment that were not yet available. Necessary, for the Atomics International Division (AI) of North American Aviation (NAA) as a special facility for the experimental investigation of various components and techniques. This was accomplished through the modifications of an existing structure. Within this facility instruments were developed to determine liquid level, flow, pressure and oxide content in Sodium Systems. All instruments are tested and calibrated here before installation in a reactor.	Agreed. This information will be added to the HSA 5C TM.
33	There looks to be a potential storage area to the North of the Facility (Below Photograph). These areas should be noted as potential areas of Radiological Concern.	Noted. Based on review of gamma surface scan and geophysical survey results, surface or subsurface anomalies were not identified in this area. Also, review of both the HSA findings and the results of past soil radiological characterizations in this area did not justify the placement of soil samples.
34	Below we see an aerial view of Buildings 4383 and 4393 in the year 1965.	Agreed. EPA will incorporate this information into the Final HSA.
35	This is also the area of the Former Building 383 Septic Tank and should be located.	Agreed. EPA will incorporate this information into the Final HSA TM for Subarea 5C. EPA will consider this location as a potential location for Round 2 soil sampling for Subarea 5C.
36	Below is the current location of Building 4015 (Photo 2007 with grazing cow in the area).	Agreed. EPA will incorporate this information into the Final HSA TM for Subarea 5C.

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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37	The Building 4373 Leach Field could impact this group even though located outside.	Noted. This impact is possible, however, since Building 4373 is located within Subarea 5D, this potential impact will be evaluated as part of the Subarea 5D Addendum to the FSP.
38	Records should be obtained by the Landauer Dosimetry Company to see the excess of certain radiological information on employees and where they were recorded to have the highest readings (See below).	Noted. This comment was considered by EPA. However, at this time, EPA believes that the current strategy and multiple lines of evidence for locating soil samples in Subarea 5C appear sufficient.
39	The below areas were used as staging during the Demolition and Decontamination (D&D) of the Building 4059 Systems for Nuclear Auxiliary Power (SNAP) Facility. There have been many examples of using parking lots in the past as radiological storage. More study of historical photography needs to be implemented to target certain areas for a proper cleanup.	Agreed. The area just north of Buildings 4013 and 4012 footprints were used for staging of the potentially contaminated excavated soil from this D&D project. The potential impacts of this activity, namely the potential for contaminating surrounding adjacent areas, was evaluated during the preparation process for the Subarea 5B Addendum to the FSP. Eight soil sample locations were targeted in this area.
40	Please include the ACME Resource Conservation and Recovery Act (RCRA) Facility Investigation Report of the Santa Susana Field Laboratory (RFI) Group 5 Comments that were submitted in 2009 as they deal with some of these same areas. http://acmela.org/images/ACME_Group_5_Comments_DTSC_May_14th_2009.pdf	Agreed. EPA has evaluated information related to RFI Group 5, including reports and comments, and has attempted to include relevant information.

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41	The above photo should help in identifying some outdoor storage areas that could be a potential Radiological Concern. There needs to be a more in-depth study of these type of photographs. The September 2004 Presentation Poster on the Energy Technology and Engineering Center (ETEC) Website notes that the Building 59 area is a possible Tritium source and should be addressed.	Agreed. The analytical suite for soil samples collected at the Building 4059 will include Tritium.
42	It should be noted that on February 12th of 1970 in the Building 59 Test Vault during the D& D of the SNAP 8 DR a Vacuum Filter ruptured contaminating various areas. Again in February of 1970, there was a reported incident where an employee was cutting a NaK Line in Pipe Chase Room in Building 59 that caused a fire. This report should be obtained and looked into further.	Agreed. This information was included in the revised draft HSA-5C TM.
43	Below are two links that I would like to submit to help understand the operations in the HSA 5-C area. The first document located on the link below is the Characterization of Atomics Internationals SNAP Fuels from 1966-1973. http://acmela.org/images/SNAP_Fuels_Characterization_1966_thru_1973.pdf and this link below explaining the uses of Liquid Metals within the HAS 5-C area...http://acmela.org/images/PWR_LM_Molten_Salt_Testing.pdf	Agreed. This information was included in the revised draft HSA-5C TM.

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44	The below photo is taken from outside of Building 19 and should be noted that this area was used for staging of debris, soil and water that could have a potential impact. There are also documents that note a Reservoir under this facility and there is a large welded cap of a circle larger than 10 feet across. More investigation of the past operation of this facility need to included in the HAS 5-C section.	Agreed. This facility is standing today and EPA considers this building area as a D&D likely remediation zone. All above and below ground structures, components, and ancillaries will be removed during the D&D of this facility at a future date. Verification sampling of the remaining soil and excavation will be conducted both during and after the facility D&D by EPA and DTSC to ensure that impacted soils are not left behind. Potential contamination currently below facility structures, if encountered, will be removed during facility D&D.
45	The majority of the HAS 5-C of the Santa Susana Field Laboratory (SSFL) AREA IV surface drainage of the SSFL drains into the Los Angeles River via Bell Creek, yet this reporting area is a portion of the 257 acres of northern surface of the total 2850 acres of the SSFL that drain onto the Simi Valley side onto the property of the American Jewish University's Brandeis-Bardin Campus.	Agreed. Clarifications to drawings and descriptions of site drainages have been incorporated into the revised HSA-5C TM.
46	Yet all the Sewers run from the HAS 5-C reporting area connect to the AREA III Sewage Treatment Plant and contamination should be followed as per the Multi-Agency Radiation Survey & Site Investigation Manual (MARSSIM). See Below Map for Reference.	Agreed. The scope of the soil investigation described in the Subarea 5C Addendum to the FSP includes 18 drainage samples to be collected over the storm runoff network of conveyances within Subarea 5C.

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47	In the bibliographical references at the bottom of each page in the HAS 5-C any reference to DTSC –SSFL should be confirmed with the Department of Toxic Substances Control (DTSC) as they have created a new website and this one is to be inactive. These documents should be referenced in their current location, as this public information is important. Also, some of the other reference materials should be place on the EPA Website as a downloadable document for an easier public reference.	Agreed. Any reference source cited from a website has been downloaded and stored along with the other documents reviewed for this TM. Therefore, even if the link becomes inactive at a future date, the information will be retained.
48	Building Numbers are cut off in some cases incomplete. Where the number belongs and almost make out what number is to be placed there. Please check all of these map pages. On page 19, there is a missing building (4374 - The Test Loop Enclosure).	Agreed. Improvements and clarifications have been made to the plates and accompanying figures presented in subsequent TMs. FSP maps and drawings also provide additional details.
49	On Page 49 where you see the location of Building 4450 (Which Reads 445 and a blank spot where the "0" should be) this was the former location of Building 4459 - The Uninterruptible Power Supply and should be noted as such (As per the Facilities Engineering Map created by R.K. Boyles for Rockwell International in 1984).	Agreed. Significant revisions were made to this and other drawings and are presented in the revised HSA-5C TM.
50	The above map shows how the boundaries were not always divided up as AREA's I, II III & IV and older Plot Plans should be investigated in terms of Building Locations and Compared to Current & Former and what the past operations were.	Noted. EPA's radiological study is defined as the current Area IV boundary plus the northern undeveloped land.

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51	Some of the areas that are removed and reused should be looked into closer than usual in the example of Building 4065 - ETEC Chemistry Lab and the fenced yard behind building 38 (Below) that now has a structure covering it from the expansion of Building 4038.	Agreed. Building 4038 is standing today. Therefore, EPA considers this building area as a D&D likely remediation zone. All above and below ground structures, components, and ancillaries will be removed during the D&D of this facility at a future date. Verification sampling of the remaining soil and excavation will be conducted both during and after the facility D&D by EPA and DTSC to ensure that impacted soils are not left behind. Potential contamination currently below facility structures, if encountered, will be removed during facility D&D. The same approach applies to the former location of Building 4065 because although the building has been removed, the concrete facility slab was left in place.
52	I would like Gregg to explain the process in the above photo and if it's a concern.	Noted.
53	The pond next to concrete pad 4662 of the SPTF is a concern and should be noted more with further investigation needed. In the above photo it appears to be Unlined.	Agreed. This concrete pond facility is standing today. Therefore, EPA considers this facility area as a D&D likely remediation zone. All above and below ground structures, components, and ancillaries will be removed during the D&D of this facility at a future date. Verification sampling of the remaining soil and excavation will be conducted both during and after the facility D&D by EPA and DTSC to ensure that impacted soils are not left behind. Potential contamination currently below facility structures, if encountered, will be removed during facility D&D.

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Area IV Radiological Study, Ventura County, California

Item	Comment	Response
54	The Above photo shows the pond next to concrete pad 4662 of the SPTF noted as IMPOUNDMENT. We also see OPEN STORAGE, which could be the area of the Building 100 Trench. The exact location of the building 100 Trench should be noted as it has been disputed over the years.	Agreed. This concrete pad facility is standing today. Therefore, EPA considers this facility area as a D&D likely remediation zone. All above and below ground structures, components, and ancillaries will be removed during the D&D of this facility at a future date. Verification sampling of the remaining soil and excavation will be conducted both during and after the facility D&D by EPA and DTSC to ensure that impacted soils are not left behind. Potential contamination currently below facility structures, if encountered, will be removed during facility D&D. With respect to the Building 4100 trench, two potential locations have been noted by EPA; one potential location was sampled in accordance with the Subarea 5C Soil FSP Addendum and the other location is under the Building 4662/4463 facility and therefore will be removed during D&D work.
55	On Page 64 it should be noted that the Computerized Tomography (CT) Scanner is the property of NASA and was featured in a National Geographic program where a dinosaur was investigated with this machine. http://news.nationalgeographic.com/news/2007/12/photogalleries/dinosaurpictures/photo4.html	Agreed.
56	Building 100 was also used for the Advanced Epithermal Thorium Reactor (AETR).	Agreed. This information was included in the revised draft HSA-5C TM.
57	In closing, the last two pages of the Draft HAS (Summary of Subarea HAS-5C Sites) should not have conclusions of "None Specifically Identified" in the areas of Potential Radiological Contaminants of Concern.	Agreed and changed on subsequent 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.

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VOLUME V

FINAL
TECHNICAL MEMORANDUM
SUBAREA HSA-5D
HISTORICAL SITE ASSESSMENT
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.
Northway 10 Executive Park
313 Ushers Road
Ballston Lake, New York 12019

October 2012

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HGL

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LIST OF ACRONYMS AND ABBREVIATIONS

AEC	U.S. Atomic Energy Commission
AETR	Advanced Epithermal Thorium Reactor
AOC	Administrative Order on Consent
ARRA	American Recovery and Reinvestment Act
Atomics International	Atomics International Division of North American Aviation, Inc.
ATS	above ground storage tanks
µCi/cc	micro Curies per centimeter cubed
CDPH	California Department of Public Health
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
Ci	Curie
COC	Contaminants of Concern
cpm	counts per minute
D&D	decontamination and decommissioning
DHS	Department of Health Services
DOE	Department of Energy
dpm/100 cm^2	disintegrations per minute per 100 centimeters squared
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
FHM	fuel handling machine
ft^2	square feet
HEPA	high-efficiency particulate air
HGL	HydroGeoLogic, Inc.
HP	Health Physicist
HSA	Historical Site Assessment
kW	kilowatt
LMEC	Liquid Metal Engineering Center
µR/hr	micro roentgen per hour
mR/hr	milli roentgen per hour
mrad/hr	millirad per hour
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MDA	minimum detectable activity
mrem	Milli Roentgen Equivalent in Man
MWd	megawatts day
NASA	National Aeronautics and Space Administration
NBZ	Northern Buffer Zone

NDA	no detectable activity
NRC	Nuclear Regulatory Commission
OMRE	Organic Moderated Reactor Experiment
ORAU	Oak Ridge Associated Universities
ORISE	Oak Ridge Institute for Science and Education
pCi/g	picocuries per gram
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
SCA	SNAP critical assembly
SEFOR	Southwest Experimental Fast Oxide Reactor
SETF	SNAP Environmental Test Facility
SGR	sodium graphite reactors
SHEA	Safety Health and Environmental Affairs
SNAP	Systems for Nuclear Auxiliary Power
SRE	Sodium Reactor Experiment
SSFL	Santa Susana Field Laboratory
Tetra Tech	Tetra Tech EM, Inc.
TM	technical memorandum
TO	task order
TRU	Transuranic

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TEXT

FINAL
TECHNICAL MEMORANDUM
SUBAREA HSA-5D
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 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-5D. This TM, along with subsequent 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 TM 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 may be revised.

1.2 GOALS AND METHODOLOGY OF THIS TM

This TM is focused on radiological information within subarea HSA-5D and the drainage channels that lead to and from this area. The location of subarea HSA-5D is shown on Figure 1.3. Plate 1 presents a summary of the features related to potential radiological sources identified within the HSA-5D subarea. Detailed information pertaining to the use of radioactive materials and the potential release of radionuclides at sites and buildings within HSA-5D are provided in Sections 2 and 3 of this TM. Preliminary findings specific to HSA-5D 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 (COC).

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-5D. 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 utilize nuclear energy through its Atomics International (AI) Division.[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.

Table 1.2
Research Reactors Located at the Santa Susana Field Laboratory[4]

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 (SRE)	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

[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
[4] 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[1]

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.[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 has been 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]

Table 1.3
Criticality Test Facilities at the Santa Susana Field Laboratory[4]

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] 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
[4] 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 down slope to surrounding populated areas.[1] The NBZ was purchased by 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-5D

Subarea HSA-5D is approximately 71.5 acres of flat land that contained 20 buildings and 2 aboveground storage tanks (AST) over the years. It includes G, J, and K and 22nd through 24th Streets. Drainage is generally to the east along roadways and surface drainages to a 3,000,000-gallon reservoir located within SSFL. There are no ponds in this subarea. Primary radiological operations in the HSA-5D area related to the SNAP programs as well as to the Hot Laboratory and the Nuclear Material Development Laboratory. The majority of radiological operations in Subarea 5D occurred in the Hot Laboratory or the Nuclear Material Development Laboratory. The Hot Laboratory was used to examine irradiated nuclear fuel assemblies, SNAP Reactor cores, irradiated test materials, radioactive sources, and to declad irradiated plutonium bearing fuels. The Nuclear Material Development Laboratory contained a series of glove boxes which were designed to work with nuclear fuels and radioactive materials.

1.5 SITES IN HSA-5D

During the peak of operations, Subarea HSA-5D comprised 21 sites, 20 buildings and 1 site consisting of ASTs. This technical memorandum addresses each of these 21 sites within Subarea HSA-5D. Of the 21 sites, 1 was a critical facility and 6 housed operations possibly involving radioactive materials, including the Hot Laboratory and the Nuclear Development Laboratory. Of the 21 sites in Subarea HSA-5D, only 1 building and 2 ASTs 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;

[1] Agency for Toxic Substances and Disease Registry, *Draft Preliminary Site Evaluation, Santa Susana Field Laboratory*, Atlanta, GA, December 3, 1999, pp.2-5.

- 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 off-site 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 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. Numerous additional information requests have been ongoing and, 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. Upon receipt of supplemental documents from Boeing, EPA will carefully review the information and revise this TM and it recommendations for soil sampling, as appropriate.

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-5D TM, 2,146 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 2,146 documents relevant to past operations at facilities within HSA-5D and were therefore determined to warrant in-depth evaluation. Each of these 2,146 relevant documents was thoroughly evaluated for information considered useful for carrying out the goals listed in Section 1.2 of this TM. 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 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.

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. 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-5D according to four logical "clusters" (a.k.a. groups) based on operational characteristics and geographic locations. Plate 1 depicts the entire HSA-5D subarea and should be referenced while reading Section 2. Each HSA-5D group (discussed in Sections 2.1 through 2.4, 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-5D Group 1 are presented. HSA-5D Group 1 includes one parking lot, Parking Lot 4509.

2.1.1 Parking Lot 4509 Area

Site Description: The Parking Lot 4509 area comprises a parking lot located approximately 100 feet southeast of Building 4009, located within the boundaries of HSA-8, at the southwest corner of G and H Streets. Figures 2.1.1a through 2.1.1c provide a current photograph and the best available 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 4509. Substation Building 4709 was located southwest of the parking lot. Building 4709 was a substation that serviced Building 4009, and as a result, is discussed in the TM for HSA-8.

Former Use(s): Parking Lot 4509 appears to have been mainly used for its intended purpose.[1]

Information from Interviewees: None to date.

Radiological Incident Reports: There have been no incident reports associated with Parking Lot 4509 located to date.

Current Use: Parking Lot 4509 remains in place. 2007 aerial photographs show the storage of large containers in the area, as well as evidence of some industrial activities, although the nature of these activities is unknown.[2,3]

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): Radiological surveys specific to Parking Lot 4509 have not been conducted.

Radiological Use Authorizations: None.

[1] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 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.
[3] Channel Islands Regional GIS Collaborative (CIRGIS), 2007

Former Radiological Burial or Disposal Locations: No formal burial or disposal locations have been identified at or around Parking Lot 4509. However, as indicated in the March 2011 HSA-8 TM, until 1961, Building 4009 was connected to two septic tanks, including a 2,340-gallon septic tank on the northwest side of the building and a 6-line 300-linear-feet leach field located approximately 50 feet north of Building 4009. These were used for the disposal of sanitary and liquid wastes. Building 4009 was connected to the sewer system in 1961. Between 1961 and 1967 when OMR and sodium graphite reactors (SGR) operations ceased, the leach field was used for the disposal of liquid waste, only. In 2002, the leach field was excavated down to bedrock and removed. This area is in close proximity to Parking Lot 4509, and it is possible the parking lot was used as a staging area during the removal; however, information regarding the staging of material during the leach field removal could not be located in available documents. Additional information may become available when additional documents are received from Boeing.[1,2,3]

Aerial Photographs: Parking Lot 4509 first appears in aerial photographs in August 1959. Drainage channels are visible on the northwestern boundary of the parking lot. These drainage channels originate from the northwest corner of the parking lot and flow southwest to an escarpment southwest of Building 4009. The parking lot remains relatively unchanged until 1980 when drainage appears to flow northeast along the northwest boundary of the parking lot to G Street and then east along G Street. The storage of large containers appears in 2005 aerial photographs. 2007 aerial photographs show as many as 19 storage containers on the parking lot. There also appear to be other storage activities at and around the parking lot.[4]

Radionuclides of Concern: There are no radionuclides of concern associated with the parking lot; however, Building 4009, located northeast of Parking Lot 4509, used enriched uranium and thorium as reactor fuels during reactor operations. In addition, a Van de Graaff accelerator was housed in the SGR graphite storage area during the early 1960s. In the 1980s, the Organic Moderated Reactor high bay was later used for High-Energy Rate Forging, which included the handling of highly enriched uranium. While these operations did not occur at the Parking Lot 4509 area, there is no information to indicate that the Parking Lot 4509 was not used for staging purposes for Building 4009. As a result, the research team cannot conclude that potential radionuclides of concern at Building 4009 did not migrate to the Parking Lot 4509 area. Decay products from U-235, U-238, and Th-232 decay chains include Th-234, Th-228, actinium-228 (Ac-228), radium-226 (Ra-226), lead-214 (Pb-214), bismuth-214 (Bi-214), Pb-212, Bi212, and thallium-208 (Tl-208). In addition, H-3, Sr-90 and Cs-137, Na-24, Co-57, Co-60, europium-152 (Eu-152), and americium-243 (Am-243) would have been formed.[5] All radionuclides of concern listed, with the exception of Na-24 and Co-57 (due to relatively short half-lives), are included in the August 2010 Final Field Sampling Plan for soil sampling in Area IV. Table 3.3 presents a summary of radionuclides of concern.

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[1] ICF Kaiser Engineers, *Current Conditions Report and Draft RCRA Facility Investigation Work Plan: Volume 1*, October 1993, pp. 4-84, 4-87.
[2] Montgomery Watson Harza, *DOE Leach Fields (Area IV AOC) RCRA Facility Investigation Report, Santa Susana Field Laboratory, Ventura County, California, Draft*, October 2003, pp. 2-2, 3-4.
[3] Montgomery Watson Harza, *Group 8– Western Portion of Area IV RCRA Facility Investigation Report, Santa Susana Field Laboratory, Ventura County, California, Volume 1-Test, Tables, and Figures*, September 2007, p. 3-3.
[4] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[5] Chapman, J. A., *Radiological Survey of Building T009*, Energy Technology Engineering Center Report No. GEN-ZR-0014, August 26, 1988, pp. 10, 66, 97.

Drainage Pathways: Currently surface water in the vicinity of Parking Lot 4509 flows to the northwest, north, and northeast across the site. The northwestern boundary of the parking lot is bordered by an asphalt lined drainage channel that is associated with Building 4009. To the north-northeast is a ditch that runs east along the south side of G Street. All surface water originating from Parking Lot 4509 eventually drains into the ditch on the south side of G Street and flows east, into Area III.

Historical aerial photographs initially show the flow to be to the southwest to an escarpment southwest of Building 4009. In 1980, the flow appears to have been directed northeast along the northwest boundary of the parking lot to G Street and then east along G Street. The northeast drainage pattern is also depicted in a 1969 plot plan of the site.[1,2]

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Parking Lot 4509 area is Class 2 because of the unknown nature of current storage activities on the site and the proximity of the parking lot to Building 4009, discussed in TM HSA-8.

Recommended Locations for Soil/Sediment Sampling: Plate 1 and Figure 2.1 provide a convenient reference for the following recommendations.

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 Parking Lot 4509 area. It is recommended the characterization be included with the sampling plan identified for HSA-8.

- The perimeter of the former Parking Lot 4509, including the drainage channel located northwest of the parking lot. Residual contamination above the levels consistent with the DTSC/DOE December 2010 AOC may be present as a result of radioactive materials draining from facilities associated with Building 4009 to the northwest to the parking lot. Also, industrial activities at the parking lot may have included radioactive materials, including any staging during removal of the Building 4009 leach field or underground radioactive waste holdup tanks.

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-5D Group 2 are presented. HSA-5D Group 2 includes six building areas including Building 4020, the Hot Laboratory, Building 4468, the waste storage tank building for the Hot Laboratory, Building 4055, the Nuclear Materials Development Facility, Building 4373, the first SNAP critical facility, and Building 4374, a NaK loop building that supported Building 4373. This area also includes a suspected pond dredge area for which no information has been located, to date, and an unknown building that appears in aerial photographs in 1988 and has been removed prior to 2005.

[1] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[2] Atomics International, Santa Susana Facility Plot Plan Drawing 303-GEN-C45, Sheet 11 of 14, February 21, 1969.

2.2.1 Building 4020 Area

Site Description: The Building 4020 area includes Building 4020, Building 4323 (a guard building), and Building 4720 (a substation) and the surrounding area. Constructed in 1959, Building 4020, the Hot Laboratory, formerly the Component Development Hot Cell, was constructed for the remote handling and examination of highly radioactive materials.[1] The building was a below- and above-ground structure comprising approximately 16,000 square feet. Other buildings within the vicinity of Building 4020 included Building 4468, discussed below in Section 2.2.2. Figures 2.2.1a through 2.2.1t provide a current photograph and the best available building-specific drawing(s) and photographs that the research team could find. Plate 1 presents a summary of all identified features for this site.

Building Features: Building 4020, comprising approximately 16,000 square feet, was constructed of both reinforced normal and dense concrete. The building included a main level, as well as a basement and an attic. The basement included three sumps, while the attic included utility plumbing and piping.[2] Figure 2.2.1b provides an elevation view of Building 4020. The basement of Building 4020 was constructed of 24-inch thick concrete walls. The basement structure included five large concrete support columns that provided part of the structural support for the hot cells (see Figure 2.2.1d). A carbon-steel pipe storage tube was embedded in the center of Columns 1, 2, 3, and 5, extending vertically downward from the hot cell floor to a distance of approximately 12 feet. The three sumps in the basement were provided in support of the drain subsystem. During initial construction, the facility radioactive drain was connected to two 500-gallon holdup tanks that were located in the north end of the basement. One of the tanks was designed for high-level waste and the other for low-level waste.[3] Following an incident whereby these tanks overflowed, the system was modified by installing a 3,000-gallon tank in Building 4468 in around 1970, and removing the 500-gallon tanks in 1977. After the new system had been put into place, the contents of these sumps were pumped into the Building 4468 holdup tank, discussed below (see Figure 2.2.1e).[4,5,6]

[redacted][7,8] The operations support facilities included a hot storage room (Room 153), air lock (Room 155), hot laboratory (Room 141), manipulator maintenance room (Room 128), and glove box laboratory (Room 139).[9]

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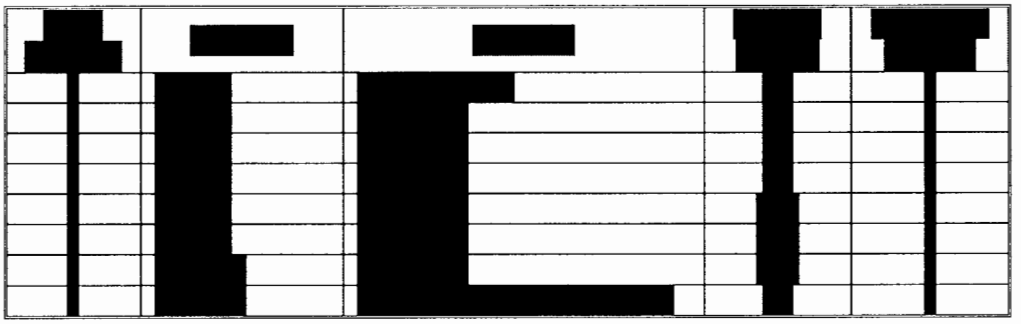
[1] Boeing, Document No. RS-00010, *Area 4020, MARSSIM Final Status Survey Report*, October 31, 2000.
[2] Rockwell International, Document No. RI/RD90-118P, *Decontamination and Decommissioning of Hot Laboratory, Building 020 SS, Volume 1, Technical Proposal for Complication of Task*, March 31, 1990.
[3] Source documents do not provide additional information to indicate whether the high-level waste is what is more traditionally defined as "HLW." Source documents also do not provide information to indicate the level of radioactivity in the waste.
[4] Boeing, EID-06141, "Hot Laboratory Decontamination and Dismantlement Final Report," November 27, 2001.
[5] Boeing, Document No. RS-00010, *Area 4020 MARSSIM Final Status Survey Report*, October 31, 2000.
[6] Badger, F.H., Rockwell International Internal Letter, *Re: Radiological Occurrence – Bldg T020*, October 3, 1977.
[7] Rockwell International, ESG-82-33, *Health and Safety Sections for Renewal Application of the Special Nuclear Materials License SNM-21, Docket 70-25, Issued to Energy Systems Group of Rockwell International*, June 5, 1984.
[8] Atomics International, *Atomics International Hot Laboratory Capabilities and Facilities*, Date Unknown.
[9] Boeing, EID-06141, "Hot Laboratory Decontamination and Dismantlement Final Report," November 27, 2001.

[1] Rockwell International, ESG-82-33, *Health and Safety Sections for Renewal Application of the Special Nuclear Materials License SNM-21, Docket 70-25, Issued to Energy Systems Group of Rockwell International*, June 5, 1984.
[2] Atomics International, *Atomics International Hot Laboratory Capabilities and Facilities*, Date Unknown.
[3] Rockwell International, ESG-82-33, *Health and Safety Sections for Renewal Application of the Special Nuclear Materials License SNM-21, Docket 70-25, Issued to Energy Systems Group of Rockwell International*, June 5, 1984.
[4] Atomics International, *Atomics International Hot Laboratory Capabilities and Facilities*, Date Unknown.
[5] Rockwell International, ESG-82-33, *Health and Safety Sections for Renewal Application of the Special Nuclear Materials License SNM-21, Docket 70-25, Issued to Energy Systems Group of Rockwell International*, June 5, 1984.
[6] Atomics International, *Atomics International Hot Laboratory Capabilities and Facilities*, Date Unknown.
[7] Rockwell International, ESG-82-33, *Health and Safety Sections for Renewal Application of the Special Nuclear Materials License SNM-21, Docket 70-25, Issued to Energy Systems Group of Rockwell International*, June 5, 1984.
[8] Atomics International, *Atomics International Hot Laboratory Capabilities and Facilities*, Date Unknown.

[redacted]



[redacted][1]

[redacted][2]

Building 4020 was reported to have been equipped to handle a large variety of radioactive materials shipping casks. In one instance, the Piqua fuel transfer cask weighed 40,000 pounds and was loaded and unloaded using the cask handling docks at Building 4020. The cask would then have been brought into the decontamination room, unloaded and the various materials would have entered the cells through the large doors between the decontamination room and hot cells. Smaller casks were reportedly placed into the hot cells with an electric fork truck by moving the casks into the cells through the service gallery. Once within the cells, small components from each cask, if required, would have been transferred from cell to cell through the transfer drawers described above. Figure 2.2.1h shows Piqua Fuel Element handling cask and more typical S8ER core cask that were handled at Building 4020.[3]

[redacted]

[1] Rockwell International, ESG-82-33, *Health and Safety Sections for Renewal Application of the Special Nuclear Materials License SNM-21, Docket 70-25, Issued to Energy Systems Group of Rockwell International*, June 5, 1984.
[2] Rockwell International, ESG-82-33, *Health and Safety Sections for Renewal Application of the Special Nuclear Materials License SNM-21, Docket 70-25, Issued to Energy Systems Group of Rockwell International*, June 5, 1984.
[3] Atomics International, *Atomics International Hot Laboratory Capabilities and Facilities*, Date Unknown.

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[1] Rockwell International, ESG-82-33, *Health and Safety Sections for Renewal Application of the Special Nuclear Materials License SNM-21, Docket 70-25, Issued to Energy Systems Group of Rockwell International*, June 5, 1984.
[2] Rockwell International, ESG-82-33, *Health and Safety Sections for Renewal Application of the Special Nuclear Materials License SNM-21, Docket 70-25, Issued to Energy Systems Group of Rockwell International*, June 5, 1984.
[3] Atomics International, *Atomics International Hot Laboratory Capabilities and Facilities*, Date Unknown.
[4] Rockwell International, ESG-82-33, *Health and Safety Sections for Renewal Application of the Special Nuclear Materials License SNM-21, Docket 70-25, Issued to Energy Systems Group of Rockwell International*, June 5, 1984.
[5] Rockwell International, ESG-82-33, *Health and Safety Sections for Renewal Application of the Special Nuclear Materials License SNM-21, Docket 70-25, Issued to Energy Systems Group of Rockwell International*, June 5, 1984.
[6] Rockwell International, ESG-82-33, *Health and Safety Sections for Renewal Application of the Special Nuclear Materials License SNM-21, Docket 70-25, Issued to Energy Systems Group of Rockwell International*, June 5, 1984.
[7] Rockwell International, ESG-82-33, *Health and Safety Sections for Renewal Application of the Special Nuclear Materials License SNM-21, Docket 70-25, Issued to Energy Systems Group of Rockwell International*, June 5, 1984.

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[redacted][5]

[redacted][6]

[redacted]

[1] Rockwell International, ESG-82-33, *Health and Safety Sections for Renewal Application of the Special Nuclear Materials License SNM-21, Docket 70-25, Issued to Energy Systems Group of Rockwell International*, June 5, 1984.
[2] Rockwell International, ESG-82-33, *Health and Safety Sections for Renewal Application of the Special Nuclear Materials License SNM-21, Docket 70-25, Issued to Energy Systems Group of Rockwell International*, June 5, 1984.
[3] Rockwell International, ESG-82-33, *Health and Safety Sections for Renewal Application of the Special Nuclear Materials License SNM-21, Docket 70-25, Issued to Energy Systems Group of Rockwell International*, June 5, 1984.
[4] Rockwell International, ESG-82-33, *Health and Safety Sections for Renewal Application of the Special Nuclear Materials License SNM-21, Docket 70-25, Issued to Energy Systems Group of Rockwell International*, June 5, 1984.
[5] Rockwell International, ESG-82-33, *Health and Safety Sections for Renewal Application of the Special Nuclear Materials License SNM-21, Docket 70-25, Issued to Energy Systems Group of Rockwell International*, June 5, 1984.
[6] Rockwell International, ESG-82-33, *Health and Safety Sections for Renewal Application of the Special Nuclear Materials License SNM-21, Docket 70-25, Issued to Energy Systems Group of Rockwell International*, June 5, 1984.

[redacted][1]

[redacted][2,3]

[redacted][4]

According to March 1990, technical proposal for the decontamination and decommissioning of Building 4020, two alpha boxes were installed in the Hot Shop, Room 139, for the handling of small quantities of contaminated materials. The alpha box atmospheres were maintained at negative pressure with respect to Room 139 using an independent pressure control system. The box atmosphere exited the alpha box through a series of three HEPA filters and a redundant blower system before entering the facility stack.[5]

As indicated above, during initial construction, the facility radioactive drain was connected to two 500-gallon holdup tanks that were located in the north end of the basement. One of the tanks was designed for high-level waste and the other for low-level waste. According to the final decontamination and dismantlement report for Building 4020, following an incident whereby these tanks overflowed, the system was modified in approximately 1970 by installing a 3,000-gallon tank in Building 4468 and removing the 500-gallon tanks. The date of the incident causing the installation of the 3,000-gallon tank is unknown; however, a September 1977 incident report indicated that the old radioactive liquid waste tanks were being prepared for removal from the basement of Building 4020. Building 4468 was located to the east of the Hot Laboratory at the perimeter fence line.[6,7,8]

[redacted]

[1] Rockwell International, ESG-82-33, *Health and Safety Sections for Renewal Application of the Special Nuclear Materials License SNM-21, Docket 70-25, Issued to Energy Systems Group of Rockwell International*, June 5, 1984.
[2] Rockwell International, ESG-82-33, *Health and Safety Sections for Renewal Application of the Special Nuclear Materials License SNM-21, Docket 70-25, Issued to Energy Systems Group of Rockwell International*, June 5, 1984.
[3] Rockwell International, 82ESG-224 Enclosure, *Energy Systems Group Effluent Monitoring Report, Special Nuclear Material License SNM-21*, Date unknown.
[4] Rockwell International, ESG-82-33, *Health and Safety Sections for Renewal Application of the Special Nuclear Materials License SNM-21, Docket 70-25, Issued to Energy Systems Group of Rockwell International*, June 5, 1984.
[5] Rockwell International, Document No. RI/RD90-118P, *Decontamination and Decommissioning of Hot Laboratory, Building 020 SS, Volume 1, Technical Proposal for Complication of Task*, March 31, 1990.
[6] Boeing, Document No. RS-00010, *Area 402 MARSSIM Final Status Survey Report*, October 31, 2000.
[7] Boeing, EID-06141, "Hot Laboratory Decontamination and Dismantlement Final Report," November 27, 2001.
[8] Badger, F.H., Rockwell International Internal Letter, *Re: Radiological Occurrence – Bldg T020*, October 3, 1977.

According to the 2000 verification survey, two underground fission gas tanks were located on the north end of the building; however, a March 1999 technical proposal for the decontamination and decommissioning of the building indicates there were three underground tanks for the fission gas system, which are also indicated in building facility drawings (see Figure 2.2.1k).[8] According to the description provided in that document, the fission gas system consisted of plumbing from the cells, through the basement, through a control pit north of the building and

[1] Rockwell International, ESG-82-33, *Health and Safety Sections for Renewal Application of the Special Nuclear Materials License SNM-21, Docket 70-25, Issued to Energy Systems Group of Rockwell International*, June 5, 1984.
[2] Rockwell International, ESG-82-33, *Health and Safety Sections for Renewal Application of the Special Nuclear Materials License SNM-21, Docket 70-25, Issued to Energy Systems Group of Rockwell International*, June 5, 1984.
[3] Rockwell International, ESG-82-33, *Health and Safety Sections for Renewal Application of the Special Nuclear Materials License SNM-21, Docket 70-25, Issued to Energy Systems Group of Rockwell International*, June 5, 1984.
[4] Rockwell International, ESG-82-33, *Health and Safety Sections for Renewal Application of the Special Nuclear Materials License SNM-21, Docket 70-25, Issued to Energy Systems Group of Rockwell International*, June 5, 1984.
[5] Atomics International, *Atomics International Hot Laboratory Capabilities and Facilities*, Date Unknown.
[6] Rockwell International, ESG-82-33, *Health and Safety Sections for Renewal Application of the Special Nuclear Materials License SNM-21, Docket 70-25, Issued to Energy Systems Group of Rockwell International*, June 5, 1984.
[7] Atomics International, *Atomics International Hot Laboratory Capabilities and Facilities*, Date Unknown.
[8] Atomics International, Drawing No. A-3-4213, Components Development Hot Cell Yard Piping Plan, Date Illegible.

into three underground gas tanks located north of the facility. According to the survey report and final decontamination and decommissioning report, the tanks were never put into service.[1,2]

In addition to the facilities located inside the building, a loading dock and holdup yard were located on the west side of the building and a concrete pad was located at the north end of the building.[3] Temporary office and health physics office trailers were also located within the facility boundary at various times.[4] Aerial photographs show the presence of a trailer on the east side of the building between Buildings 4020 and 4468. The building, upon construction, was also connected to two septic tanks and a leach field upon construction. The leach field manhole detail in facility drawings show the leach field to have been lined with gravel. The leach field included a drain line that exited from the east along 24th street through a 1 1/2-inch drain to a ditch (see Figures 2.2.1l and 2.2.1m).[5,6] However, the MARSSIM final status survey report indicated that these facilities were never used and the building was connected to the Area III sewage treatment plant around 1960.[7] The leach field and septic systems were removed in 1997 along with the removal of the liquid waste facility, Building 4468, discussed in Section 2.2.2 below. The building also included a 5,000-gallon underground diesel storage tank that was installed in 1959 and removed on August 3, 1989.[8]

The building stack was located on the north side of the building. Based on available facility drawings, it appears the stack was located adjacent to a manhole that contained gravel at the bottom and included six 3-inch pipe sleeves. The purpose of this manhole is unknown; however, a review of the available documents within Boeing's 1.4 million document database may provide additional information regarding this manhole (see Figure 2.2.1n).[9]

Former Use(s): Constructed in 1959, Building 4020, the Hot Laboratory, formerly the Component Development Hot Cell, was constructed for the remote handling and examination of highly radioactive materials.[10] Building 4020 was used for the examination and evaluation of reactor fuels and components, and in irradiation test materials. This included Sodium Reactor Experiment (SRE) fuel assemblies and moderator cans, fuel elements from the Ohio Piqua Nuclear Power Facility and the Organic Moderated Reactor Experiment reactors, and fuel test capsules irradiated at the Materials Testing, Engineering Test, General Electric Testing, "HWOCS," and Hanford reactors. Irradiated fuel test capsules, based on available documents, appear to have been used in experiments to verify predicted release rates and disposition of

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[1] ORISE, Document No. ORISE 2000-1524, *Verification Survey for the Land Area Formerly Supporting the Hot Laboratory, Santa Susana Field Laboratory, The Boeing Company, Ventura County, California*, December 2000.
[2] Rockwell International, Document No. RI/RD90-118P, *Decontamination and Decommissioning of Hot Laboratory, Building 020 SS, Volume 1, Technical Proposal for Complication of Task*, March 31, 1990.
[3] ORISE, Document No. ORISE 2000-1524, *Verification Survey for the Land Area Formerly Supporting the Hot Laboratory, Santa Susana Field Laboratory, The Boeing Company, Ventura County, California*, December 2000.
[4] Boeing, Document No. EID-06141, *Hot Laboratory Decontamination and Dismantlement Final Report*, November 27, 2001.
[5] Atomics International, Drawing No. 303-020-P17, Building 020 Santa Susana Facility, Breathing Air Supply, Date Illegible.
[6] Atomics International, Drawing No. A-3-4213, components Development Hot Cell Yard Piping Plan, Date Illegible.
[7] Boeing, Document No. RS-00010, *Area 4020, MARSSIM Final Status Survey Report*, October 31, 2000.
[8] Rockwell International, Document No. RI/RD90-132, *Environmental Monitoring and Facility Effluent Annual Report De Soto and Santa Susana Field Laboratories Sites, 1989*, May 1990.
[9] Atomics International, Drawing A3-7810, CDHC Building Foundation Details, Date Illegible.
[10] Boeing, Document No. RS-00010, *Area 4020, MARSSIM Final Status Survey Report*, October 31, 2000.

fission products from vented fuel elements. These capsules required disassembly at Building 4020, similar to fuel rods, to remove radioactive material. An April 13, 1971, internal letter documents the preparation of Building 4020 for the acceptance and disassembly of an "URIPS-1P-RTG" from Aerojet-General Nuclear Company. The fuel for the RTG was documented to be a capsule containing 7,700 Ci of Sr-90.[12] At an unknown date, the entire SNAP 8 Experimental Reactor core, containing 211 fuel elements, was disassembled and examined at Building 4020. The SNAP 10FS3 reactor, including the vessel, core, primary pump, and piping, was also disassembled and examined at the Hot Laboratory. During disassembly of these components, typical tests included torque measurements, spring constant measurements, and bearing quality tests.[3,4]

The Hot Laboratory was also used for the disassembly and examination of Systems for Nuclear Auxiliary Power (SNAP) Reactor cores, the analysis of irradiated test materials, the manufacture and leak testing of sealed radioactive sources (primarily Pm-147), and the machining of radioactive Co-60.[5,6,7]

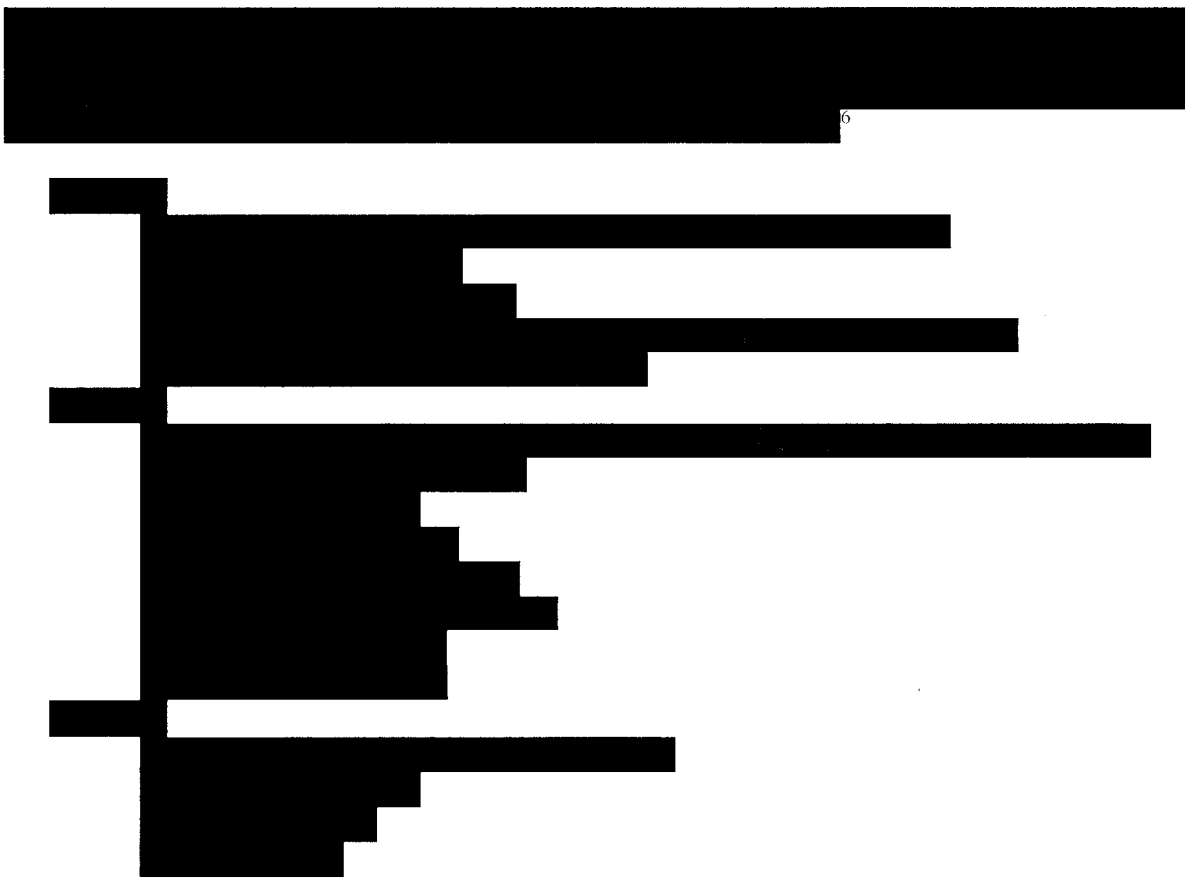
In 1976, the operations in Building 4020 involved the preparation of irradiated SRE fuel for eventual reprocessing by removal of the metal cladding and thermal bonding material, cleaning and repackaging of the fuel slugs and shipping the fuel for reprocessing.[8] Core I fuel consisted of low-enrichment uranium metal, clad with stainless steel and NaK bonded. Core II fuel consisted of thorium-uranium alloy with highly enriched uranium, clad with stainless steel and NaK bonded. Additionally, several miscellaneous SRE test elements were being prepared for processing. According to the 1976 environmental impact assessment, the majority of the irradiated fuel was stored in element form in special storage cans. Each fuel element consisted of five to seven fuel rods and each rod was made up of several fuel slugs clad in a stainless steel sheath and thermally bonded with NaK.[9]

At the disassembly station in Cell 3 of Building 4020, the fuel elements were removed from the fuel cans and disassembled. The disassembled fuel rod was transferred to a washing tank to remove any external residual Na or NaK. Residual Na or NaK on the surface of the elements was removed by reacting it in a solution of Dowanol. The fuel slugs were pushed out of the cladding tubes and washed, again with Dowanol, to remove any residual NaK. The fuel slugs were further cleaned by brushing with alcohol and immersing in an ultrasonic tank. The 1976

[1] Atomics International, Document No. NAA-SR-9469, *Project Proposals Fiscal Years 1965 and 1966, Sodium Cooled Reactor Development Programs,* November 2, 1964.
[2] Heine, W.F., North American Rockwell Internal Letter Re: Operational Safety Unit Weekly Highlights – Week Ending 4/9/71, April 13, 1971.
[3] Atomics International, *Atomics International Hot Laboratory Capabilities and Facilities*, Date Unknown.
[4] ORISE, Document No. ORISE 2000-1524, *Verification Survey for the Land Area Formerly Supporting the Hot Laboratory, Santa Susana Field Laboratory, The Boeing Company, Ventura County, California*, December 2000.
[5] Vandiver, D.B., Letter Re: Nuclear Hazards Indemnity, July 10, 1986, and DuVal, R., Letter Re: Removal of 12 WESF Capsules from RIHL," undated.
[6] Atomics International, *Atomics International Hot Laboratory Capabilities and Facilities*, Date Unknown.
[7] Boeing, Document No. EID-06141, *Hot Laboratory Decontamination and Dismantlement Final Report,* November 27, 2001.
[8] Rockwell International, AI-76-21, *Environmental Impact Assessment of Operations at Atomics International Under Special Nuclear Materials License No. SNM-21*, April 30, 1976.
[9] Rockwell International, AI-76-21, *Environmental Impact Assessment of Operations at Atomics International Under Special Nuclear Materials License No. SNM-21*, April 30, 1976.

assessment did not identify the location of the ultrasonic tank referenced. [1] Dowanol is a trade name for ethylene glycol n-butyl ether (99%) and was found to be effective for the removal of sodium and NaK from components by reaction.[2] Its use at the SSFL for the removal of sodium is documented in documents as early as 1965.[3]

The clean fuel slugs from a maximum of two fuel elements were then transferred into a shipping canister and the lid was welded on. The shipping canister was then returned to the SRE fuel storage vault.[4] The environmental impact assessment noted that the radioactive materials that were handled in encapsulated or uncapsulated form contained the following uranium isotopes: U-234, U-235, U-236, and U-238, thorium, Cs-137, Sr-90-Y-90, Kr-85, and Pm-147 as mixed fission products.[5]



[1] Rockwell International, AI-76-21, *Environmental Impact Assessment of Operations at Atomics International Under Special Nuclear Materials License No. SNM-21*, April 30, 1976.
[2] Energy Technology Engineering Center Document No. A4CM-AR-0005, *Area IV Chemical Usage Summary Report*, September 30, 1994.
[3] Atomics International, NAA-SR-MEMO-11605, *Weekly Hightlights for S8ER Operations Week Ending August 21, 1965*, August 27, 1965.
[4] Later in the document, the environmental impact assessment stated the canistered slugs were stored at the RMHF until ready for shipment to Savannah River.
[5] Rockwell International, AI-76-21, *Environmental Impact Assessment of Operations at Atomics International Under Special Nuclear Materials License No. SNM-21*, April 30, 1976.
[6] Rockwell International, ESG-82-33, *Health and Safety Sections for Renewal Application of the Special Nuclear Materials License SNM-21, Docket 70-25, Issued to Energy Systems Group of Rockwell International*, June 5, 1984.

According to an undated document, personnel in Building 4020 were responsible for the maintenance and repair of the manipulators and the in-cell equipment to ensure maximum hot cell availability at all times. Control of the radioactive contamination level in the hot cells was maintained by periodic cleaning to permit cell entries without excessive personnel radiation exposure. The document did not indicate how frequently the cells were cleaned, the methods used to clean the cells, or the methods to dispose waste products created by the fuel cell cleaning operations.[1] However, the 2001 final decontamination and decommissioning report indicated that it was standard practice during building operations to decontaminate and clean the facility "as well as practical" at the end of each program. According to the report, all project-related equipment and materials used in the complete program were removed and either surplused or disposed of as radioactive waste. The cells and decontamination rooms were washed down and the gross contamination was removed in preparation for the next program.[2]

[1] Atomics International, *Atomics International Hot Laboratory Capabilities and Facilities*, Date Unknown.
[2] Boeing, EID-06141, "Hot Laboratory Decontamination and Dismantlement Final Report," November 27, 2001.
[3] According to available information on the internet, Hastelloy is the registered trademark name of Haynes International, Inc. The trademark is applied as the prefix name of a range of twenty two different highly corrosion-resistant metal alloys loosely grouped by the metallurgical industry under the material term "superalloys" or "high-performance alloys."
[4] Rockwell International, ESG-82-33, *Health and Safety Sections for Renewal Application of the Special Nuclear Materials License SNM-21, Docket 70-25, Issued to Energy Systems Group of Rockwell International*, June 5, 1984.

[redacted][1]

Following the termination of the SNAP program, Building 4020 was used for the decladding of irradiated plutonium-bearing fuels from SRE and off-site reactors. The decladding operations included the disassembly of fuel assemblies, removal of the fuel from its cladding, size-reduction of the non-fuel components, and shipment off-site of the separated materials. These operations were performed for fuels from the SRE, Hallam Reactor, Experimental Breeder Reactor I (EBR-I), Experimental Breeder Reactor II (EBR-II), Southwest Experiment Fast Oxide Reactor (SEFOR), and the Fermi Reactor. These operations continued for a period of approximately ten years, immediately prior to the facility shutdown.[2]

[redacted]

[redacted]

[redacted]

[1] Rockwell International, ESG-82-33, *Health and Safety Sections for Renewal Application of the Special Nuclear Materials License SNM-21, Docket 70-25, Issued to Energy Systems Group of Rockwell International*, June 5, 1984.
[2] Boeing, Document No. EID-06141, *Hot Laboratory Decontamination and Dismantlement Final Report,* November 27, 2001.

[redacted]

[redacted][1]

[redacted][2,3,4]

[redacted][5]

[1] Atomics International, Facility Review of Historical MUF, Appendix A, Date unknown.
[2] Rockwell International, ESG81-30, *Onsite Radiological Contingency Plan for Rockwell International Operations Licensed Under Special Nuclear Material License No. SNM-21*, March 3, 1982.
[3] Rockwell International, ESG-82-33, *Health and Safety Sections for Renewal Application of the Special Nuclear Materials License SNM-21, Docket 70-25, Issued to Energy Systems Group of Rockwell International*, June 5, 1984.
[4] Rockwell International, Enclosure 2 to 87RC02380, *Rockwell Division, Rockwell International, Transuranic Waste Handling and Packaging Plan*, February 27, 1987.
[5] Rockwell International, ESG-82-33, *Health and Safety Sections for Renewal Application of the Special Nuclear Materials License SNM-21, Docket 70-25, Issued to Energy Systems Group of Rockwell International*, June 5, 1984.

In addition to the decladding operations, in 1986, twelve DOE-owned Cs-137 capsules were transported from Building 4020 to the Gamma Irradiation Facility in Canoga Park, California.[2]

The final decladding program performed in Building 4020 was related to Fermi program. According to the 2001 final decontamination and decommissioning report, the Fermi program was completed ahead of schedule and all equipment and materials related to the decladding project were removed and the cells decontaminated in 1986 in preparation for another project. However, the DOE decided to begin decommissioning and demolition of the facility, rather than continuing operations. DOE assumed responsibility for the decontamination and decommissioning of Building 4020 as a result of the building's use in support of DOE programs. As such, the decommissioning was conducted under Special Nuclear Material License No. SNM-21.[3]

Between 1987 and 1991 all hazardous materials and equipment not related to decommissioning and demolition were removed. Decontamination efforts focused on the removal of general contamination from support areas, decontamination rooms and hot cells. According to the 2000 Oak Ridge Institute for Science and Education (ORISE) verification survey, areas of modest contamination, due to spills and container leakage, were detected on the exterior of Building 4020 at the loading dock and holdup yard to the west of the building, as well as the concrete pad located on the north end of the building.[4,5] These areas were to be decontaminated with the removal of asphalt, concrete and dirt as indicated by the results of radiation surveys. Figure 2.2.1o presents the projected radioactive contamination located at and around Building 4020 as presented in a March 1990 technical proposal for the decontamination and decommissioning of Building 4020.[6]

In 1992, activities in Building 4020 transitioned from decontamination to demolition; however, decontamination continued from 1992 through 1995 in support of demolition activities. Prior to final demolition, ownership of the facility transferred from Rocketdyne to DOE in October 1995. Concurrent with the transfer of ownership, Rocketdyne requested the termination of the NRC license, which was granted on October 3, 1996, with the condition that Rocketdyne and the DOE complete decontamination and release of the facility in compliance with NRC guidelines.[7]

By 1996, the above-ground structure was completely removed. These demolition operations are discussed in detail in the final decontamination and dismantlement report and are not discussed in this TM. Of greater interest are the demolition activities of the basement structure, which was below-ground and had the most direct contact with surrounding soils. The following provides a

[1] Schaubert, V. and Allen, D., *Special Nuclear Material Control Program for SEFOR Fuel Decladding*, Date Unknown.
[2] Vandiver, D.B., Letter Re: Nuclear Hazards Indemnity, July 10, 1986, and DuVal, R., Letter Re: Removal of 12 WESF Capsules from RIHL," undated.
[3] Boeing, Document No. EID-06141, *Hot Laboratory Decontamination and Dismantlement Final Report,* November 27, 2001.
[4] Boeing, Document No. EID-06141, *Hot Laboratory Decontamination and Dismantlement Final Report,* November 27, 2001.
[5] ORISE, Document No. ORISE 2000-1524, *Verification Survey for the Land Area Formerly Supporting the Hot Laboratory, Santa Susana Field Laboratory, The Boeing Company, Ventura County, California*, December 2000.
[6] Rockwell International, Document No. RI/RD90-118P, *Decontamination and Decommissioning of Hot Laboratory, Building 020 SS, Volume 1, Technical Proposal for Complication of Task*, March 31, 1990.
[7] Boeing, Document No. EID-06141, *Hot Laboratory Decontamination and Dismantlement Final Report,* November 27, 2001.

detailed summary of the Building 4020 basement demolition as presented in the 2000 Final Decontamination and Dismantlement Report.

During Fiscal Year 1997, the demolition activities of Building 4020 focused on the removal of the basement structure. According to the final report, the first step in removing the basement was the decontamination of the basement interior surfaces to a level that would allow the saw cutting and removal of the concrete basement roof, walls, and floor with a minimum of radiological contamination concerns. As a result, all basement surfaces were washed down with a high-pressure water spray. The resultant waste water was collected in the three basement sumps and was transferred to the RMHF in a 500-gallon portable transfer tank for evaporation.[1]

Following the wash down, personnel completed a radiological survey for the basement interior surfaces and radiologically contaminated spots were identified and marked. The three basement sumps were drained, the sludge was removed, and the sumps were painted to fix all loose contamination. The floor drains were plugged or sealed with flanges to isolate the higher levels of contamination remaining within the underlying drain lines.

Decontamination of the floor area within the basement was performed using a pneumatic floor scabbler. Scabbling operations concentrated on the known hot spots, including specific floor sections and areas around sumps and drain openings. During the course of rains in late 1996 and early 1997, approximately 6,500 gallons of rain water had to be pumped from the basement as a result of infiltration through a specially constructed wooden structure that was constructed to prevent rain from entering the basement structure. The final report did not indicate how this water was managed or disposed of or if any of it overflowed or escaped the open structure.

In November 1996 work began on the saw-cutting of the floor slab of the former office and support areas, which were outside the basement area. Following the rainy season, the cut slab sections were removed, numbered, and stacked in the south parking lot of the facility for storage where the slabs were to be surveyed and prepared for disposal. According to the Boeing report, the exposed soil was surveyed and any detectable contamination was removed. EPA cannot independently confirm or deny conclusions regarding such past contamination efforts that were not under EPA oversight. The report did not provide information to indicate contaminant levels or how much soil in this area was found to be contaminated and removed.[2] Potential runoff from this parking lot where concrete slabs were stored would have flowed east under 24th street and into a drainage ditch along the south side of J Street.

Following the removal of the concrete slabs surrounding the basement area, excavation around the support foundation walls were begun. According to the final report, an objective of the basement demolition was to reuse the soil that was excavated from around the basement walls to fill in the excavation once the area had been released. Photographs of the demolition activities show the soil to have been stock-piled around the work area (see Figure 2.2.1p). Detailed radiological surveys of the surrounding areas were performed prior to the excavation of the foundation and three areas with significant contamination were located; however the report did not provide the analytical results of these surveys or if these three areas were cleaned up. These three areas included the vicinity of the waste-water transfer station on the west side of Building 4468. Approximately 30 cubic yards of contaminated soil was removed from this area prior to

[1] Boeing, EID-06141, "Hot Laboratory Decontamination and Dismantlement Final Report," November 27, 2001.
[2] Boeing, EID-06141, "Hot Laboratory Decontamination and Dismantlement Final Report," November 27, 2001.

the excavation of the basement. The source of contamination was determined to have been an underground 2-inch diameter pipe that was used to transfer contaminated waste water from the facility 3,000-gallon drain tank to the 500-gallon portable transfer tank loading station.[1] Drainage from these soil stockpile areas would have flowed east into the drainage ditch along the south side of J Street or into the drainage along the south side of G Street.

Another area of contaminated soil was located in a seam between two concrete slabs in the service gallery area, adjacent to Cells 1 and 2. Contamination in the seam area was reported to have been fixed previously to prevent contamination from migrating. Upon removal of the foundation and floor slab, it was discovered that the seam between the slabs had separated and was open to the underlying soil. According to an interviewee, the cracks in the floor were likely caused by the extensive and aggressive decontamination of the floors and the concrete "couldn't take it." The interviewee also stated that the roof leaked severely in some areas and rainwater problems were big concerns in part of the building. Contaminated water from routine cleaning of the area during facility operations migrated through this seam and into the "top few inches of soil." According to the report, construction seams in the floors or at wall-floor joints were the major source of contamination in the soil beneath the Building 4020 slab.[2,3]

The final area of radiologically contaminated soil was found in a seam between the north cell wall and the floor below the Cell 4 fuel transfer port. During normal facility operations, fuel transfer casks were mated to the port for fuel package transfer into the cell. Contaminated water from the fuel transfer casks, and from facility decontamination activities, leaked through the seam. Approximately 4 cubic yards of contaminated soil were excavated from this area. The contaminated soils were removed from all three areas, and were surveyed and "free-released" by Rockwell International's Radiation Safety.[4]

Following the removal of contaminated soil surrounding Building 4020, the basement roof (24 inches thick) was sectioned by a combination of core drilling, circular saw cutting, and wire saw cutting. The final report stated that all concrete coring and cutting was preceded by surveying and decontamination of the cutting path in order to minimize the generation of contaminated dust or cooling water. Cutting wastewater was generated during these operations and accumulated in the basement sumps. The waste water was pumped from the basement sumps into ground-level portable holding tanks where solids were allowed to settle out. The tanks were then transferred to the RMHF. Concrete rubble that was generated was packaged for disposal as radioactive waste. A large excavator lifted the sections of cut concrete and transported them to the staging area.[5]

Following the removal of the basement roof, and the excavation of the soil adjacent to the exterior of the basement wall, the contractor began saw cutting the basement walls. The walls were cut into 15-foot high by 30-inch wide sections after being surveyed by Rockwell International's Radiation Safety. The cuts were made from the interior of the basement and cut depth was set at approximately ¼ inch less than the thickness of the wall to attempt to eliminate the potential for the spread of radiological contamination from the saw blade cooling water

[1] Boeing, EID-06141, "Hot Laboratory Decontamination and Dismantlement Final Report," November 27, 2001.
[2] Boeing, EID-06141, "Hot Laboratory Decontamination and Dismantlement Final Report," November 27, 2001.
[3] Dempsey, Gregg, Email to Craig Cooper (EPA), April 6, 2011
[4] Boeing, EID-06141, "Hot Laboratory Decontamination and Dismantlement Final Report," November 27, 2001.
[5] Boeing, EID-06141, "Hot Laboratory Decontamination and Dismantlement Final Report," November 27, 2001.

spray. The contractor was also instructed to leave approximately 4 inches of wall at the base to act as a barrier to hold contaminated water inside the basement. Following the cutting of the sections, each section was snapped off by an excavator and transported to a holding area for a detailed survey and decontamination by ETEC. The report did not indicate whether the Building 4020 parking lot was the holding area for the basement wall sections.[1]

The large high-density concrete support columns were also sectioned, size-reduced, and removed from the basement. The personnel entry tunnel at the southeast corner of the based was also excavated and cut into sections in the same manner as the basement wall sections. According to the report, the cutting of the east basement wall was complicated by the presence of the 2-foot diameter and 30-foot long utility tunnel that connected the basement with Building 4468. Each section of this tunnel was surveyed prior to being demolished. The waste material from these activities was placed in a roll-off container.[2]

The final report indicated that all waste water and cutting slurry generated during the cutting operations was captured in approved radiological shipping containers and sampled for contamination. The Boeing report indicated that radiologically clean water was held for approximately 2 days to allow the solids to settle out and the water was pumped to a holding tank, re-sampled to verify it was free of contamination, and released into the site sanitary water system. EPA cannot independently confirm or deny conclusions regarding such past decontamination efforts that were not under EPA oversight. The residual concrete slurry was allowed to dry in the shipping containers and was transferred to the RMHF for off-site disposal. Contaminated water was separated from the concrete fines and transferred to the RMHF and was processed through the facility liquid waste handling system.[3]

The final stage of basement demolition included the removal of the floor drains and the concrete floor slab. According to the final report, the floor drains were the largest potential source of radiological contamination and source of the highest exposure levels in the basement. Following the removal of the walls, ETEC personnel saw-cut 18-inch wide trenches in the floor to expose the drainage system beneath the concrete slab. Radiation Safety personnel monitored exposure levels as segments of the underlying drain line system were exposed. As it was removed, the drain line was sectioned, the section ends were sealed, and the sealed components were transferred to the RMHF in standard waste containers for clean out and isotopic analysis; however, the final report did not provide the results of this analysis.[4]

After the removal of the drain system from the basement area, the remaining floor slab was surveyed and additional areas were decontaminated; however, the method of decontamination was not documented in the report. Following decontamination, the slab was saw-cut into sections with an emphasis on the containment of the saw-cutting water to avoid the potential spread of contamination. According to the final report, approximately 3,500 gallons of waste water was generated in a typical week of horizontal saw cutting of thick concrete. The report did not indicate the duration of these activities or how the waste water was managed.[5]

[1] Boeing, EID-06141, "Hot Laboratory Decontamination and Dismantlement Final Report," November 27, 2001.
[2] Boeing, EID-06141, "Hot Laboratory Decontamination and Dismantlement Final Report," November 27, 2001.
[3] Boeing, EID-06141, "Hot Laboratory Decontamination and Dismantlement Final Report," November 27, 2001.
[4] Boeing, EID-06141, "Hot Laboratory Decontamination and Dismantlement Final Report," November 27, 2001.
[5] Boeing, EID-06141, "Hot Laboratory Decontamination and Dismantlement Final Report," November 27, 2001.

The basement slab sections in the tunnel area were removed by a large excavator. As stated in the report, the first slabs removed were washed down in a "large tub" to remove loose contamination. However, the procedure was determined to be too time consuming and the subsequent slab sections were set aside for later decontamination although where the slabs were placed was not documented in the report.[1]

It was found that the basement slab sections in the area of the five support columns were 3 to 4 feet thick instead of the 2 feet specified in the as-built facility drawings and could not be removed similarly to other sections of the slab as a result of the increased thickness. According to the report, an excavator with a large hi-ram was ultimately used to reduce the final 30 percent of the slab area to rubble. The resulting concrete and steel debris was placed in roll-off containers and waste boxes for disposal as low-level radioactive waste.[2]

According to the report, the demolition of the facility basement was completed at the end of Fiscal Year 1997. Figure 2.2.1q provides a view of the resulting excavation. Final radiological surveys of the excavation and the surrounding site area by Rocketdyne Radiation Safety personnel were performed in parallel with the basement removal, and included the collection and analysis of soil samples. As a result, the excavated area was verified by Rocketdyne to be radiologically clean at the end of Fiscal Year 1997, as well.[3]

The Fiscal Year 1998 activities included the final verification surveys of the excavated Building 4020 basement area, as well as the removal of the liquid waste facility and the leach field/septic tank system. The removal of the liquid waste facility is described in Section 2.2.2, below. The soil above and surrounding the septic tank and leach pits were excavate din 2-foot depth increments, with radiological surveys and soil samples taken at each level. According to the final decontamination and dismantlement report, all of the soil from this excavation process was determined to be radiologically clean. The septic tank was found to be backfilled with soil, which was believed to have been done when the septic tank system was bypassed to connect the facility to the site sanitation system. The septic tank was sampled, pulled from its location, "demolished" and placed into a roll-off container for disposal. According to Boeing, the final report stated that the septic tank was "free of radiological contamination and any hazardous biological materials.[4]

Each of the two leach pits comprised a cylindrical brick structure that was surrounded by gravel and had a gravel layer on the inside bottom. The final decontamination and dismantlement report indicated that "extensive surveys were made during excavation" and both pits were determined to be "free of radiological contamination and biological hazards. The bricks from the pits were placed in roll-off containers for disposal as clean waste. The report did not indicate where the bricks or septic tank pieces were ultimately disposed of. Rocketdyne Radiation Safety personnel performed a final release survey of the septic tank and leach pit excavations.[5]

The final verification surveys were completed by ORISE and the California Department of Health Services Radiological Branch. ORISE issued a written report in January 1998 indicating

[1] Boeing, EID-06141, "Hot Laboratory Decontamination and Dismantlement Final Report," November 27, 2001.
[2] Boeing, EID-06141, "Hot Laboratory Decontamination and Dismantlement Final Report," November 27, 2001.
[3] Boeing, EID-06141, "Hot Laboratory Decontamination and Dismantlement Final Report," November 27, 2001.
[4] Boeing, EID-06141, "Hot Laboratory Decontamination and Dismantlement Final Report," November 27, 2001.
[5] Boeing, EID-06141, "Hot Laboratory Decontamination and Dismantlement Final Report," November 27, 2001.

that the excavated area was radiologically clean. However, only the Rocketdyne test results and a verbal confirmation from ORISE were used to make a "programmatic" decision to backfill the excavation prior to the release of the official ORISE report in order to avoid the presence of an open pit during the winter rainy season.[1]

The excavation was first lined with a 1-foot thick layer of sand as marker to identify the bottom of the excavation. The area was then backfilled and compacted during the first quarter of fiscal year 1998. Figure 2.2.1r show the beginning of the backfilling operation and the site at completion, respectively. As seen in Figure 2.2.1r, the storage of concrete block sections from the basement demolition activities are visible on the parking lot, Parking Lot 4520, located south of the former Building 4020 location.[2]

During the first quarter of fiscal year 2000, ORISE and the California DHS performed final release surveys of the entire backfilled and graded site, including the leach field, septic tanks, and waste storage tank. Rocketdyne completed a final status survey report in October 2000.[3]

Information from Interviewee: A number of interviewees had experience with the operations in Building 4020. A summary of the information provided from these interviewees is presented below.

Interviewee 3 worked for Atomics International for 35 years (1963-1999) as a forklift operator, plutonium facility worker, and operations engineer. The following excerpts were pulled from the interview:

> *"Buildings 20, 21, 22, 24, 25, 19, 59, 9, and 100 were all hot buildings."*
>
> *"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."*
>
> *"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."*

Interviewee 4 worked for Rocketdyne in the 1960's and again in the early 1990's. . The following excerpt was pull from the interview.

> *"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*

[1] Boeing, EID-06141, "Hot Laboratory Decontamination and Dismantlement Final Report," November 27, 2001.
[2] Boeing, EID-06141, "Hot Laboratory Decontamination and Dismantlement Final Report," November 27, 2001.
[3] Boeing, EID-06141, "Hot Laboratory Decontamination and Dismantlement Final Report," November 27, 2001.

Sodium Reactor Experiment (SRE). I think there was a concrete pad outside the Hot Lab for staging drums."

Interviewee 106 started working at Santa Susana in 1954 eventually becoming a Senior Research Mechanic who had extensive knowledge of the Hot Lab (Building 020), the Engineering Test Building (Building 003), the hot cell and the SRE.

"I also fabricated plutonium into fuel rods. At one time I had enough materials in my safe to make four bombs. I had to balance the radioactive materials every night to 1 gram."

"As far as materials handling and disposal we had people who took care of that stuff. I did develop a cleaning technique to clean oil from ones hands so that it wouldn't be transferred to the fuel elements that involved using ethyl alcohol or acetone and a triple set of gloves. But the oil would still show up on the fuel. We also stored the uranium and plutonium fuel in birdcages so that there would be no interaction between them. A maximum of one birdcage could be carried on a truck. We couldn't stack them together or they would go critical."

As an expert high temperature stress analyst and an expert on high temperature sodium facilities with a degree in Engineering, Interviewee 110 worked for the Atomic Energy Commission at Santa Susana. The following excerpts came from the interview with Interviewee 110.

"I do remember the Hot Cell in Building 20 where we examined elements from the OMRE (Organic Moderated Reactor Experiment). I designed the fuel elements or control rods for the OMRE. After action work included Hot Cell examination of the fuel elements that were shipped from Idaho to SSFL in sealed shipping casks."

"With respect to impacts to the environment, the only thing that we discharged directly into the atmosphere was non-radioactive sodium and water. Sodium oxide eventually degrades to become sodium carbonate which is just chalk. Sodium oxide is corrosive and it may have landed on a cow or two and their skin may have gotten a little irritated."

According to an interviewee (125) who worked for Atomics International in Building 20 from 1962 to 1965 as a machinist:

"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."

"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."

"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.[1] *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 offsite 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 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 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."

[1] Hot laundry facilities appear to have been located in Building 4283 based on industrial planning maps.

Interviewee 149 worked for Atomics International from 1961 to 1989 occasionally working at SSFL as an engineer and program manager. Interviewee 149 was responsible for some of the oversight at the hot cell along with reviewing some of the written procedures.

> *"The world's largest privately operated hot lab was at SSFL. They did amazing things there – among other things, spent fuel was cut apart and examined. The Fermi-1 fuel that had experienced a meltdown was brought to the SSFL Hot Cell for examination. Fermi-1 was the granddaddy of the sodium-cooled reactor. The Hot Cell facility had 6 cells. A Lionel train was used, on special occasion, to move the fuel from one cell to another."*
>
> *"Technicians did the work in the hot cell. I had oversight of some of these operations and only had a film badge when on site. Someone else would write procedures and I reviewed them. At that time I had responsibility for the engineering release process and design control."*
>
> *"At SSFL there was an experimental plutonium fuel development program for which we were tasked with developing a plutonium fuel. Plutonium in powdered form, I'm guessing 3 percent plutonium with U-238, was formed into cylindrical slugs of different shapes and length that were installed in stainless steel tubes[1]. We studied heat transfer by installing liquid metal (sodium or NaK) as a cladding between the fuel slug and the steel tubing. My group was tasked to write procedures for this process."*
>
> *"Workers wore leaded rubber gloves inside glove boxes when necessary to handle the slugs in their hands because it emitted low level alpha radioactivity. They would always use respirators for breathing protection while doing this work."*
>
> *"I did not work with chemicals and thus had no exposure to them. The technicians used TCE to clean parts. Sodium was sometimes misused – throwing a block of sodium into a pond was unauthorized but it did happen. The burn pit would be the source of these problems. When I was hired in 1961, I was given a tour of the SSFL and the LOX plant was already gone by the time ETEC was up and running."*

From approximately 1960 to 1966, Interviewee 155 worked at SSFL in the Radiation Safety Department (Healthy Physics). The following are excerpts from that interview.

> *"During my employment at Rockwell/AI/North American Aviation, I wore a film badge one hundred percent of the time, as did all personnel working in a radiation area. Every month the film badge was processed. When I was in health physics – radiation safety – if someone was going to work in an area where they could get a higher exposure, then they would wear 2 film badges (a regular one and a visitor badge) as well as a pencil dosimeter. I was the Health Physicist (HP) at the Hot Lab, for a year or so. I would collect the film badges and send them down to headquarters where they would process them or send them to Landauer's in Burbank. They would call me as to what they had found and I would give a report to each person's supervisor. The supervisor would then let anyone know if they had reached their limit for the month and that person would have to be reassigned somewhere else for the remainder of the month."*

[1] The use of plutonium metal in Building 4020 cannot be confirmed in available documents; however, documents do indicate the use of plutonium metal in Building 4055. Additional information is provided below.

> *"As the HP in the Hot Lab, I only did the monitoring (not the film badge processing) and I would take smears daily. If they were going to change manipulators they would lay down plastic or whatever I asked them to do. We had air samplers going constantly. Radiation safety was very important."*

> *"When I started working at the SRE, they were building a new fuel handling machine (FHM). The old FHM still had the broken elements in it the entire time I was there. After I was off rotating shifts, I went in one Saturday with the crew that removed the broken elements from the FHM... The uranium from the fuel elements and the cladding I think went to the Hot Lab."*

Interviewee 166 worked at SSFL in the hot cell for a short time in 1960. The following is an excerpt from that interview.

> *"I worked up at the SSFL periodically in Area 4 during that period doing things like determining densities of fuel elements, simulated testing of fuel elements in one of the reactors, working on a scale in a hot cell, and other related activities. I received a year's worth of radiation in the one day where I worked in the hot cell."*

During the 32 years Interviewee 254 was employed for Atomic International, the interviewee worked a variety of positions at SSFL, including mechanic and Engineer in Charge. Below are several excerpts from the interview.

> *"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 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 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."

"The Hot Lab had a hot storage room behind the hot cell. The guy who ran the place, name redacted, was a strange duck... 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... 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."

"I worked at the Hot Lab for many years on and off..."

"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."

"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."[1]

"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."

"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."

"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."

"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

[1] This incident was documented in Incident A0016, and is summarized below.

document everything... 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..."

According to an interviewee (255) who worked for Atomics International from 1967 to 1985 as an atomic inspector and certified x-ray technician:

"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."

Interviewee 277 started working at SSFL as a Labor Grade 6 Technician before eventually being promoted to a Labor Grade 17 Technician. Interviewee 277 worked performing a variety of tasks in Area IV of which some time was spent at the Hot Lab. Below are some excerpts from that interview.

"The fuel rods in the canisters were stored at the radioactive materials handling facility (RMHF) until they had cells ready at the Hot Lab (Building 020) to unclad the sodium from the fuel rods. They would open up the bundles at Building 020. We would lower the baskets into the floor vaults at the RMHF. Note that at the Hot Cell Building 020 would always clean up the cells used in each project and then paint the cells in order to keep the Rad contamination down in each cell for the next project."

"We would bid on contracts for receiving fuel rods from other sodium reactors such as Hallam. The cladding and bonding would be removed at Building 20. The fuel rods stored in casks had water in them from the leak test. There were 7, 8, or 9 bundles in each cask. We would take the bundles out of the cask and make sure there was no water on the bundles, there would be water remaining in the cask – not a lot, maybe a couple of gallons. We had to be careful if there was any water in the cask because it would be very hot. We wore film badges and dosimeters. We would wear the dosimeters on our heads and arms. They had been using dosimetry for a good 10 years before I started work there."

"(Regarding disposal of rad waste to floor drains or toilets) Unless somebody had something against the company, it would only have happened by accident or neglect; it was never done intentionally. I do know that Buildings 5 and 24, the Hot Lab, and RMHF had radioactivity in the drains. The system could easily be breached.[1] *Also the HEPA*

[1] The meaning of this interviewee statement is unknown.

vents were radioactive, but they would get blocked and then taken out later when we took the building down."

"... and at the Hot Lab we worked with cleaning fluids but there was no procedure or protocol to dispose of some of the chemicals. The mechanics would put some of it in a coffee can and when they were done, I think the mechanics would just pour it on the ground."

Interviewee 280 worked for Atomics International from 1959 until 1968 as a Senior Mechanic, primarily at Building 4020, and had the following to say:

"At the Hot Lab, we would receive reactors and work on fuels used at the SSFL as well as by other companies, which included examining the fuel, take the elements apart, declad, and test. There were no releases at the Hot Lab. The Hot Lab contained four cells. The front part of the Hot Lab was safe from radiological exposure, and hot items were handled behind walls with mechanical arms. The back room was where exposure was a concern."

"All the rods in the SRE had to be taken apart at the Hot Lab, but most were intact as very few failed or broke apart. I was involved with the cleanup, which included taking things apart to clean and decontaminate."

Radiological Incident Reports: There have been several incidents associated with Building 4020 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 4020 Incident Report Summary

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A0002	8/26/1959	CDHC		Hot Cell Door Ramp Fell Striking An Employees Hand.
A0001	12/5/1959	CDHC	Mixed Fission Product	Radioactive Liquid Spilled During Vendor Pickup.
A0392	4/14/1960	CDHC DECON 4	Mixed Fission Product	Weekly Radiation Limits Exceeded.
A0003	4/18/1960	CDHC	Mixed Fission Product	Irradiated SRE Fuel Slug Placed In An Employees Hand.

Building 4020 Incident Report Summary (continued)

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A0011	5/12/1961	CDHC	Mixed Fission Product	Unsafe Handling Of B Of E Cask.
A0505	5/20/1961	CDHC	Mixed Fission Product	Personnel Contaminated During Waste Transfer Operations.
A0347* *This incident is the same as A0505 above.	5/21/1961	SERVICE GALLERY	Mixed Fission Product	Employee Contaminated While Loading Waste Box.
A0283	6/2/1961	CELL 3	Mixed Fission Product	Employee Exposed To Airborne Activity When Supplied Air hose Was Pinched.
A0012	6/19/1961	CDHC C2 & D2	Mixed Fission Product	Employee Attempted To Enter Very High Radiation Area.
A0317	5/9/1962	CELL 4	Mixed Fission Product	Irradiated Fuel Slug Burned In Cell 4 Releasing Radioactive Gas.
A0016	5/31/1962	NORTH PAD/DRAIN	Mixed Fission Product	Portable Radioactive Liquid Tank Overflowed On North Pad Flowing To Surface Drainage.
A0018	9/4/1962	CDHC OP GAL	Mixed Fission Product	Repair Of Fission Gas Analyzer Caused High Airborne Activity And Contaminated Personnel And Lab.
A0020	12/5/1962	ALL	Mixed Fission Product	Contaminated Shoes From Controlled Area Contaminated Most Of Hot Lab.
A0021	1/25/1963	CELL 3	Mixed Fission Product	Employees Hand Contaminated When Glove Tore In Hot Cell.
A0433	5/8/1963	CDHC MOCK-UP	Mixed Fission Product	Waxing Mop Swung Through Controlled Area Contaminated Clean Area.
A0022	7/2/1963	RADIOACTIVE STORAGE YD		Spill Of OMRE HB 40 Coolant In Radioactive Storage Yard.
A0316	7/8/1963	RIHL & OFF SITE	Mixed Fission Product	Employee Contaminated Clothing During Cask Movement Out To Storage Yard.
A0027	9/25/1963	CELL 3	Mixed Fission Product	A Fire Occurred During Dissolution Of NaK From Fuel Decladding In Cell 3.
A0024	9/26/1963	DECON/CELL 3	Mixed Fission Product	NaK And Alcohol Fire During Cleaning Of Fission Gas Monitor.
A0025	9/26/1963	CELL 3	Mixed Fission Product	Exposure Above Guidelines During Cell Clean Up.
A0026	10/9/1963	CELL 2	Mixed Fission Product	Uncontrolled Furnace Left On Overnight Burning Cell Equipment.
A0031	3/20/1964	OP GALLERY	Mixed Fission Product	Fire Suppressing Nitrogen Purge Of Hot Cells Generated Airborne Activity.
A0551	6/8/1964	CDHC SLAVE SHOP	Mixed Fission Product	Unauthorized And Unprotected Employee Contaminated By Contaminated Equipment.
A0443	6/16/1964	CDHC OP GALLERY	Mixed Fission Product	Fuel Element Elevated In Cell Causing Radiation Streaming Thru Slave Ports.
A0338	7/10/1964	SERVICE GALLERY		Outer And Inner Doors To Airlock Open At The Same Time.
A0554	7/23/1964	CDHC CELL 4	Mixed Fission Product	Contaminated Employee Was Deconed By Medical Dept.

Building 4020 Incident Report Summary (continued)

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A0354	8/27/1964	OP GALLERY	Mixed Fission Product	High Airborne Activity Resulted After Loss Of Exhaust Controller.
A0415	9/3/1964	CDHC CELL 1	Mixed Fission Product	In-cell Work Resulted In Exposure Above Guidelines And Employee Contamination.
A0337	10/15/1964	SERVICE GALLERY	Mixed Fission Product	Employee Became Contaminated While Bagging Shielding Blanket.
A0574	11/18/1964	CDHC CELL 3	Mixed Fission Product	Exit Survey From Cells Revealed Speck Contamination.
A0033	11/26/1964	NORTH PAD	Mixed Fission Product	Radioactive Liquid Transfer Tank Was Over Filled And Contaminated Outside Area.
A0034	12/7/1964	STORAGE YARD		Radioactive Material Stored In Yard Creating Radiation Levels Above Guidelines.
A0035	5/27/1965	OP GALLERY	Mixed Fission Product	High Airborne Activity During Deeladding NaK Bonded Uranium Carbide Fuel.
A0037	7/16/1965	OP GALLERY	Mixed Fission Product	Disintegrated Fuel Deposited In Filter Was Spread During Recovery.
A0441	8/12/1965	AIHL YARD	Mixed Fission Product	Rain Water From One Way Waste Cask Dumped In Clean Area Contaminating Ground.
A0038	9/21/1965	OP GALLERY	Mixed Fission Product	Cell Purging With Nitrogen Caused High Airborne Activity.
A0039	2/2/1966	METALOGRAPH RM	Mixed Fission Product	Extremity Exposure Above Guidelines From Picking Up Irradiated Fuel Sample.
A0040	2/24/1966	SERV GALLERY	Mixed Fission Product	Maintenance Of Contaminated Elox Machine Resulted In High Airborne Activity.
A0042	8/16/1966	ALL OF AIHL		Failure Of Emergency Power Generator Caused Increased Airborne Activity.
A0044	12/31/1966	RM 139	Pm147	Fabrication Of Heat Sources Caused Extremity Exposures Above Guidelines.
A0607	1/28/1967	SER GAL AIHL	Mixed Fission Product	Contamination Tracked From Slave Shop To Service Gallery And Hot Shop.
A0613	4/6/1967	AIHL CELL 3	Mixed Fission Product	Fire Occurred In Cell 3 During Cutting Of Metallurgical Sample.
A0617	5/17/1967	AIHL GLOVE BOX	PM147	Promethium Glove Box Transfer Caused High Airborne Activity And Nasal Smears.
A0619	6/10/1967	AIHL GLOVE BOX	PM147	Waste Removal From The Promethium Glove Boxes Caused High Airborne Activity.
A0046	8/21/1967	RM 139 GLOVE BO	Pm147	Extremity Exposure Above Guidelines During Fabrication Of Heat Sources.
A0047	10/11/1967	RM 139	Pm147	Ingestion Of Pm 147 During Clean Up Operation.
A0627	10/30/1967	AIHL	Mixed Fission Product	AIHL Radioactive Drain System Plugged Up And Flooded Controlled Areas.

Building 4020 Incident Report Summary (continued)

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A0050	7/22/1970	CELL 3 AIHL	Mixed Fission Product	Small Alcohol Fire During Disassembly Of NaK Bonded Fuel Element.
A0051	10/11/1970	OP GALLERY AIHL	Ra Th	High Airborne Alarm After Hours Due To Increase In Natural Activity.
A0052	5/19/1971	DECON 4 AIHL	Mixed Fission Product	A Major Fire Resulted During Draining Of NaK Tank In Decon 4.
A0054	7/29/1975	CELL 2 AIHL	Kr 85	SRE Fuel Slug Partially Burned Releasing Radioactive Gas And Contamination.
A0060	9/30/1977	BASEMENT	Mixed Fission Product	Failure To Comply With Requirements Caused Contamination Of Basement Floor.
A0067	4/25/1978	DECON 2	Mixed Fission Product	Employee Contaminated With Concentrate From Sodium Digestion.
A0069	5/3/1978	DECON 2 STILL	Mixed Fission Product	A Five Minute Alcohol Evaporator Fire In Decon 2.
A0076	2/9/1979	DECON 2	Mixed Fission Product	Alcohol Distillation System Spilled Contaminating Employee.
A0088	8/21/1981	HOT STORAGE RM	Mixed Fission Product	Bags Of Radioactive Waste Were Broken During Loading Releasing Contamination.
A0092	10/20/1981	MOCK-UP RM	Mixed Fission Product	Loss Of Control Resulted In Contaminated Ladder In Clean Area.
A0094	12/18/1981	AIR LOCK	Ta182	One Rad Pac Pin Tossed In Radioactive Waste.
A0101	3/22/1982	CELL 1	Mixed Fission Product	Zirconium Fuel Pin Cladding Fines Ignited Causing High Airborne.
A0104	6/28/1982	D 4 AND AIRLOCK	Mixed Fission Product/Ta	Working Two Projects Resulted In Extremity Exposure Above Guidelines.
A0105	7/13/1982	DECON 4	Mixed Fission Product	Faulty Crimping Seal Resulted In Alpha Contamination Of Employees.
A0325	8/16/1982	LIQUID WASTE BL		RAS Alarm Response At RHHL Radioactive Liquid Waste Bldg.
A0110	10/11/1982	DECON 4	Pu/Mixed Fission Product	Leaking Glove box Glove Caused Cross Contamination Of Two Employees.
A0112	12/22/1982	DECON 4		Employee Experienced A Seizure While Working In Controlled Area.
A0262	4/21/1983	MBA 54	Pu	Incorrect Id Of Fuel Rod Resulted In Grams Of Pu In Excess Of Mba Limit.
A0120	7/15/1983	ALPHA BOX D 4	Pu/Mixed Fission Product	Loss Of Glove Seal During Change Out On Alpha Box Contaminated Employee.
A0119	8/8/1983	DECON 3	Mixed Fission Product	Leaking Transfer Tube Contaminated Employee And Decon Room.
A0118	10/11/1983	CELL 3 FACE	Mixed Fission Product	Radioactive Liquid Siphoned From Cell Contaminating Wide Area Of Building.
A0122	1/30/1984	RHHL	Ta182	Contaminated Electrode Was Worked On A Clean Grinder And Tracked Out Of Bldg.

Building 4020 Incident Report Summary (continued)

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A0124	3/22/1984	CELL 3	Mixed Fission Product	Protective Clothing Failure Allowed Caustics To Burn And Contaminate Employee
A0125	8/20/1984	CELL 3		During In-Cell Repair An Employee Bumped His Head Drawing Blood.
A0126	8/21/1984	DECON 3	Mixed Fission Product	Employee Contaminated Smearing Low Level Tools With High Level Contamination.
A0127	10/15/1984	CELL 3	Mixed Fission Product	During Remote Decon The Alcohol Caught Fire.
A0128	10/28/1984	SLAVE SHOP	Mixed Fission Product	Employee Contaminated Hands Handling Bag Of Radioactive Waste.
A0129	12/6/1984	CELL 1	Mixed Fission Product	Failure Of Protective Clothing Seal Contaminated Employee.
A0130	12/10/1984	CELL 1	Mixed Fission Product	Failure Of Protective Clothing Seal Contaminated Employee.
A0131	12/10/1984	CELL 1	Mixed Fission Product	Improper Unsuiting Contaminated Employee.
A0133	12/10/1984	CELL 1	Mixed Fission Product	During Decon Of Cell 1 Extremity Exposure Exceeded Administrative Guidelines.
A0134	1/14/1985	DECON 1	Mixed Fission Product	Bag Radioactive Waste Came Untaped And Contaminated Employees Pants.
A0132	1/15/1985	SLAVE SHOP	Mixed Fission Product	Employee Cut Finger With Contaminated Screwdriver.
A0135	2/20/1985	SHOP	Mixed Fission Product	Employee Cut Finger On Cell 4 End Door Gear Shaft During Repair.
A0136	3/4/1985	CELL 1	Mixed Fission Product	Contaminated Sharp Object Punctured Protective Clothing Contaminating Shoes.
A0137	3/20/1985	SERVICE GALLERY	Mixed Fission Product	Contaminated Item From Cell 1 Contaminated Personnel And Area When Opened.
A0139	6/6/1985	SLAVE SHOP	Mixed Fission Product	Decon With Acid Resulted In Burning And Contamination Of Employee.
A0140	8/12/1985	DECON 1	Mixed Fission Product	Contaminated Puncture Wound Occurred During Packaging Radioactive Glass Waste.
A0142	10/4/1985	SERVICE GALLERY	Mixed Fission Product	Personal Clothing Worn Under Protective Clothing Became Contaminated.
A0141	10/17/1985	CELL 3	Mixed Fission Product	Sharp Object In Cell 3 Punctured Protective Clothing Contaminating Shoes.
A0147	10/25/1985	CELL 3	Mixed Fission Product	Protective Clothing Leached Contamination Onto Employee.
A0148	11/4/1985	CELL 3	Mixed Fission Product	Protective Clothing Leached Contamination Onto Employee.
A0145	11/13/1985	CELL 3	Mixed Fission Product	Protective Clothing Leached Contamination Onto Personal Shoes And Socks.
A0143	11/20/1985	CELL 4	Mixed Fission Product	Protective Clothing Leached Contamination Onto Personal Shoes And Socks.

Building 4020 Incident Report Summary (continued)

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A0144	11/21/1985	CELL 3	Mixed Fission Product	Protective Clothing Leached Contamination Onto Personal Shoes And Socks.
A0146	11/22/1985	DECON 4	Mixed Fission Product	Protective Clothing Leached Contamination Onto Personal Shoes And Socks.
A0149	12/10/1985	HOT STORAGE RM	Mixed Fission Product	Employee Pinched Hand While Loading Radioactive Waste In Box Drawing Blood.
A0150	1/14/1986	ALL RHHL		A Review Of Recent Nonreportable Incidents At RHHL.
A0151	2/4/1986	CELL 4		Loss Of Breathing Air Supply During Cell Entry.
A0152	2/19/1986	RM 139		Maintenance Employee Cut Finger On Radioactive Exhaust Plenum.
A0155	3/4/1986	SERVICE GALLERY		Alconox And Water Solution Splashed In Eye Of Employee.
A0156	4/16/1986	HOT STORAGE RM	Sr90	Inventory Revealed Check Source Missing.
A0165	10/28/1986	CELL 4	U/Mixed Fission Product	Ignition Of Fermi Saw Chips During Disassembly In Cell 4.
A0173	3/12/1987	CELL 4		Employee Passed Out From Heat Exhaustion In Radioactive Environment Of Cell 4.
A0174	7/10/1987	CELL 2	Mixed Fission Product	Employee Contaminated Wrist During Doffing Protective Clothing.
A0175	7/14/1987	CELL 2	Mixed Fission Product	Protective Clothing Seal Failure Resulted In Contamination Of Employee's Neck.
A0177	7/20/1987	CELL 2	Mixed Fission Product	Exit Survey Revealed Neck Contamination On Employee.
A0178	10/15/1987	SERVICE GALLERY	Mixed Fission Product	Waste Handling Exit Survey Revealed Contaminated Pants.
A0181	12/1/1987	OPERATING GAL		Employee Pinched Finger And Drew Blood While Working With Radioactive Shield Plug.
A0182	12/17/1987	SUMP PUMP		Employees Entered RAAEP Area And Confined Space Without Permits Or Approvals[a]
A0185	6/13/1988	BASEMENT ALCOVE		Faulty Meter Alarmed Security Guards.
A0190	9/30/1988	CELL 1	Mixed Fission Product	Exit Survey Revealed Contamination On Knee After Cell Work.
A0191	10/10/1988	CELL 1	Mixed Fission Product	Exit Survey Revealed Contamination On Knee And Forearms After Cell Work.
A0192	11/14/1988	STORAGE RM 153		Employee Received Puncture Wound In Contaminated Area.
A0193	1/4/1989	CELL 1	Mixed Fission Product	Improper Seal Of Protective Equipment Allowed Radioactive Inhalation By Employee.
A0198	6/6/1989	CELL 1	Mixed Fission Product	Employee Exit Survey Revealed Contamination From In-Cell Operation.

Building 4020 Incident Report Summary (continued)

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A0199	6/29/1989	CELL 2 & DECN 1	Mixed Fission Product	Exit Survey Revealed General Point Of Contact Contamination.
A0201	10/4/1989	GLOVE BOX RM139	Pu	Puncture Wound In Plutonium Glove Box Room.
A0587	12/15/1989	RHHL AIRLOCK		Filter Failure On Vacuum Cleaner During Scabbling Of Contaminated Concrete.
A0205	4/18/1990	CELL 2	Mixed Fission Product	Contaminated Steel Chip Projectile Penetrated Wrist Cutting Radial Artery.
A0207	7/17/1990	CELL 3	Mixed Fission Product	Ladder Slid Out From Under Employee While Sledge Hammering In Cell.
A0210	10/17/1990	SERVICE GALLERY	Mixed Fission Product	A Dropped Duct Section Missed Employees But Caused Airborne Activity.
A0213	12/17/1990	T468 RADIOACTIVE LIQ BL		False Reading On RAS Detector Caused Alarm.
A0267	8/26/1991	OPERATING GAL		Contamination Barriers Blown Out Into Clean Area By Grit Blaster In Cell.
A0571	6/17/1993	RHHL BASEMENT	Mixed Fission Product	Employee Became Contaminated During D&D Of Radioactive Exhaust Duct.
A0575	9/15/1993	RHHL CELL 3		Dosimeter Went Off Scale During Work In High Radiation Area.
A0662	5/10/1995	AREA IV, DECON3		Dumping Of Vacuum Catch Drum Without Notification.
A0668	4/16/1996	SS T020 Rm 147		Particle On Right Shoe
A0675	3/26/1997	PARKING LOT		Loss Of Control Of Radioactive Material
A0677	7/2/1997	FRISKED SHOE		Contaminated Pipe
A0679	8/15/1997	RUBBER BOOT		Rubber Boot Had A Hole In It
A0678	8/15/1997	LEFT HAND		Contractor Removed Paper Suit Without Gloves
A0689	10/1/1997	T020 PARKIN LOT		Shipment Of Clean T020 Building Debris Prior To State Confirmatory Survey
A0682	3/20/1998	South Stor. Yd		Unauthorized Move Of Radioactive Material

[a] The acronym RAAEP cannot be defined from available documents. On December 17, 1987, an incident occurred at a sump pump and employees entered a confined space without the proper permits or approval (Incident Report A0182). The original incident report is identified as missing from Boeing's incident files. No other details are available on this incident at this time.

Incidents of known environmental releases:

- On December 5, 1959, radioactive liquid spilled during vendor pick up and contaminated the vendor's truck. The Coastwise Marine Disposal Company arrived to pick up approximately 2,000 gallons of liquid waste from the hold-up tanks in the basement of Building 4020. The truck was parked adjacent to the north loading dock of the building and the flow of liquid was controlled by a valve near the dock. The van was loaded with 51 empty 55-gallon drums and lids. The wooden floor of the van was covered with a white powder used to solidify liquid waste, but the floor was not watertight. A long plank was resting on top of the drums for walking from the back to the front of the van

and a long stick was used for stirring the solidifying agent into the wastewater. The first drum of water was pumped out to the 50-gallon mark and then the solidifying agent was added to demonstrate its capabilities.

When the agent was dumped into the drum, a small amount of radioactive water splattered out into the truck body and flooring and also onto some planks in the back of the open van. The vendor was directed to put some covering down in the back of the open van. A piece of plastic sheeting was provided and the vendors were told not to move off the plastic without removing all protective clothing and leaving it on the plastic sheeting. A bit later, a small amount of water was observed coming out of the van body and running onto the rear wheels of the van. Solidifying agent was immediately thrown on the floor of the van to try and soak up the radioactive water that was trickling down onto the wheels and ground. Pumping of the water was halted until a satisfactory means of controlling the water inside the van body was devised so that more radioactive water would not be spilled onto the asphalt loading pad. The wastewater transfer was stopped until the degree of contamination could be determined.

Smears were taken of the truck wheels, axle, and body and the asphalt area under the truck. Twenty smears were taken and averaged approximately 75 disintegrations per minute per 100 centimeters squared (dpm/100 cm^2) beta-gamma. The background radiation intensity had not risen on the survey instrument over normal levels. Pumping operations were discontinued until the truck and area were decontaminated to a level of 30 dpm/100 cm^2 beta-gamma, the Atomics International contamination limit for an uncontrolled area. The truck was wiped down and allowed to leave the area after smears showed the beta-gamma measurement was less than 30 dpm/100 cm^2 (Incident Report A0001).[1]

The quantity of liquid waste that was released to the ground surface was not reported in this incident report. Additionally, the report does not describe any cleanup efforts that were made on the asphalt surface. Resulting contamination on the asphalt surface would have flowed to the northeast across the parking lot into the drainage ditch on the south side of G Street.

- On May 9, 1962, a fire occurred in Cell #4 of Building 4020. Prior to the fire, an irradiated capsule containing uranium slugs in a stainless steel tube bonded with sodium-potassium alloy (NaK) was being disassembled in the Hot Lab. The capsule was separated into two pieces and during decladding of the longer piece in Cell #4 the liquid nitrogen supply necessary to maintain the cell atmosphere ran out. Examination of the fuel was discontinued and the fuel slugs were stored under amyl alcohol in a metal tray and covered with a metal plate.

  It was thought that a piece of partially oxidized NaK may have fallen onto the cell floor during the transfer of slugs to the metal tray. When the humidity in the cell increased, the NaK oxidized at a rate that generated sufficient heat to ignite the cell floor covering and the alcohol vapors outside the metal tray. Alcohol inside the tray also evaporated exposing the fuel slugs to air and allowing NaK inside the slugs to oxidize. Three of the

[1] Clow, H.E., Atomics International Internal Letter, *Re: Liquid Waste Removal at CDHC*, January 20, 1960.

nine fuel slugs were destroyed completely. According to the incident report, at the time of the fire, the only volatile radioisotopes remaining in the fuel in significant quantities were krypton-85 (Kr-85) and iodine-131 (I-131). A maximum of 7.8×10^{-5} micro curies per cubic centimeter (µCi/cc) of Kr-85 and 1.3×10^{-6} µCi/cc of I-131 were estimated to be released through the exhaust stack. The incident report summarized that the release could not have resulted in significant exposure to personnel or surrounding areas (Incident Report A0317).[1]

- On May 31, 1962, a portable radioactive liquid holdup tank was being filled from the radioactive holdup tank inside Building 4020. The operator's attention was diverted by a leaking pipe fitting at the bottom of the portable tank. While the operator was tightening the pipe fitting, the portable tank overflowed and a maximum of 50 gallons of liquid was spilled. Analysis of the liquid remaining in the tank showed an activity level of 2.2×10^{-3} µCi/cc, indicating a total activity of 420 µCi involved in the spill. The portable tank was on a concrete pad surrounded by an asphalt apron that sloped to the roadway. The spilled liquid immediately flowed down slope to the road and then to a drainage ditch, which connected to the "cold sewerage system." The pattern of the spill is shown in a Building 4020 figure included in this report (Figure 2.2.1s).

  Decontamination procedures began immediately. Within minutes of the spill the area was hosed down with fire hoses to prevent any fixation of particulate matter and to dilute liquid already in the drainage ditch. The area was roped off and decontamination of the asphalt began with mops and brushes. Prior to decontamination smears of the asphalt and concrete pad were as high as 50,000 dpm. After a series of scrubbing procedures the area was decontaminated to the point that no detectable removable contamination was found. The area was then surveyed with a portable floor monitor and a 2612 G.M. survey instrument to locate areas of fixed contamination.

  Thirty-seven "hot-spots" approximately 2 inches in diameter were found to have radiation levels in excess of 1 millirad per hour (mrad/hr). Levels ranged from 2 mrad/hr to 130 mrad/hr beta-gamma. These areas were marked with white paint and chipped away. Following chipping, no detectable activity remained. A survey of the drainage ditch with the 2612 G.M. survey instrument found no activity above normal background. Sixty samples were taken from the bed of the drainage ditch from the site of the spill to the sewage treatment facility. Contamination levels ranged from less than 30 dpm to greater than 500 dpm beta-gamma, with an average of approximately 100 dpm beta-gamma contamination. The ditch was sampled from the site of the incident to its entry into the sewage treatment facility. The contamination appeared to be evenly distributed throughout this 400 yard length. Surface soil samples of the ditch showed contamination in the amount of 0.06 micro curies per square foot (µCi/ft^2) (using a factor of 10 for self absorption of the sample). The entire length of the ditch was approximately 1,500 square feet (ft^2), so it was estimated that the total contamination remaining in the ditch was 90 µCi. The incident report notes that removal of the contamination was probably not warranted by the contamination levels, the "narrow, tortuous and deep" nature of the ditch, and the fact that the ditch traversed unoccupied areas. Additional flushing was seen as increasing the rate of contamination in the sewer system. It appears from the

[1] Remley, M.E., Atomics International, to Levy, J. V., U.S. Atomic Energy Commission, *Re: Fire in the Component Development Hot Cell, May 9*, June 7, 1962.

incident report that no other cleanup was performed, although recommendations for prevention of similar incidents were made (Incident Report A0016).[1,2]

- On July 2, 1963, an area in the radioactive holding area of Building 4020 approximately 15 feet by 3 feet was contaminated to a level of 7.4×10^{-4} µCi/cc. The incident report did not provide a detailed description of the location of this contamination. The Health and Safety Section requested the area be decontaminated and sealed before the contamination spread to other clean areas. This area was contaminated during a spill of "EB 40" from the Organic Moderated Reactor Experiment (OMRE) cask (Incident Report A0022).[3]

- On July 8, 1963, three Atomics International employees working at Building 4020 were contaminated while moving a cask containing radioactive waste material. The cask was transferred from Cell #1 to a building airlock using a fork lift and special lifting rig. At the airlock the cask was placed in clean plastic bags. The cask was then transferred to a clean fork lift outside the building, without changing the contaminated lifting rig that had been used inside the building. Three employees working outside the building had contact with the contaminated lifting rig. Because the three employees were involved in different stages of the procedure and had continued on to other activities in the day, personnel contamination was discovered over the course of a day. One employee had to have his car and home surveyed as he had gone home before the contaminated lifting rig had been discovered. A spot of contamination was noted on the employee's shirt and his trousers at 0.03 mr/hr and 0.7 mr/hr, respectively; however, it was not felt that contamination had spread outside of Atomics International premises (units may be incorrectly presented in the source document). The lifting rig was decontaminated and personnel surveys indicated no significant external or internal radiation exposure (Incident Report A0316).[4]

- On September 25, 1963, a fire occurred in Cell #3 of Building 4020. The fire occurred during the dissolving of NaK bonding material on fuel cladding using butyl alcohol, a routine operation. Concurrent with the start of the fire, the operating gallery continuous air monitor increased approximately 400 Ci/m beta-gamma.[5] A high volume air sample taken in front of Cell #3 after the fire began indicated 9.4×10^{-10} µCi/cc beta-gamma, a factor of 10 higher than a sample taken a short time before the fire. The fire burned a piece of wood, Tygon tubing, butyl alcohol, blotter paper, and the plastic boot that helps keep the contamination levels of the manipulator down. The fire was extinguished within 10 minutes using a nitrogen purge. The airborne concentrations were significant and bioassays of all personnel in the area at the time of the fire indicated a positive and significant intake of mixed fission product. If the cell had not recently undergone a major cleanup, the airborne release could have been more serious. During investigation of the

[1] Heine, W.F., Atomics International Internal Letter, *Re: Radioactive Spill at CDHC Bldg. 20 Santa Susana*, June 13, 1962.
[2] Coonce, G.L., Atomics International Internal Letter, *Re: Contamination Survey*, June 7, 1962.
[3] Lane, W.D., North American Aviation, Inc. Internal Letter, *Re: Decontamination of R/A Holding Area at CDHC*, July 2, 1963.
[4] Remley, M.E., Atomics International, to Levy, J.V., U.S. Atomic Energy Commission, *Re: Unusual Incident at the Component Development Hot Cell*, July 15, 1963.
[5] It is unclear from the incident report whether the operating gallery continuous air monitor increased approximately 400 Ci/m beta-gamma or 400 cpm beta-gamma.

incident it was discovered that air flow in the building was below design standards in some areas (Incident Report A0027).[1]

- On November 24, 1964 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. Transfer of the liquid waste from inside of Building 4020 had stopped when the pump malfunctioned leaving the transfer tank half full. Repairs were made and pumping was restarted at a rate of 30 gallons per minute. The operator, unaware the pump was working at full rate, was approximately 12 feet from the tank when it overflowed. The shutoff valve was immediately closed and a maximum of 25 gallons of liquid was lost at the north loading dock area.

  Analysis of the liquid remaining in the transfer line showed an activity of 2.4×10^{-1} µCi/cc indicating a total release of 2.3×10^{4} µCi/cc was involved in the spill. The radioactive liquid included Cs-137, zirconium-95 (Zr-95), and niobium-95 (Nb-95). Approximately 300 ft^2 of cement pad and asphalt were contaminated. The spill area was outlined with spray paint and desiccant was placed in the larger puddles to control runoff. A radiation survey indicated general levels of 10-15 mrad/hr beta-gamma activity and a maximum of 20 mrad/hr beta-gamma at approximately 2 inches above the water on the ground.

  Preliminary decontamination efforts included scrubbing and vacuum cleaning. The gross contamination of the cement pad was reduced to 1 mrad/hr at the surface and less than 10,000 dpm beta-gamma on a tape smear. Levels on the asphalt, which was covered with a primer coat of paint, were 20 mrad/hr beta-gamma. Final decontamination efforts were completed on December 2, 1964. A final survey showed the cement pad to have 0.3 – 0.5 mrad/hr beta-gamma at the surface, less than 150 dpm beta-gamma on a tape smear, and less than 30 dpm/cm^2 beta-gamma on a normal smear, with three small surface cracks indicating 1.0 mrad/hr. A second coating of primer was applied to the asphalt and a maximum radiation level of 20 mrad/hr beta-gamma was embedded in the asphalt. No removable contamination was evident after the second coat of primer. The contaminated asphalt was not removed. Health and Safety determined that no further decontamination be performed, but the area would be routinely surveyed for future smearable contamination (A0033).[2]

- On May 27, 1965, Cell #3 was under a nitrogen purge to accommodate the decladding of irradiated uranium carbide fuel. The cladding was cut and NaK oozed out. An air monitor at the north end of the operating gallery started to increase setting off the primary alarm (1,000 Ci/m) and then the upper alarm point of 3,000 Ci/m. The 12 minute air sample indicated 1.5×10^{-8} µCi/cc. A second air sample taken 30 minutes after the initial alarm was 2.3×10^{-9} µCi/cc. Smears taken throughout the area were less than 30 dpm. A third air sample taken fifty minutes after the initial alarm indicated 7.3×10^{-10} µCi/cc beta-gamma immediate count This sample was recounted 90 minutes later and was 1.4×10^{-10} µCi/cc beta-gamma. The stack monitor indicated two distinct increases in activity.

[1] Badger, F.H., North American Aviation Internal Letter, *Re: Investigation of In-Cell Fire at CDHC*, November 4, 1963.
[2] Ericson, G.I., Atomics International Internal Letter, *Re: Radioactive Liquid Spill at CDHC Building 020*, January 12, 1965.

The maximum count rate was 500 Ci/m or an estimated 6.5 x 10^{-8} µCi/cc. The total gaseous release at the stack was estimated to be 0.12 mCi over a two hour period. No personnel or equipment contamination was detected (Incident Report A0035).[1]

- On August 12, 1965, rainwater from a one-way waste cask was being dumped in a "non-radioactive outside storage area" at the Hot Lab when an "unusually large" volume of water spilled out of the cask. The incident report did not provide a detailed description of the location of the incident. A survey of the water found it contaminated with 300 µCi of mixed fission product in suspension. The runoff was contained and the area secured. An absorbent was placed on the liquid and contamination was measured up to 20 mrad/hr. After vacuuming the absorbent and scrubbing the area with "Radiac Wash" the contamination was brought down to 0.2 mrad/hr. Contamination was confined to a 3-foot by 10-foot section of asphalt and no personnel contamination resulted from the incident. It was surmised that the cask had been improperly tagged and had possible internal contamination (Incident Report A0441).[2]

- On October 30, 1967, a radioactive liquid drain system clogged, spreading contaminated water throughout controlled areas of Building 4020. The water was pumped into the Radioactive Materials Handling Facility (RMHF) 500-gallon transfer tank, but removable beta contamination levels as high as 1.3 x 10^6 dpm/100 cm^2 remained. It was reported that all areas were successfully decontaminated (Incident Report A0627); however, details of the decontamination efforts were not provided.[3]

- On May 19, 1971, there was a fire in Decon #4 during the disposal of 100 gallons of liquid NaK, which contained 100 µCi of mixed fission products. A hole in a tank fill line caused the release of about 25 gallons of contaminated NaK, which then caught fire. Nearly all contamination was contained in Building 4020. Airborne activity and surface radiological contamination concentrations inside the building from the event range from 2 percent to 20 percent of permissible concentration for occupational use and the average concentration released through the stack to the outside of the facility was about 5 percent of the permitted concentration for an unrestricted area (Incident Report A0052).

- On July 29, 1975, a single irradiated SRE fuel slug ignited and partially burned in Cell #2 releasing an estimated 0.77 mCi of Kr-85 gas out of the stack and resulting in the momentary release of airborne radioactivity to the operating gallery. The fire was extinguished in 20 minutes with a nitrogen purge. The incident did not result in any overexposure and did not constitute a reportable incident. The SRE Core I fuel was being prepared for reprocessing by removing all NaK from the fuel slugs.

  The planned NaK distillation proved ineffective on badly damaged fuel and a new system was developed in Cell #2 to heat the fuel slugs and sweat the NaK out then dissolve it in alcohol. The slug in question had been soaked in alcohol for several days and ignited when it was heated with a high intensity lamp. The continuous air monitor in the

[1] Badger, F.H., Atomics International Internal Letter, *Re: Incident Report*, June 25, 1965.
[2] Badger, F.H., Atomics International Internal Letter, *Re: Incident Report, Non-Radioactive Outside Storage Area at AIHL Bldg. 020, SS, 8-12-65*, August 16, 1965.
[3] Alexander, R.E., Atomics International Internal Letter, *Re: Radiation Safety Unit Weekly Newsletter for Period Ending November 4, 1967*, November 10, 1967.

operating gallery stabilized at 6,000 cpm. The stack monitor indicated 700 cpm or 6.5 x 10^{-6} µCi/cc going out the stack. Routine analysis of basement air samples indicated 1.87 x 10^{-8} µCi/cc beta-gamma for a seven day period following the fire. This was a result of airborne activity released to the operating gallery being drawn down the electrical breezeway into up-air dampers in the basement (Incident Report A0054).[1]

- On October 20, 1981, a "clean" ladder located in an uncontrolled area and scheduled to be loaned out was routinely surveyed and found to be contaminated. The feet of the ladder indicated the highest activity with 30 mrad/hr beta-gamma and 5,000 dpm/ 100 cm^2 beta-gamma removable contamination. A general contamination level of 1,000 to 2,000 dpm/100 cm^2. No signification alpha activity was detected. The ladder was bagged and placed in a controlled area. All personnel were surveyed and the facility was smeared. No other activity was detected, with the exception of 300 dpm/ 100 cm^2 beta-gamma in Room 139 alongside a file cabinet. Further investigation found the ladder was from the radiologically-controlled service galley area of Building 4020. It had been used in painting Decon #4 in May 1980 and then accounting of the ladder after that time became vague (Incident Report A0092).[2]

- On December 18, 1981, a survey of the "Rad Pac" loading area of the airlock indicated an abnormally high reading from a low level waste can. A controlled search of the waste revealed a "Rad Pac" pin entangled in a Kimwipe. The tantalum-182 source pin measured 16.5 mCi of radioactivity. Typically, sources are calibrated individually and stored in numbered holes in a lead brick. Then the specific source pins for the customer are grouped for sealing in capsules and remove to a storage pig. The remaining source pins are removed and placed in a storage vial on a Kimwipe. The vial is closed and placed outside the storage pig. A mechanic missed placing one pin in the vial and it became hidden in a fold of the Kimwipe (Incident Report A0094).[3]

- On March 22, 1982, zirconium fuel pin fines (fine particles) from grinding of Fermi fuel in Cell #1 reacted violently during an oxidation process and nitrogen purge resulting in high airborne activity in an uncontrolled area of Building 4020. Fermi fuel pins are clad with zirconium. In order to recover the 25 percent enriched uranium remaining in the fuel the zirconium must be removed. Center-less grinding of the fuel was the preferred method. The grindings would be filtered from the coolant and oxidized in a furnace to render the normally unpredictable flammability of the zirconium fines harmless. The wet filter papers with wet fines were stored in a sealed tube until loaded into the furnace. The cell atmosphere would be reduced to less than 5 percent oxygen by a nitrogen purge. The furnace and fines were put under a vacuum to remove water vapor and then the furnace was turned on to 1,650 degrees Fahrenheit until the fines were oxidized. The oxide would then be placed in a storage can for analysis and disposition.

[1] Badger, F.H., Rockwell International Internal Letter, *Re: Fuel Slug Fire – Cell 2, July 29, 1975*, September 29, 1975.
[2] Badger, F.H., Rockwell International Internal Letter, *Re: Radiological Safety Incident Report, T020, October 20, 1981*, November 19, 1981.
[3] Badger, F.H., Rockwell International Internal Letter, *Re: Radiological Safety Incident Report, T020 Airlock, 12/18/81*, December 23, 1981.

During the incident, an "O" ring failed and created a loss of vacuum, allowing the "O" ring to burn. The electrical power to the operation was shut down and personnel were evacuated. Initial air samples and smears were normal and personnel returned to work. The oxygen content in Cell #1 was below 5 percent so the high volume nitrogen purge was switched to low volume and the furnace cool down air jets were started. A bit later, an air monitor in the operating gallery was checked again and showed a sharp increase in beta-gamma activity (~1,500 cpm). Additionally, the stack monitor showed a 400 cpm increase in particulate activity and a basement air monitor alarmed at ~3,500 cpm. A dilution fan was started and a high volume air sample was taken showing 3×10^{-9} µCi/cc. The nitrogen purge rate was changed and the air monitor in the operating gallery stabilized.

Air samples were collected through the building and analyzed. Activities were calculated on the basis of a one hour release. The maximum release occurred in the basement, an unoccupied area, at 1.3×10^{-8} µCi/cc. The maximum release in an occupied area was 3.4×10^{-9} µCi/cc at the face of Cell #2. The activity in the stack sample with a one hour base was 1.2×10^{-10} µCi/cc. Analysis of the air samples indicated Cs-137 as the dominant isotope and possible antimony-125 (Sb-125). No other isotopes were identified. Investigation found controllers on the cell purge systems were not working properly and cracks were noted in the radioactive exhaust ducts in the basement. The release of airborne activity was found to be the result of faulty controllers and activation of the furnace air jet cooling system while on a low volume nitrogen purge. All operations were halted until corrective actions and another safety review of the operations could be conducted (Incident Report A0101).[1,2]

- On March 26, 1997, a block with low level contamination was inadvertently not surveyed and released as clean. It was transferred to a radiologically uncontrolled area at the Hot Lab. The contaminated block (300 cpm) was discovered during a state confirmation survey. The block was moved into a radioactive material area and the contamination was reduced to less than 20 dpm/cm^2 alpha, less than 100 dpm/cm^2 beta, less than 100 cpm above lowest background, and less than 5 µr/hr (units may be incorrectly presented in the source document) above ambient background (Incident Report A0675).[3]

- On July 2, 1997, a block originally connected to a highly contaminated drain pipe and believed to be filled with concrete slurry was removed, leaking contamination onto the soil and asphalt. The discovery was made after an employee working in the area found contamination on his shoe (800 cpm). The affected area was roped off and highlighted for decontamination. The cause of the incident was determined to be incorrect handling procedures for the block, which was not originally known to be connected to the

[1] Badger, F.H., Rockwell International Internal Letter, *Re: Radiological Safety Incident Report, T020 – Cell 1, March 22, 1982*, March 29, 1982.
[2] Badger, F.H., Rockwell International Internal Letter, *Re: Final Report – Fermi Zirconium Fines Explosion Bldg. 20*, April 2, 1982.
[3] Harcombe, R., Boeing Internal Letter, *Re: Incident Report, Loss of Control of Radioactive Material, A0675, T020 Parking Lot, 3/26/97*, April 9, 1997.

contaminated drain pipe (Incident Report A0677). Additional information regarding the decontamination of this area could not be located in available documents.[1]

- On October 15, 1997, it was discovered that a roll-off of scrap material from Building 4020 was released to an outside contractor without a California Department of Health Services confirmatory survey. The materials in the roll-off had been surveyed clean, the survey documented, and the roll-off released from radiological control by Rocketdyne Health Physics. The state was not given the opportunity to perform a confirmatory survey as required under Rocketdyne's license. A notice of violation was issued. Rocketdyne implemented corrective procedural actions to prevent a recurrence (Incident Report A0689).[2]

- On March 17, 1998, four unauthorized contract personnel were loading concrete blocks on a flatbed truck from the radioactive materials area at Building 4020. The personnel were not "radiological worker qualified" and thus not authorized for area access. The "Radioactive Materials Area" posting boundary rope had been removed without authorization. A verbal stop work was issued and personnel were released from the area after being surveyed for radioactive contamination. All contract labor received additional training, and it was determined that the contract workers were allowed through control gates prior to the site supervisor being notified of their arrival (Incident Report A0682).[3]

Current Use: The building was completely demolished between 1995 and 1996, and the site was backfilled in 1997.[4] On January 31, 2005, DOE provided a letter to Boeing declaring that Boeing and ORISE surveys confirmed that DOE and DHS-approved soil cleanup levels had been met and that the Building 4020 site was suitable for release for unrestricted use.[5]

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): A chronology of radiological investigations at this building is as follows:

- **1973-1997 Annual Environmental Monitoring.** According to the 1973 annual report for environmental and radioactive effluent monitoring, the gaseous effluent released to unrestricted areas was monitored at Building 4020. Monitoring included the volume of the effluent releases, the average and maximum concentration (µCi/mL), and the total activity released (Ci). The results of this yearly data are presented in the annual environmental monitoring and facility effluent reports from 1973 through 1997.[6,7,8,1,2,3,4,5,6,7,8]

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[1] Deschamps, R., Boeing Internal Letter, *Re: Incident Report, Contamination Found on Employee's Shoe, A0677, T020, 7/2/97*, April 15, 1998.
[2] Guy, E., Energy Technology Engineering Center, *Occurrence Report, SAN ETEC-GENL-1997-0001*, January 29, 1998.
[3] Schaeppi, W., Boeing Internal Letter, *Re: Unauthorized Movement of Radioactive Material*, March 23, 1998.
[4] Boeing, Document No. EID-06141, *Hot Laboratory Decontamination and Dismantlement Final Report*, November 27, 2001.
[5] Lopez, M., Letter Re: Release of Building 4020, January 31, 2005.
[6] Moore, J.D., *Environmental and Radioactive Effluent Monitoring Annual Report 1973*, Undated.
[7] Rockwell International, Report No. ESG-79-7, *Environmental Monitoring and Facility Effluent Annual Report 1978*, April 1979.
[8] Rockwell International, Report No. ESG-81-17, *Environmental Monitoring and Facility Effluent Annual Report 1980*, May 27, 1981.

- **1996-1997 Building 4020 Decontamination and Decommissioning (D&D).** During the 1996 and 1997 excavation of the Building 4020 area and the surrounding asphalt and concrete, Rocketdyne took 135 soil samples to verify that any soil left in place and used as backfill met the release limits at the time. According to the 2000 final MARSSIM status survey report, which included a summary of the results as Appendix E of the report, the only man-made isotope detected was Cs-137 with the highest detectable level in soil being 0.91 pCi/g with an average level of 0.17 pCi/g. The location of the sample with the highest detectable level in soil was a surface soil sample located under the concrete slab at the southwest end of the service gallery. The report indicated that all samples were below the clean-up standard of 9.2 pCi/g. Soil samples were taken at the surface and to a depth of up to 18 feet below ground surface. As indicated above, when the excavation was backfilled, a 1-foot layer of sand was placed to indicate the depth of excavation.[9]

- **1998 Boeing Soil Sample Survey.** Boeing performed a soil sample survey in 1998 to ensure the Building 4020 site and leach pits were free of radiological contamination. The survey found no radioactivity above background levels. Measurements of activity ranges from 1,897 to 2,194 cpm compared with an average background measurement of 2,013 ± 50 cpm. Most soil samples were less than the minimum detectable activity of 0.02 pCi/g for Cs-137, with the highest measurement being 0.21 pCi/g (Cs-137 $DCGL_W$ is 9.2 pCi/g).[10]

- **1998-1999 State of California Radiological Health Branch Confirmatory Surveys.** During the course of demolition efforts, the State of California Radiological Health Branch performed confirmatory surveys of Building 4020 concrete blocks and building debris. These surveys were performed in 1998 and 1999 because at the time of demolition, the blocks were found to have radioactive contamination of several surfaces and were decontaminated by Boeing. The survey was to determine whether the blocks could be released for unrestricted use as defined in the Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use, DECON-1. For the purposes of these surveys, background measurements were taken at Building 4487. The surveys determined the representative sample of the concrete blocks were all at

[1] Rockwell International, Report No. ESG-82-21, *Environmental Monitoring and Facility Effluent Annual Report 1981*, July 15, 1982.
[2] Rockwell International, Report No. ESG-83-17, *Environmental Monitoring and Facility Effluent Annual Report 1982*, June 1983.
[3] Rockwell International, Report No. ESG-84-9, *Environmental Monitoring and Facility Effluent Annual Report 1983*, March 1984.
[4] Rockwell International, Report No. RI/RD85-123, *Environmental Monitoring and Facility Effluent Annual Report De Soto and Santa Susana Field Laboratories Sites 1984*, March 1985.
[5] Rockwell International, Report No. ESG-84-9, *Environmental Monitoring and Facility Effluent Annual Report 1983*, March 1984.
[6] Rockwell International, Report No. RI/RD85-123, *Environmental Monitoring and Facility Effluent Annual Report De Soto and Santa Susana Field Laboratories Sites 1984*, March 1985.
[7] Rockwell International, Report No. RI/RD86-140, *Environmental Monitoring and Facility Effluent Annual Report De Soto and Santa Susana Field Laboratories Sites 1985*,April 1986.
[8] Rockwell International, Report No. RI/RD87-133, *Environmental Monitoring and Facility Effluent Annual Report De Soto and Santa Susana Field Laboratories Sites 1986*, March 1987.
[9] Boeing, Document No. RS-00010, *Area 4020, MARSSIM Final Status Survey Report*, October 31, 2000.
[10] Shao, J., Letter Re: Soil Sampling Results for Buildings 468 & 020 at SSFL, August 3, 1998.

background levels, and the results of the contact measurements and laboratory analysis of collected samples indicated activity levels below the acceptable surface contamination levels in DECON-1. Accordingly, the State of California recommended the approval for release for unrestricted use of the concrete.[1,2,3]

- **1999 Rocketdyne Final Status Survey.** Rocketdyne performed a MARSSIM final status survey in September 1999, of the Hot Lab facility and the surrounding area (including Buildings 4468 and 4020). According to Rocketdyne, the principal contaminant of concern was identified as being Cs-137. The survey report indicated that "no other significant isotopes were found in the environment or soil without the adjoining presence of Cs-137." Soil sample analysis was performed for all potential radionuclides of concern, including gamma emitting radionuclides, Sr-90, Am-214, and isotopic plutonium, thorium, and uranium.

  The survey included a direct qualitative scan (100%) for surface gamma exposures, ambient gamma exposure rates at 1 meter above the ground, and soil sampling. The survey concluded that the site was acceptable for unrestricted use and could be released without radiological restrictions.

  The report summarized that the average surface exposure rates were 2.3 µR/hr for Class 1, 3.2 µR/hr for Class 2, and 2.3 µR/hr for Class 3.[4] The NRC limit was 5.0 µR/hr above background. The average ambient exposure rates ranged from 0.7 to 1.4 µR/hr, where the NRC limit was also 5.0 µR/hr above background. The nominal background exposure rates were measured at locations surrounding the Building 4030 area. The average background was 13.3 µR/hr.[5]

  Soil samples for Cs-137 showed an average level of 0.22 pCi/g and a maximum of 4.8 pCi/g. The Cs-137 derived concentration guideline limit ($DCGL_W$) was identified in the survey report to be 9.2 pCi/g above background. Soil samples for Th-228, Th-230, and Th-232 showed a maximum of 2.86 pCi/g, 1.38 pCi/g, and 2.68 pCi/g, respectively. The $DCGL_W$ for Th-228, Th-230, and Th-232 was identified in the survey report to be 5 pCi/g for each.[6]

  There were thirteen Pu-238 analyses, four Pu-239 analyses, one U-238 analysis, and one Sr-90 analysis. According to the survey report, plutonium results appeared somewhat elevated in comparison to the expected background levels. The Sr-90 sample was significantly higher than background at 22 pCi/g. While re-analysis of the same indicated 0.54 pCi/g, the area was remediated. The survey did not indicate the area requiring remediation or how the area was remediated. Rocketdyne requested reanalysis of the 18

[1] Lupo, Roger, *Confirmatory Survey of Building T020 Concrete Blocks and Other Building Debris, Santa Susana Field Laboratory*, September 17, 1998.
[2] Lupo, Roger, *Confirmation Survey of Building T020 Concrete Blocks and Other Building Debris, Santa Susana Field Laboratory*, March 26, 1999.
[3] Lupo, Roger, Confirmation Survey of Building T020 Concrete Blocks and Other Building Debris, Santa Susana Field Laboratory, September 27, 1999.
[4] According to the report, the average surface background level of 15.4 µR/hr was subtracted from the maximum surface exposure level to establish the above-listed results.
[5] Boeing, Document No. RS-00010, *Area 4020, MARSSIM Final Status Survey Report*, October 31, 2000.
[6] Boeing, Document No. RS-00010, *Area 4020, MARSSIM Final Status Survey Report*, October 31, 2000.

samples and the re-analysis showed most samples to be either non-detects, or significantly less than the original set of results.[1]

- **1997, 1998, & 1999 ORISE Verification Surveys**. On the dates of October 1, 1997, September 28, 1998, and October 28, 1999, ORISE performed a verification survey of Building 4020 and the surrounding area (including Building 4468 and 4720). The surveys were performed during three phases. Building 4020 had not been completed remediated during Phases I and II of the surveys in 1997 and 1998; however, Rocketdyne requested the surveys to be performed on the building footprint and septic trench to allow the areas to be backfilled prior to the start of the rainy season. The final survey used the final status survey methodologies contained in MARSSIM, classifying areas of the site as Class 1, 2, or 3 based on the history of radioactive material use.[2]

  During Phases I and II of the verification survey, the measurements and sampling locations were referenced to a 10-by-10-meter grid system established by ORISE. During Phase III, the grid system had been modified to be consistent with Rocketdyne's established 200-by-200-foot grid system.

  The survey included a 100 percent direct surface scan for gamma activity of the entire former Building 4020 facility. The survey also included exposure rate measurements at one meter above the surface at 26 locations, and soil samples were collected from a total of 42 locations within the former Building 4020 land area. Samples and data were sent to ORISE's ESSAP laboratory in Oak Ridge, Tennessee, for analysis and interpretation. The radionuclides of interest, according to the report, were uranium and mixed fission and activation products; however gamma spectra were also reviewed for other identifiable photopeaks. Composite samples from the Phase I survey were analyzed for strontium and isotopic plutonium.[3]

  The survey report concluded the site satisfied the DOE guidelines for release without radiological restrictions. The surface scan did not identify any locations of direct radiation in excess of "ambient background levels," which had been measured previously in 1996. The exposure rates, including background, ranged from 10 to 18 µR/hr compared to a background level of 14 µR/hr, which was reported to be below the NRC limit of 5 µR/hr above background and the DOE limit of 20 µR/hr above background. The report did not provide information to indicate how the background level of 14 µR/hr had been determined for the SSFL.[4]

  Minimum detectable concentrations of the following radionuclides were detected in soil samples: Am-241, Co-57, Co-58, Co-60, Cr-51, Eu-152, Fe-59, Mn-54, Sb-124, U-235, Sr-90, Pu-238, Pu-239, and Zn-65. Cs-137 ranged from less than 0.1 to 0.4 pCi/g in soils and Ra-226 ranged from less than 0.4 to 1.2 pCi/g. Th-232 ranged from less than 0.9 to

[1] Boeing, Document No. RS-00010, *Area 4020, MARSSIM Final Status Survey Report*, October 31, 2000.
[2] ORISE, Document No. ORISE 2000-1524, *Verification Survey for the Land Area Formerly Supporting the Hot Laboratory, Santa Susana Field Laboratory, The Boeing Company, Ventura County, California*, December 2000.
[3] ORISE, Document No. ORISE 2000-1524, *Verification Survey for the Land Area Formerly Supporting the Hot Laboratory, Santa Susana Field Laboratory, The Boeing Company, Ventura County, California*, December 2000.
[4] ORISE, Document No. ORISE 2000-1524, *Verification Survey for the Land Area Formerly Supporting the Hot Laboratory, Santa Susana Field Laboratory, The Boeing Company, Ventura County, California*, December 2000.

1.8 pCi/g and U-238 was detected at concentrations less than 2.3 pCi/g. All four of the above radionuclides measured below their respective guidelines, which were reported to have been approved by DOE and the State of California. These guidelines are presented in the table below as provided in the 2000 survey report:[1]

Generic Limits for Soil and Water
Santa Susana Field Laboratory (ORISE, 2000)

Radionuclide	Soil Guidelines (pCi/g)	Water (pCi/l)
Am-241	5.44	1.5
Co-60	1.94	200
Cs-134	3.33	75
Cs-137	9.20	110
Eu-152	4.51	840
Eu-154	4.11	570
Fe-55	629,000	9,000
H-3	31,900	20,000
K-40	27.6	290
Mn-54	6.11	2,000
Na-22	2.31	480
Ni-59	151,000	26,000
Pu-238	37.2	1.7
Pu-239	33.9	1.6
Pu-240	33.9	1.6
Pu-241	230	80
Pu-242	35.5	1.6
Ra-226	5 and 15[a]	4.1
Sr-90	36.0	8
Th-228	5 and 15[a]	6.8
Th-232	5 and 1[a]	2.0
U-234	30[b]	
U-235	30[b]	Total uranium 20[b]
U-238	35[b]	

[a]DOE Order 5400.5 limits were proposed (5 pCi/g averaged over first 15 cm of soil depth and 15 pCi/g averaged over 15 cm layers below the top 15 cm.
[b]Generally more conservative NRC limits for uranium isotopes were proposed

- DHS performed verification sampling in October 1999. However, the research team has been unable to find the report detailing this sampling. Therefore, the results of this sampling effort are unknown at this time.

Radiological Use Authorizations: Building 4020 was included in Special Nuclear Materials License No. SNM-21. The first license issued by the U.S. Atomic Energy Commission (AEC) for the SSFL site was Special Nuclear Material License No. SNM-21. 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.

[1] ORISE, Document No. ORISE 2000-1524, *Verification Survey for the Land Area Formerly Supporting the Hot Laboratory, Santa Susana Field Laboratory, The Boeing Company, Ventura County, California*, December 2000.

This license was terminated on September 27, 1996. The license required that all potentially contaminated liquid effluents from Building 4020 be analyzed prior to discharge.[1,2]

Former Radiological Burial or Disposal Locations: As indicated above, during initial construction, the facility radioactive drain was connected to two 500-gallon holdup tanks that were located in the north end of the basement. One of the tanks was designed for high-level waste and the other for low-level waste. Following an incident whereby these tanks overflowed, the system was modified by removing the 500-gallon tanks and the installation of the 3,000-gallon tank in Building 4468 in around 1970. After the new system had been put into place, the contents of these sumps were pumped into the Building 4468 holdup tank, discussed below.[3,4] Available documents, to date, have not provided information regarding the disposal of the two tanks located in the basement. Building 4468 was located to the east of the Hot Laboratory at the perimeter fence line.[5,6]

According to the 1984 license renewal application, an attempt was made to absorb or solidify all highly contaminated waste in the cell at the time of generation. The license renewal application indicates that "suitable materials" including Bentonite clays were used to form solid waste. As a result, "most of the tank contents" was generated during decontamination, using water. A weir box was used to catch large particles prior to their entering the holdup tank.[7] In Cell 1, the metallographic cell, highly acidic and basic solutions were used. A 5-gallon baffle tank separated coarse particles from the liquid prior to release to the holdup tank.[8]

Solid wastes that remained after the decladding of spent reactor fuel for the DOE was sealed in drums and shipped to the RMHF for handling and ultimate disposal at an authorized burial site. Contaminated solid wastes from other licensed activities were accumulated in drums and disposed of by shipment to a burial site authorized by Rockwell or were returned to the customer for burial under their license.[9] The frequency of the movement of the drums to the RMHF is unknown and documents do not provide information to indicate where the drums were stored prior to removal from Building 4020.

Aerial Photographs: In 1952, the area comprising the future Building 4020 area is agricultural land. Beginning in 1957, the area surrounding the future Building 4020 locations is becoming developed. By 1959 the building is present and is surrounded by possible outside storage to the north of the building and outside storage to the west of the location at the location of the hold yard for incoming casks. A parking lot is located south of the building and the building is bordered on the east by 24th Street. Few changes are visible in 1965 and 1967 with the exception

[1] U.S. Nuclear Regulatory Commission, *Materials License*, SNM-21, September 15, 1977.
[2] U.S. Nuclear Regulatory Commission, NUREG-1077, *Environmental Impact Appraisal for Renewal of Special Nuclear Material License No. SNM-21*, June 1984.
[3] Boeing, EID-06141, "Hot Laboratory Decontamination and Dismantlement Final Report," November 27, 2001.
[4] Boeing, Document No. RS-00010, *Area 402 MARSSIM Final Status Survey Report*, October 31, 2000.
[5] Boeing, Document No. RS-00010, *Area 402 MARSSIM Final Status Survey Report*, October 31, 2000.
[6] Boeing, EID-06141, "Hot Laboratory Decontamination and Dismantlement Final Report," November 27, 2001.
[7] Rockwell International, ESG-82-33, *Health and Safety Sections for Renewal Application of the Special Nuclear Materials License SNM-21, Docket 70-25, Issued to Energy Systems Group of Rockwell International*, June 5, 1984.
[8] Rockwell International, ESG-82-33, *Health and Safety Sections for Renewal Application of the Special Nuclear Materials License SNM-21, Docket 70-25, Issued to Energy Systems Group of Rockwell International*, June 5, 1984.
[9] Rockwell International, ESG-82-33, *Health and Safety Sections for Renewal Application of the Special Nuclear Materials License SNM-21, Docket 70-25, Issued to Energy Systems Group of Rockwell International*, June 5, 1984.

of the presence of a trailer located to the east of the building. By 1972, the trailer is no longer visible, but Building 4468 has been constructed to the east of the building. The aerial photograph interpretation makes note of the presence of a possible horizontal tank and possible vertical tank north of Building 4020. These remain visible in 1978, as well as the continued use of the western side of the building for outside storage. In 1980, at the northwest corner of the building, outside storage is visible with possible staining of the pavement. The area remains unchanged until 1988 when increased operations are visible surrounding the building. Numerous vehicles are located at the parking lot, outside storage is visible to the west and north of the building, and a trailer is located on the east side of the building between Buildings 4020 and 4468. By 1995 the area surrounding Building 4020 does not appear to be very active, with the exception of crates located at the northwest corner of the building and the presence of some light outside storage activities at the southwest end of the building. The building is reported to have been removed between 1995 and 1998, and by 2005 the area has been leveled and is vegetated.[1]

Radionuclides of Concern: Building 4020 handled a number of radionuclides including uranium, plutonium, thorium, and promethium. Decay products from U-235, U-238, and Th-232 decay chains include Th-234, Th-228, Ac-228, Ra-226, Pb-214, Bi-214, Pb-212, Bi212, and Tl-208. In addition, H-3, Sr-90, Cs-137, Na-24, Co-57, Co-60, Eu-152, and Am-243 would have been formed. All radionuclides of concern listed, with the exception of Na-24 and Co-57 (due to relatively short half-lives), are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. Table 3.3 presents a summary of radionuclides of concern.

Drainage Pathways: Historical photos indicate that 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. Currently, the majority of the surface water run-off drains to the north-northeast, into the ditch on the south side of G Street, then east into Area III.

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4020 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 2.2 provide a convenient reference for the following recommendations.

Based on the available information, soil sampling is recommended in the Building 4020 area. As discussed above, 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:

[1] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.

- 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.

2.2.2 Building 4468 Area

Site Description: The Building 4468 area includes Building 4468 and the surrounding area. Constructed in approximately 1970, Building 4468 housed a 3,000-gallon waste holdup tank that was connected to Building 4020. Other buildings within the vicinity of Building 4468 included Building 4020 to the west and Building 4055 located to the east across 24th Street. Figures 2.2.2a through 2.2.2g provide a current photograph and the best available building-specific drawing(s) and photographs that the research team could find. Plate 1 presents a summary of all identified features for this site.

Building Features: Building 4468 was located adjacent to and at a slightly lower elevation than the Hot Laboratory building, Building 4020. It was a 10-foot by 22-foot by 20-foot aboveground cinderblock building with a steel roof. The building also consisted of a 12-foot below-grade structure of poured concrete. During operation, the building was prone to occasional groundwater seepage that would fill the facility sump and overflow onto the floor.[1]

The building housed an underground 3,000-gallon liquid waste holdup tank connected to Building 4020 thru a radioactive drain system. All of the radiologically controlled areas within Building 4020 were connected to the drain system that terminated in the Building 4468 holdup tank (see Figures 2.2.2b and 2.2.2d). The Building 4020 radioactive drain system consisted of several drain lines that drained each of the controlled areas, including the hot cells, decontamination rooms, service gallery, hot support rooms, hot change room, and basement. The system was an all-butt-welded stainless steel piping system that joined in the basement and flowed through a double-walled pipe to the Building 4468 holdup tank. The drain lines were embedded in the support-area concrete slab and the rebar-reinforced concrete between the main floor of Building 4020 and the basement. The basement of Building 4020 contained a drain subsystem that drained into three sumps (described above in Section 2.2.1), one at each end of the basement and one near the center. The contents of these sumps were automatically pumped into the Building 4468 holdup tank through a 30-foot long, 2-foot diameter utility tunnel (see Figures 2.2.2b and 2.2.2d).[2]

The inlet at the top of the Building 4468 holdup tank was preceded by a weir that trapped much of the sediment that had been transported down the drain lines. A 4-inch drain line at the inlet to the weir and tank connected to the west wall of Building 4020. During decommissioning, remote video cameras were used to inspect the line and it was noted that centering lugs were welded to the pipe to connect the pipe to an outer secondary containment casing.[3]

The tank was also connected to an underground 2-inch diameter pipe that was used to transfer contaminated waste water from the 3,000-gallon tank to a 500-gallon portable transfer tank loading station. The pipes, unlike the facility radioactive drain lines, were not welded stainless steel, but were a combination of black iron and galvanized pipe. According to the 2001 decontamination and dismantlement report, the pipes degraded through electrolysis between the two different types of pipe material. The result was the contamination of approximately 30 cubic yards of soil on the west side of Building 4468; however, available documents do not indicate the duration of the contaminating activities or how much waste was lost through the degraded pipes. Information regarding the removal of contaminated soil in this area in 1995 is discussed below.[4]

Former Use(s): According to the 2000 final status survey document, Building 4468 was added to the Hot Lab facilities in approximately 1970 to contain a new radioactive liquid waste holdup tank in a pit at the east side of Building 4020. The building was constructed to support the operations of Building 4020 by receiving and storing radioactive effluent generated by the operations of the Hot Lab. As indicated above, when Building 4020 was originally constructed, the facility radioactive drain was connected to two 500-gallon holdup tanks located in the north

[1] Boeing, EID-06141, "Hot Laboratory Decontamination and Dismantlement Final Report," November 27, 2001.
[2] Boeing, EID-06141, "Hot Laboratory Decontamination and Dismantlement Final Report," November 27, 2001.
[3] Boeing, EID-06141, "Hot Laboratory Decontamination and Dismantlement Final Report," November 27, 2001.
[4] Boeing, EID-06141, "Hot Laboratory Decontamination and Dismantlement Final Report," November 27, 2001.

end of the basement. An unknown incident involving the overflow of one of the tanks documented in the final decontamination and dismantlement report resulted in the construction of a new 3,000-gallon tank in Building 4468 for increased storage capacity. The new tank reduced radiation exposure to personnel working in the basement area, and the new system contained and controlled larger quantities of radioactive wastewater.[1]

The 3,000-gallon liquid waste tank was removed from the building during the 1994 fiscal year after the drainage system was removed from Building 4020. The tank was wrapped in plastic and transported to the RMHF where it was place in interim storage in a below-grade shielded vault for "later removal of the remaining sludge and debris, size reduction, and packaging for disposal." Rockwell International initiated the decontamination and demolition of Building 4468 with the removal of the steel roof, the wash-down of interior surfaces with a high-pressure spray, and the removal of all loose contamination and liquid waste generated during the cleaning process. The interior surfaces were surveyed (discussed below), and the lower 12 feet of all wall surfaces were sealed with ALARA paint to fix remaining surface contamination in place. A contractor was hired to excavate the soil surrounding the building and to saw-cut and demolish the facility. The above-grade portions of the walls were saw-cut first and placed in roll-off containers for "off-site" disposal. The soil surrounding the remaining structure was excavated to a depth of 4 feet, and a series of 3-inch diameter holes were cored through the concrete walls for removal. The contractor then excavated a trench around the building to the base of the structure. During excavation, the soil was surveyed in 2-foot increments and was determined to be radiologically clean (survey results presented below).[2] A construction change request indicated that the removed soil surrounding Building 4468 was transported in an ETEC dump truck to the "other side of the yard" for sampling. The change request did not define the "other side of the yard."[3] Available documents do not indicate whether the soil was backfilled into the excavation or disposed off site. Upon receipt of additional documents from Boeing's 1.4 million document database, additional information regarding the removal of this soil may be located.

The contractor saw-cut the excavated wall structure from the outside, leaving an approximately ¼-inch thickness uncut at the interior surface to "ensure that the cutting water did not become contaminated." The individual wall segments were supported using the Rocketdyne mobile crane and a sling through one of the holes while the bottom horizontal cut was made. The cut segment was snapped off and moved to an unidentified staging area where it was "double-wrapped in plastic for contamination control." Twenty-seven wall and floor slab sections were cut and transferred to the RMHF for staging and shipment to a DOE-approved disposal site. The source document does not state what the final DOE-approved disposal site was.[4]

DOE approved the removal of Radioactive Material Management Area for the Hot Lab facility in November 1998, which included the holdup tank and leach pits.[5]

During demolition activities, the contractor removed soil surrounding Building 4468 and transported the soils in an ETEC dump truck to the "other side of the yard" for sampling. The

[1] Boeing, EID-06141, "Hot Laboratory Decontamination and Dismantlement Final Report," November 27, 2001.
[2] Boeing, EID-06141, "Hot Laboratory Decontamination and Dismantlement Final Report," November 27, 2001.
[3] Unknown, *Construction Change Request (I) G.D. Heil Inc. Building 468/B020 Yard*, Date Unknown. HDMSE00233388.
[4] Boeing, EID-06141, "Hot Laboratory Decontamination and Dismantlement Final Report," November 27, 2001.
[5] Lopez, M., Letter Re: Removal of RMMA Designation for B020, November 13, 1998.

contract was instructed to remove 4 feet of soil at a time to allow saw cutting of the concrete walls in 4- by 4- by 1-foot slabs. The crane to lift the blocks was provided by ETEC and ETEC engineering designed the configuration of the size of the blocks and "lifting core hole." This work was to be completed in parallel with the excavation of the abandoned septic tank and abandoned leaching system. According to the demolition proposal, the area around the perimeter of Building 4468 was to have been excavated 3 feet wide and to a depth of 12 feet. The area of the septic tank and abandoned leaching system were to have been excavated 20 feet wide and to a depth of 12 feet. Similar to Building 4020, the Building 4468 excavation was filled with 6 inches of sand prior to backfilling with on-site material.[1] The Building 4020 leaching system and septic tank system are discussed above in Section 2.2.1.[2]

Information from Interviewees: None, to date.

Radiological Incident Reports: There have been two reported incidents associated with Building 4468; however, neither incident resulted in a release to the environment. The following table provides information presented in an incidents database provided by Boeing.

Building 4468 Incident Report Summary

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A0325	8/16/1982	LIQUID WASTE BL		RAS Alarm Response At RIHL Radioactive Liquid Waste Bldg.
A0213	12/17/1990	T468 RADIOACTIVE LIQ BL		False Reading On RAS Detector Caused Alarm.

Current Use: According to the 1998 Site Environmental Report, Boeing completed D&D activities of the Hot Lab in 1998 with the removal of Building 4468. During demolition, Boeing determined the inside of Building 4468 was contaminated, although the soil surrounding the building was not. Rocketdyne, ORISE, and the California DHS samples the soil within the excavation to verify no contamination remained prior to backfilling the excavated areas, which was completed prior to the 1998/1999 rainy season.[3] On January 31, 2005, DOE declared that Boeing and ORISE surveys confirmed that the Building 4020 site, including Building 4468, was suitable for release for unrestricted use.[4]

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): A chronology of radiological investigations at this building is as follows:

- **1996 Boeing Soil Removal.** In 1996, approximately 30 cubic yards of contaminated soil was removed from the area between Building 4020 and Building 4468. The depth of removal was not located in the report, nor did the report indicate how the soil was disposed. The source of contamination was an underground 2-inch diameter pipe that has

[1] McLain, Steve, G.D. Heil, Inc., Demolition Contractors Letter Re: Excavation and Sawcutting at Building 468, Santa Susana Field Lab, Ventura County, CA, June 11, 1998.
[2] Unknown, *Construction Change Request (I) G.D. Heil Inc. Building 468/B020 Yard*, Date Unknown. HDMSE00233388.
[3] Boeing, RD99-115, *Site Environmental Report for Calendar Year 1998 DOE Operations at Rocketdyne Propulsion & Power*, September 22, 1999.
[4] Lopez, M., Letter Re: Release of Building 4020, January 31, 2005.

been used to transfer contaminated waste water from the 3,000-gallon tank to the 500-gallon portable transfer tank loading station.[1]

- **1996 Rocketdyne Area IV Radiological Characterization Survey.** During the 1996 Area IV Radiological Characterization Survey, soil samples were taken at one location in the vicinity of Building 4468. None of the measurements were distinguishable from background and all measurements were below the acceptable concentration levels established by Boeing.[2]

- **1997 Boeing Final Status Survey.** In 1997, two hundred and sixteen surface and subsurface soil locations were sampled following the removal of the concrete basement area of Building 4020. The samples were analyzed by gamma spectroscopy for elevated concentrations of Cs-137. The sampling included two samples from a trench on the west side of Building 4468 and one sample from the northern side of the "liquid waste facility," which is also believed to be Building 4468. Both samples from the trench were subsurface samples taken approximately 8 feet below ground surface while the sample from the northern side of the building was a surface sample. One of the subsurface samples measured 0.03 pCi/g for Cs-137 and the surface sample measured 0.02 pCi/g for Cs-137. The report indicated that all samples were below Boeing's clean-up standard of 9.2 pCi/g.[3]

- **1998 Boeing Radiation Survey of Excavated Soil.** On August 3, 1998, Boeing reported the results of a radiation survey performed on samples from excavated soil from Building 4468. During the soil excavation at Building 4468, Boeing collected one soil sample from approximately every 10 cubic feet of excavated soil, resulting in 195 soil samples. Each soil sample was measured using a one-minute count with a 1-by1-inch sodium iodine (NaI) detector. The measurement results ranged from 1,897 to 2,197 counts per minute (cpm) with a mean value of 1,990 cpm. To determine background, Boeing collected a sample approximately 150 feet west of the excavation area in "an area unaffected by Building 20 operations." Ten measurements were taken and the mean background soil measurement was 2,013 cpm.

- **1998 Boeing Soil Sampling.** During the demolition of Building 4468, Boeing analyzed 13 soil samples to determine the need to remediate contaminated soil and to "pre-release" the facility. The sampling included only gamma spectrometry and, as a result, only gamma emitting radionuclides were identified for the sampling locations. The results showed that all samples were below the site-wide release limit for Cs-137 of 9.2 pCi/g as well as below local fallout levels. ORISE and the DHS/Radiological Health Branch (RHB) also sampled the soil remaining in the cavity following demolition activities. Both agencies reported all sample results were below typical background concentrations that were lower than the 1998 cleanup standards.[4]

[1] Boeing, EID-06141, "Hot Laboratory Decontamination and Dismantlement Final Report," November 27, 2001.
[2] Rocketdyne, Report A4CM-ZR-0011, "Area IV Radiological Characterization Survey Final Report," August 15, 1996.
[3] Boeing, RS-00010, *Area 4020 MARSSIM Final Status Survey Report*, August 31, 2000.
[4] Boeing, RD99-115, *Site Environmental Report for Calendar Year 1998 DOE Operations at Rocketdyne Propulsion & Power*, September 22, 1999.

- **1998 Boeing Soil Sample Survey.** Boeing performed a soil sample survey in 1998 on samples from excavated soil from Building 4468 and the septic columns and leach field associated with Building 4020. During soil excavation, one soil sample was taken from approximately every 10 cubic feet of excavated soil, resulting in 195 soil samples. Measurements of activity ranged from 1,897 to 2,194 cpm compared with an average background measurement of 2,013 ± 50 cpm. Most soil samples were less than the minimum detectable activity of 0.02 pCi/g for Cs-137, with the highest measurement being 0.21 pCi/g (Cs-137 $DCGL_w$ is 9.2 pCi/g).[1]

- **1999 Rocketdyne Final Status Survey.** Rocketdyne performed a MARSSIM final status survey in September 1999, of the Hot Lab facility and the surrounding area (including Buildings 4468 and 4020). According to the report, the principal contaminant of concern was Cs-137. The report also included soil sample analysis for all potential radionuclides of concern, including gamma emitting radionuclides, Sr-90, Am-241, and isotopic plutonium, thorium, and uranium.

  The survey included a direct qualitative scan (100%) for surface gamma exposures, ambient gamma exposure rates at 1 meter above the ground and soil sampling. The survey concluded that the site was acceptable for unrestricted use and could be released without radiological restrictions. The average surface exposure rates, adjusted for background, were 2.3 µR/hr for Class 1, 3.2 µR/hr for Class 2, and 2.3 µR/hr for Class 3. At this time the NRC limit was 5.0 µR/hr above background. The average ambient exposure rates ranged from 0.7 to 1.4 µR/hr, where the NRC limit was also 5.0 µR/hr above background). Soil samples for Cs-137 showed an average level of 0.22 pCi/g and a maximum of 4.8 pCi/g. The Cs-137 $DCGL_w$ is 9.2 pCi/g above background.[2]

- **1999 ORISE Verification Survey.** As summarized in the Building 4020 investigations section, in October 1999, ORISE performed a verification survey of Building 4020 and the surrounding area (including Building 4468 and 4720). The survey included a direct surface scan, exposure rate measurements and soil samples. The survey concluded the site satisfies the DOE guidelines for release without radiological restrictions. The surface scan did not identify any locations of direct radiation in excess of ambient background levels. The exposure rates, including background, ranged from 10 to 18 µR/hr compared to a background level of 14 µR/hr, which is below the NRC limit of 5 µR/hr above background and the DOE limit of 20 µR/hr above background. Minimum detectable concentrations of the following radionuclides were detected in soil samples: Am-241, Co-57, Co-58, Co-60, Cr-51, Eu-152, Fe-59, Mn-54, Sb-124, U-235, Sr-90, Pu-238, Pu-239, and Zn-65. Cs-137 ranged from < 0.1 to 0.4 pCi/g in soils and Ra-226 ranged from < 0.4 to 1.2 pCi/g. Th-232 ranged from < 0.9 to 1.8 pCi/g and U-238 was detected at concentrations less than 2.3 pCi/g. All four of the above radionuclides measured below their respective guidelines.[3]

[1] Shao, J., and Barnes, J., Letter Re: Soil Sampling Results for Building 468 and 020 at SSF," August 3, 1998.
[2] Boeing, RS-00010, "Area 4020, MARSSIM Final Status Survey Report," October 31, 2000.
[3] ORISE, Document ORISE 2000-1524, "Verification Survey for the Land Area Formerly Surrounding the Hot Laboratory (4020), Santa Susana Field Laboratory, The Boeing Company, Ventura County, California," December 2000.

- **2001 Hot Laboratory Decontamination and Dismantlement Final Report.** According to this report, the highest level of radioactive material found during the decommissioning activities were in the radioactive drain system running from each of the cells in Building 4020 to a header that connected to the Building 4468 radioactive water holdup tank. The report did not provide data to indicate what the levels were, but stated the contamination consisted primarily of old mixed fission products (Cs-137, Sr-90, Pm-147), Co-60, small amounts of uranium, and trace amounts of plutonium.[1]

Radiological Use Authorizations: Building 4468 operated under NRC Special Nuclear Materials License No. SMN-21.

Former Radiological Burial or Disposal Locations: There are no radiological burial or disposal locations associated with Building 4468. The building, itself, served as the location of a new radioactive liquid waste holdup tank in a pit at the east side of Building 4020. The building was constructed to support the operations of Building 4020 by receiving and storing radioactive effluent generated by the operations of the Hot Lab.[2]

Aerial Photographs: In 1952, the area comprising the future Building 4468 area is agricultural land. Beginning in 1957, the area surrounding the future Building 4468 location is becoming developed. By 1959 Building 4020 is present. Few changes are visible in 1965 and 1967 with the exception of the presence of a trailer located to the east of Building 4020 at the future location of Building 4468. By 1972, the trailer is no longer visible, and Building 4468 has been constructed to the east of the building. Few features are visible surrounding Building 4468 in subsequent photographs until 1988, when a trailer is located on the west side of the building between Buildings 4020 and 4468. The building is reported to have been removed between 1995 and 1998, and by 2005 the area has been leveled and is vegetated.[3]

Radionuclides of Concern: Building 4020 handled a number of radionuclides including uranium, promethium, thorium, and plutonium. Accordingly, these radionuclides and their decay products may have entered the Building 4468 tank. Decay products from U-235, U-238, and Th-232 decay chains include Th-234, Th-228, Ac-228, Ra-226, Pb-214, Bi-214, Pb-212, Bi212, and Tl-208. In addition, H-3, Sr-90, Cs-137, Na-24, Co-57, Co-60, Eu-152, and Am-243 would have been formed. All radionuclides of concern listed, with the exception of Na-24 and Co-57 (due to relatively short half-lives), are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. Table 3.3 presents a summary of radionuclides of concern.

Drainage Pathways: Historical photographs indicate that surface water run-off from the vicinity of Building 4468 drained either into the ditch on the south side of G street or into the ditch on the south side of J Street. Currently, surface water drains from the vacant land to the east-northeast and then into the ditch on the south side of G Street.

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4468 area is Class 1 because of the building's proximity to Building 4020 and the buildings use as a holdup tank.

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[1] Boeing, EID-06141, "Hot Laboratory Decontamination and Dismantlement Final Report," November 27, 2001.
[2] Boeing, EID-06141, "Hot Laboratory Decontamination and Dismantlement Final Report," November 27, 2001.
[3] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.

Recommended Locations for Soil/Sediment Sampling: 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 4468 area. Previous characterization studies for the Building 4468 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 4468 area. This includes the following Building 4468 areas and appurtenances:

- Similar to Building 4020, the former Building 4468 footprint is recommended for sampling to characterize the existing fill material and the underlying soil. Specifically, sample locations should be focused at locations where potential releases of liquids may have occurred such as holdup tanks, septic system, and drainage pipe lines. Drainage ditches to the east along 24 Street and north along G Street are recommended for sampling.

2.2.3 Parking Lot 4520 Area

Site Description: The Parking Lot 4520 Area comprises Parking Lot 4520 and the surrounding area. This area is located west of 24th Street south of Building 4020. Parking Lot 4520 was constructed between 1957 and 1959. Figures 2.2.3a and 2.2.3b 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 4520.

Former Use(s): Parking Lot 4520 appears to have been mainly used for its intended purpose as a parking area.[1] However, in 1996 during removal of the Building 4020 floor slab cut slab sections were removed, numbered, and stacked in the parking lot where the slabs were to be surveyed and prepared for disposal. The length of time the slabs were stored at this location was unreported.

Information from Interviewees: No information regarding the Parking Lot 4520 area has been obtained from interviewees, to date.

Radiological Incident Reports: There have been no incidents associated with Parking Lot 4520 identified in historical records obtained, to date.

Current Use: Parking Lot 4520 was removed in 1996 as part of the Building 4020 D&D effort. Aerial photographs show the area to be vegetated now.[2]

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): A chronology of radiological investigations at this building is as follows:

[1] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[2] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.

- **1999 Class 2 Survey.** In September 1999, Parking Lot 4520 was included in the Class 2 area survey unit of Building 4020. The Class 2 area survey unit included the parking lot and the roadway to the east of Building 4020. According to the survey, the average gross surface walk-about exposure level was 3,250 counts per minute or 15.1 µR/hr. The maximum surface walk-about exposure level observed as 4,000 cpm or 18.6 µR/hr. The average surface background level established for the area in 1999 was 3,311 cpm or 15.4 µR/hr, resulting in these results being below the approved derived concentration guideline ($DCGL_W$) of 5 µR/hr above background.[1]

Radiological Use Authorizations: There are no Use Authorizations associated with Parking Lot 4520.

Former Radiological Burial or Disposal Locations: There are no documented radiological burial or disposal locations at or surrounding Parking Lot 4520.

Aerial Photographs: Parking Lot 4520 is first visible in 1959 aerial photographs. In 1959, the parking lot appears to be constructed at a slightly higher elevation than Building 4020, to the north. There are numerous vehicles parked during this time period. In 1962 the area remains relatively unchanged. An area west of the parking lot appears to be undergoing development in 1967; however, the grading activities appear to cease and by 1972 the area is again vegetated. The area remains unchanged until 1995 with the appearance of a path from the southeast corner of the parking lot to an area south of the parking lot. There is also an area of disturbance southeast of the parking lot along the west side of 24th Street that includes an excavation, light-toned mounded material and mounded material with scattered vegetation. By 2005, Parking Lot 4520 has been removed and the area is vegetated. The 1995 area of disturbed ground southeast of the parking lot is also vegetated.[2]

Radionuclides of Concern: There are no radionuclides of concern associated with the parking lot; however, Building 4020 handled a number of radionuclides including uranium, thorium, and plutonium. Decay products from U-235, U-238, and Th-232 decay chains include Th-234, Th-228, Ac-228, Ra-226, Pb-214, Bi-214, Pb-212, Bi212, and Tl-208. In addition, H-3, Sr-90, Cs-137, Na-24, Co-57, Co-60, Eu-152, and Am-243 would have been formed. All radionuclides of concern listed, with the exception of Na-24 and Co-57 (due to relatively short half-lives), are included in the August 2010 Final Field Sampling Plan for soil sampling in Area IV. Table 3.3 presents a summary of radionuclides of concern.

Drainage Pathways: According to a 1969 plot plan, drainage surrounding the Parking Lot 4520 Area appears to be the northwest. Historical photos indicate that 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. Currently, surface water drainage in the vicinity of the former Parking Lot 4520 is to the northeast into a 24 inch culvert which flows east, under 24th Street. Surface water then runs along the south side of J Street into Area III.

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Parking Lot 4520 area is Class 1 because of the parking lot's proximity to Building 4020.

[1] Boeing, Document RS-00010, *Area 4020 MARSSIM Final Status Survey Report*, October 31, 2010.
[2] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.

Recommended Locations for Soil/Sediment Sampling: Plate 1 and Figure 2.2 provide a convenient reference for the following recommendations.

There is the potential of radioactive material migration via surface water flow or airborne release from Building 4020. And there have been limited site investigations at Parking Lot 4520, and 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 Parking Lot 4520 area. This includes the following Building 4317/4730 areas and appurtenances:

- The perimeter of the former Parking Lot 4520. 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, namely from Building 4020, residual contamination not consistent with the DTSC/DOE December 2010 AOC may exist.

- The area southeast of Parking Lot 4520. Unknown excavation activities appear in 1995 aerial photographs. The area of disturbed ground included light-toned mounded material and scattered vegetation. These activities occur at a time of numerous building demolition activities. Because of the unknown nature of these activities, it is recommended this area be included in field sampling activities. [1]

2.2.4 Building 4055 Area

Site Description: The Building 4055 area is located outside the ETEC boundary and includes the Nuclear Material Development Facility (NMDF) Building 4055, a guard shack (Building 4155), a substation (Building 4755) located within the southwest corner of Building 4055, and the surrounding area located on G Street. Building 4055 was constructed in 1967 to serve for specifically for development work involving plutonium. The building remains operational today for non-nuclear laser research.[2] It is a tilt up concrete structure that measures approximately 200 feet long, 60 feet wide, and 16 feet high.[3] Figures 2.2.4a through 2.2.4p 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: As indicated above, Building 4055 is a tilt up concrete structure 200 feet long, 60 feet wide, and 16 feet high. The building is constructed of noncombustible materials including windowless, precast, tilt-up concrete slab walls of 6-inch thickness and a concrete slab floor. The roof, consisting of lightweight concrete, tarred felt, and gravel, is supported on steel deck panels and girders. The portion of the building surrounding the posted area is sealed by Thiokol-filled concrete joints, painted concrete surfaces, weatherproofed doors, and "suitable partitions." The building is divided into an administrative area, change rooms, chemistry and other service laboratories, a glove box room, a vault, and facility equipment rooms (See Figure 2.2.4b and Figure 2.2.4c).[4.1]

[1] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[2] It was noted by Boeing that these operations were estimated to stop in May 2011; however, confirmation that operations in Building 4055 have ceased has not been received.
[3] Rockwell International Report, N704SRR990027, *Final Radiation Survey of the NMDF*, December 19, 1986.
[4] Rockwell International Report, N704SRR990027, *Final Radiation Survey of the NMDF*, December 19, 1986.

The primary radioactive materials containment within the building was provided by the 30 boxes in the glove box system that was used to handle radioactive materials within a regulated environment (See Figure 2.2.4e). Secondary containment was provided by the portion of the building that included the glove box room, chemical support room, general support room, counting room, electronics shop, dark room, radioactive exhaust equipment room, and radioactive material storage vault. Air locks were provided at the main and rear entrances to the secondary containment area.[2,3,4]

The radioactive exhaust network consisted of three systems tied into the primary exhaust duct and stack and included continuous alpha monitoring. Each system had its own filter and comprised the primary ventilation system used for the glove box room and support lab area, the fume hood ventilation system used for fume hoods, and the glove box ventilation system used for the glove boxes and tunnel exhaust.[5]

[redacted][6] As indicated above, each glove box was connected to the low-volume exhaust system that, under normal conditions, maintained specified atmosphere pressure within the glove box. During emergency conditions, the exhaust system drew 150 cubic feet per minute through two glove ports with the gloves removed. The floors in the glove box room and chemical support laboratory had a polyvinyl covering to provide a surface that could be easily decontaminated.[7]

According to a July 22, 1968, internal letter regarding the in-box filter systems at Building 4055, the high-efficiency in-box filter systems for the glove box trains that were involved in the mixed oxide and carbide programs had some deficiencies with regard to nuclear material recovery, accountability, and safety. To maximize the potential for recycling fuel material and recovering scrap material, and to minimize the hazards associated with finely divided plutonium metal or carbide, it was recommended that the in-box filter system and operations be modified to:[8]

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[1] Rockwell International, ESG-82-33, *Health and Safety Sections for Renewal Application of the Special Nuclear Materials License SNM-21, Docket 70-25, Issued to Energy Systems Group of Rockwell International*, June 5, 1984.
[2] Rockwell International Report, AI-DOE-13559, *Nuclear Materials Development Facility Decommissioning Final Report*, March 31, 1987.
[3] Oak Ridge Associated Universities Report, no document number, *Confirmatory Radiological Survey Nuclear Materials Development Facility (Building T-055), Rockwell International, Santa Susana, California*, July 1987.
[4] Rockwell International Report, N001TI000200, *Long-Range Plan for Decommissioning Surplus Facilities at the Santa Susana Field Laboratories*, Date Unknown.
[5] Jones, L.J., Atomics International Document No. OP-001-99-001, *Plutonium Facility, Facility Emergency Plan for NMDF – SS 55*, June 18, 1969.
[6] [redacted]
[7] Rockwell International, ESG-82-33, *Health and Safety Sections for Renewal Application of the Special Nuclear Materials License SNM-21, Docket 70-25, Issued to Energy Systems Group of Rockwell International*, June 5, 1984.
[8] Sayer, W.B., Atomics International Internal Letter Re: In-box Filter Systems at Building 055, July 22, 1968.

- "Install a pre-filter ahead of the present in-box high-efficiency filter in those boxes which may house particularly dusty operations, in order to increase the interval between high-efficiency filter changes and facilitate recycle and/or recovery of the fuel material."

- "Reduce the amount of inaccessible area and crevices in the vicinity of the recessed filter unit in order to minimize the potential for accumulation of particulates. This [could] be accomplished by relocation of the filter unit. . . Another method of reducing the amount of inaccessible area would be through the use of a gasket arrangement located at the face of the filter unit whose purpose would be to seal off the undesirable area between the wall of the recess area and the filter unit housing..."

- "Provide secondary in-box containment capability for operations which generate significant quantities of airborne particulates."

As indicated above, the glove boxes were connected to transfer tunnels, one provided for the fabrication line and another provided for the analytical line. According to the renewal application for the special nuclear materials license, each transfer tunnel included on air atmosphere glove box to receive materials to be transferred to one of the attached glove boxes. The lines each included on vacuum chamber to remove air from materials being transferred, and one argon glove box with two gloves to transfer materials from the vacuum chamber to a trolley. Both tunnels were connected to the low-volume exhaust system. Each also included one trolley for transporting material. As with the glove boxes, the atmosphere in the tunnels comprised either purified argon or air, and all atmosphere entering or leaving the tunnels passed through high-efficiency filters mounted inside the argon glove box.[1]

The building also included a Nuclear Material Storage Vault, Room 131 that was constructed of 9-inch thick, reinforced concrete walls, ceiling, and floor. The room had a vault-type door with a combination lock (See Figure 2.2.4f).[2]

Building systems included an air conditioning system that with temperature and humidity control, a radioactive liquid waste holdup system, an electrical power distribution system, an alarm and instrumentation system, fire control systems, and plumbing system. The building was reported to not require process water. Non-potable water was supplied for the restrooms and for janitorial purposes, and bottled water was supplied for drinking.[3]

The air conditioning system in Building 4055 comprised a dual ventilation and gaseous emission control system. One high-volume system was employed for air supply and exhaust in areas occupied by personnel. A separate low-volume system was used for the glove-box system atmosphere. Under normal conditions, the low-volume system was used only to exhaust the small quantities of glove-box atmosphere necessary to maintain a negative pressure with respect to the glove-box room.[4]

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[1] Rockwell International, ESG-82-33, *Health and Safety Sections for Renewal Application of the Special Nuclear Materials License SNM-21, Docket 70-25, Issued to Energy Systems Group of Rockwell International*, June 5, 1984.
[2] Atomics International, AI-74-44, *Special Nuclear Material Control Program for Plutonium Use by Atomics International Division of Rockwell International in Research and Development Activities Under Special Nuclear Material License No. SNM-21*, May 24, 1974.
[3] Rockwell International, ESG-82-33, *Health and Safety Sections for Renewal Application of the Special Nuclear Materials License SNM-21, Docket 70-25, Issued to Energy Systems Group of Rockwell International*, June 5, 1984.
[4] Rockwell International, ESG-82-33, *Health and Safety Sections for Renewal Application of the Special Nuclear Materials License SNM-21, Docket 70-25, Issued to Energy Systems Group of Rockwell International*, June 5, 1984.

Each glove box was equipped with manually actuated canisters to extinguish fires within the glove box. The building also included fire detection equipment that provided an automatic wet pipe sprinkler system in the office areas, mezzanine area, change rooms, support laboratories, glove-box room, and air conditioning equipment room.[1]

Fuel for the diesel engine in Room 132 was stored in a 1,000-gallon underground tank (UT-55) and an aboveground 50-gallon tank, both exterior to the building (see Figure 2.2.4g).[2,3]

The floor drains, service sinks, and laboratory sinks potentially capable of handling radioactive materials were connected to a radioactive liquid waste system by underground pipe to two 1,000-gallon holding tanks. The liquid waste holding tank and concrete retention well were located southeast of the building near Building 4373 (see Figure 2.2.4h).[4,5,6]
According to the 1987 final decommissioning report, a manually operated, three-way valve permitted selective discharge of the change room shower drains to either the liquid waste holding tank or to the sanitary sewer system. Normal position of the valves was to the liquid waste holding tank to accommodate emergency situations. According to the report, to eliminate the possibility of radioactive contamination entering the sanitary sewer system, the showers were restricted and used only for emergency purposes. Available documents do not provide information to indicate the showers were ever used or tested during the operation of the building.[7]

Potentially contaminated liquid wastes flowed through underground soil piping to the control tank installation (see Figure 2.2.4i, Figure 2.2.4j, and Figure 2.2.4k) that comprised a concrete vault measuring 15 by 20 feet. This facility was located within a fenced area just outside the southeast corner of Building 4055. Wastes first entered the hot waste clarifier tank (T-1) for removal of suspended solids through a 4-inch pipe that ran along the east wall of Building 4055 to approximately 17 feet from the building and then ran south for approximately 170 feet to the hot waste clarifier tank. A float-controlled pump (P-5) automatically transferred the clarified liquid to the 230-gallon receiver tank (T-2). When this tank was full, a sample was analyzed to determine whether radioactivity was present, and the contents were then manually discharged to one of the 1,000-gallon holdup tanks (T-3 and T-4) for future disposal. Final disposal from the holdup tanks was made by pumping (P-6) safe liquids through a 4-inch clay line to a surface drainage ditches that ran parallel to J Street. According to facility drawings, this system was contained within a concrete vault that measured 15- by 20 feet and was located inside a fenced area just outside the southeast corner of Building 4055. The 4-inch clay line is shown as being

[1] Rockwell International, ESG-82-33, *Health and Safety Sections for Renewal Application of the Special Nuclear Materials License SNM-21, Docket 70-25, Issued to Energy Systems Group of Rockwell International*, June 5, 1984.
[2] Rockwell International, AI-76-21, *Environmental Impact Assessment of Operations at Atomics International Under Special Nuclear Materials License No. SNM-21*, April 30, 1976.
[3] Ogden Environmental and Energy Services Co., Inc., *Phase II Subsurface Investigation Underground Storage Tank UT-55 Building 055*, November 1997.
[4] Rockwell International Report, AI-DOE-13559, *Nuclear Materials Development Facility Decommissioning Final Report*, March 31, 1987.
[5] Oak Ridge Associated Universities Report, no document number, *Confirmatory Radiological Survey Nuclear Materials Development Facility (Building T-055), Rockwell International, Santa Susana, California*, July 1987.
[6] Rockwell International Report, N001TI000200, *Long-Range Plan for Decommissioning Surplus Facilities at the Santa Susana Field Laboratories*, Date Unknown.
[7] Rockwell International Report, AI-DOE-13559, *Nuclear Materials Development Facility Decommissioning Final Report*, March 31, 1987.

discharged to a drainage ditch that runs parallel to "J" Street. These drawings also show that the 4-inch 304 SST radioactive liquid waste pipe that feeds into the hold tanks runs along the east wall about 17 feet away, for about 170 feet until it discharges into the hold tanks.

According to this 1987 report, any contaminated liquids were solidified and disposed of at appropriate radioactive disposal sites. The report did not provide information to indicate how material from the tanks was solidified and removed prior to disposal. According to the report, each radioactive waste tank was equipped with two high-liquid-level transmitters connected in parallel that initiated an alarm at high liquid levels.[1]

Building 4055 includes a 480-square foot security control station. Building 4155, that was constructed to meet government security regulations on advanced fuel programs. A secured-access passageway, Room 136, was between the entry lobby and Room 138, and was referred to as the "manned station." Figure 2.2.4l shows a layout of Building 4155.[2]

Former Use(s): Building 4055, the NMDF, was designed and constructed in 1967 and operated by the Rocketdyne Division of Rockwell International for research, development, and production of nuclear fuels and radioactive sources. As described on the ETEC website:

> Building 4055 was constructed in 1967 specifically for development work involving plutonium, and incorporated all of the safety systems and safeguards required for such work. From 1968-69, NMDF was used to support the Fast Flux Test Facility through analytical chemistry and research for uranium-plutonium scrap pellet recycling programs. Fission research on microscopic dispersion of tungsten in uranium plutonium fuel was also conducted at that time. For seven months in 1970, the NMDF fabricated mixed uranium-plutonium oxide pellets for irradiation tests. The NMDF was in standby from September 1970 until March 1974. NMDF was activated to participate in the Advanced Fuel Systems Program for liquid metal fast breeder reactors and to demonstrate reduced transuranic (TRU) solid waste with the use of a molten salt combustor. In 1975, the facility was upgraded to address new environmental, safeguard, licensing and radioactive materials facility operating standards.

In May 1965, Rockwell International completed a planning report to propose the construction of the plutonium materials development facility. The report provided a description of operations that included the following:[3]

> Sealed containers of plutonium will enter the facility through the large air lock and will be placed in the storage vault until ready for use in the glove box area. The plutonium will then be removed from the vault and placed in the first glove box where it will be blended with graphite, agglomerated, and dried. The mixture will be transferred to the induction furnace box for carbothermic reduction to PuC. The reduced material will then be crushed and sized, and transferred to the next box where it will be arc melted.
>
> The resulting cast rods will be machined into fuel slugs or metallographic specimens. . . Once the fuel rods are machined they will be incapsulated in stainless steel jackets for

[1] Rockwell International Report, AI-DOE-13559, *Nuclear Materials Development Facility Decommissioning Final Report*, March 31, 1987.
[2] Stafford, K.T., ETEC, *Site Consolidation Assessment*, April 16, 1987.
[3] deArrieta, J., et al., *Planning Report Plutonium Materials Development Facility Building 055, Santa Susana*, May 24, 1965.

> insertion into a reactor and irradiated. Wastes from the machining and melting operations will be re-processed or shipped for radioactive waste burial. . .
>
> All transfer of material into the glove box will be done by an electrical powered transfer cart. The material will be placed on the cart and moved into the glove box by means of a glove installed in the tunnel wall. Each box will have a leak tight door which can be opened from inside the glove box when the plutonium is being transferred. Removal of the contaminated material including waste scrap will be by special ports located on the side of the boxes. Every item will be packaged within the glove box, decontaminated, and then removed from the glove box through special ports called "bag out" ports.

A June 1966 license application for Building 4055 also indicated that the products of Building 4055 are solid reactor fuel materials including carbides, oxides, and other compounds such as nitrides and sulfides. Feed materials, according to the application, included oxides of plutonium and uranium and plutonium and uranium metal. The forms of fissionable materials stored or "in process" within Building 4055 were to include: plutonium oxide, uranium oxide, mixed plutonium-uranium oxide, plutonium metal, uranium metal, plutonium-uranium metal alloy, plutonium carbide, uranium carbide, and mixed plutonium-uranium carbide. The application indicated that while the scope of the facility research and development operation was intended to be flexible with regard to fuel choice, it was expected that emphasis in the research and development operations would be directed toward the fabrication of mixed carbides.[1]

Following the construction of the facility in 1967, operations began in 1968 on two programs in support of the U.S. Government's Fast Flux Test Facility. In 1970, the facility initiated a fabrication effort for the ANL. Both programs, according to a 1992 summary of Rockwell International's plutonium capabilities, involved mixed uranium-plutonium oxide fuel pellets. In July 1968, a new program was initiated to develop a technique to "introduce microquantities of tungsten into mixed uranium-plutonium carbide" with the goal of the tungsten acting as a nucleating site for fission gas.[2]

During the mid-1970s, the NMDF conducted two programs concurrently. One program involved the process development of synthesizing mixed plutonium-uranium carbide into high-density pellets. This fuel was to be used in the Advanced Fuel System Program for liquid metal fast breeder reactors. The second program "demonstrated the use of a molten salt oxidizer to reduce the volume of transuranic solid waste." According to the 1992 summary, these programs resulted in facility modifications to meet new environmental standards, new safeguard requirements, and new licensing and radioactive materials facility operation standards of safety. These modifications resulted in changes to the glove box lines and piping and ventilation systems.[3]

Based on historical documents, the major effort at Building 4055 involved plutonium-bearing fuels, primarily plutonium-239. The final products from these operations were solid reactor fuel materials, radioisotope heat sources, or radiation sources in a "variety" of forms and compositions. These, according to a 1967 radiation and nuclear safety document, included Po-

[1] Atomics International, *License Application for the Nuclear Materials Development Facility*, June 24, 1966.
[2] Litwin, R.Z., Rockwell International Letter Re: RI Background and Capability to Develop a Weapons-Grade Plutonium Fuel Cycle and Disposal Evaluation for the PDR, October 5, 1992.
[3] Litwin, R.Z., Rockwell International Letter Re: RI Background and Capability to Develop a Weapons-Grade Plutonium Fuel Cycle and Disposal Evaluation for the PDR, October 5, 1992.

210, Pu-238, Pu-239, and Cm-242. For "feed material," any of the programs used various forms of plutonium, uranium, and "other radionuclides." Operations involving encapsulated radiotoxic materials were performed in the above, described glove boxes. The building also served as an analytical chemistry support facility for the Fast Flux Test Facility from 1968 to 1969, as indicated above. Operations also included research for uranium-plutonium scrap pellet recycling programs, and fission research on microscopic dispersion of tungsten in uranium plutonium fuel.[1, 2,3,4]

The 1981 onsite radiological contingency plan indicated that research development programs were conducted to investigate preparation methods for fast reactor and radionuclide fuels including mixed carbides, oxides, nitrides, sulfides, silicides, and various radionuclides. The objective of the building laboratory was to "develop appropriate equipment and quality measures... that are adaptable to full-scale, fuel-element, and radioisotope-source fabrication."[5]

According to a 1984 application for the renewal of the special nuclear material license, the following procedure was employed at Building 4055 for the receipt and handling of plutonium:[6]

> A typical process involves the receipt of the Pu-238, in the form of an oxide at Building 4055... in DOT-approved shipping containers. It would be stored in the building vault in lots no larger than 2.5 kg of contained Pu-238, in the fixed locations established for Pu-239.
>
> As the plutonium is acquired, it would be transferred into a glove-box line at the facility and the final inner container removed. A typical fuel form would be microspheres or hollow cylindrical cermets. In a typical process sequence, the material would be weighed, placed into the primary encapsulation, and sealed by welding. The capsule would be leak-checked, decontaminated, and removed from the glove-box train. The capsule would then be transported to an electron-beam welder for subsequent secondary encapsulation and leak checks. After the integrity of the capsule was confirmed, it would be packaged in an approved storage container and stored pending shipment. The maximum batch size of Pu-238 in a glove box is 2.5 kg in the oxide form.

The contingency plan also indicated that the procedures for handling analytical chemistry samples of plutonium-bearing fuel, and other highly toxic material samples, varied according to the size of the sample and the nature of the analysis being performed. The gross sampling and weighing was performed in standard glove boxes designed for that purpose. Dissolution of the bulk samples and any analysis requiring significant quantities of toxic materials, including carbon analysis, oxygen analysis, and spectrographic analysis, was performed within glove boxes as well. For analytical procedures that required small material quantities less than 1 milligram, aliquots of solutions were prepared in the glove boxes, placed in suitable sealed containers,

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[1] Rockwell International Report, N704SRR990027, *Final Radiation Survey of the NMDF*, December 19, 1986.
[2] Oak Ridge Associated Universities Report, no document number, *Confirmatory Radiological Survey Nuclear Materials Development Facility (Building T-055), Rockwell International, Santa Susana, California*, July 1987.
[3] Rockwell International, ESG-81-30, *Onsite Radiological Contingency Plan for Rockwell International Operations Licensed Under Special Nuclear Material License No. SNM-21*, August 28, 1981.
[4] Atomics International, AI-67-3, *Radiation and Nuclear Safety at Atomics International*, March 1, 1967.
[5] Rockwell International, ESG-81-30, *Onsite Radiological Contingency Plan for Rockwell International Operations Licensed Under Special Nuclear Material License No. SNM-21*, August 28, 1981.
[6] Rockwell International, ESG-82-33, *Health and Safety Sections for Renewal Application of the Special Nuclear Materials License SNM-21, Docket 70-25, Issued to Energy Systems Group of Rockwell International*, June 5, 1984.

tagged out, and transferred to one of the two fume hoods located in the Chemical Support Laboratory. The samples were opened in the fume hoods for whatever experiment or analysis being performed. Samples were also prepared in the fume hoods for analyses requiring counting techniques prior to being transferred to the counting room in suitable containers.[1]

For seven months in 1970 Building 4055 fabricated mixed uranium-plutonium oxide pellets for irradiation tests for Argonne National Laboratory. This effort produced mixed uranium-plutonium oxide pellets that were used by Argonne National Laboratory for irradiation tests. These operations lasted through September 1970, at which time the facility was put on standby maintenance and surveillance mode. The NMDF was in standby from September 1970 until March 1974 when the NMDF was activated to participate in the Advanced Fuel Systems Program for liquid metal fast breeder reactors. Concurrently, from 1974 to 1975, Building 4055 was also upgraded and outfitted for the AIR-I fuel pin program, which demonstrated the use of a molten salt combustor at Glove Box 11 to reduce the volume of transuranic (TRU) solid waste.[2,3]

[redacted][4,5]

[redacted]

[1] Rockwell International, ESG-81-30, *Onsite Radiological Contingency Plan for Rockwell International Operations Licensed Under Special Nuclear Material License No. SNM-21*, August 28, 1981.
[2] Rockwell International Report, N704SRR990027, *Final Radiation Survey of the NMDF*, December 19, 1986.
[3] Rockwell International Report, AI-DOE-13559, *Nuclear Materials Development Facility Decommissioning Final Report*, March 31, 1987.
[4] Grantham, L.F., Rockwell International Internal Letter Re: Application to Use Plutonium in Radwaste Combustion Tests, January 21, 1975.
[5] Atomics International, Document No. TI-001-630-001, *Safety Review Committee Action on Glvoe-Box Operation Safety Evaluation for Radwaste Combustor in Bldg T055*, January 30, 1975.

As indicated above, in addition to the Advanced Fuel Systems Program, Building 4055 was also involved in the AIR-I fuel pin program. Development of the process to reduce the volume and weight of TRU waste began in 1974 when bench-scale combustion tests on uncontaminated waste were carried out. Following the uncontaminated waste tests, combustion tests of plutonium-contaminated waste in a bench-scale combustion unit were performed in Building 4055. According to the final decommissioning report, a total of three molten salt combustion tests were completed using the bench-scale equipment setup.[1]

As indicated above, Atomics International participated in the Advanced Fuels System Program under contract with the AEC. The initial phase of the program included process development in the synthesis of mixed plutonium-uranium carbides and nitrides, and the fabrication of these materials into high density fuel pellets. The maximum inventory of plutonium in Building 4055 during the first phase of operation was limited to 350 grams. According to a 1974 special nuclear material control report, typical batches of powder and pellets contained approximately 16 to 20 grams of plutonium. Upon receipt of radioactive material to Building 4055, the shipping containers of PuO_2 were transferred to the hoods in the Chemistry Laboratory where they were unpacked down to the primary containment vessel. Following a series of procedures to weigh the material and place it into storage containers, the containers are stored in the Nuclear Material Storage Vault, Room 131. Uranium dioxide was received and treated similarly.[2]

All operations for the research and development program were reported to have taken place in the interconnected glove box processing line. According to a 1975 environmental impact statement the highly enriched and depleted UO_2, PuO_2, and graphite was converted to fuel pins containing mixed uranium plutonium carbides. Following processing, all containers used, including crucibles, were to be cleaned in-line to the extent possible to recover any special nuclear materials. The items were then collected and measured "to determine [special nuclear material] content for each inventory and/or prior to disposal as non-recoverable waste unless a determination [was] made by other means that the item contain[ed] less than 10 grams Pu."[3,4]

On December 22, 1975, Rockwell International requested approval of planned physical security of materials generated in Building 4055. According to the letter, the fuel pin generated from the production above was approximately 40 inches long with an active fuel length of approximately 13.5 inches. Each fuel pin contained a nominal 116 grams of U-235 and 41 grams of plutonium for a total of 157 grams of fissionable material. Following the final closure weld, the pins were cleaned and subjected to centrifugal bonding and x-ray processes. According to Rockwell International, it was necessary to locate the centrifugal bonding machine in Building 4100 and the X-ray machine in Building 4172. As a result, it became necessary to remove the pins from the protected areas of Building 4055 and transport them, two at a time, to Buildings 4100 and 4172. The letter indicated that these operations were to begin in late February 1976 and

[1] Rockwell International Report, AI-DOE-13559, *Nuclear Materials Development Facility Decommissioning Final Report*, March 31, 1987.
[2] Atomics International, AI-74-44, *Special Nuclear Material Control Program for Plutonium Use by Atomics International Division of Rockwell International in Research and Development Activities Under Special Nuclear Material License No. SNM-21*, May 24, 1974.
[3] Atomics International, AI-74-44, *Special Nuclear Material Control Program for Plutonium Use by Atomics International Division of Rockwell International in Research and Development Activities Under Special Nuclear Material License No. SNM-21*, May 24, 1974.
[4] Rockwell International, AI-76-21, *Environmental Impact Assessment of Operations at Atomics International Under Special Nuclear Materials License No. SNM-21*, April 30, 1976.

requested approval prior to then.[1] Information regarding the approval of these operations could not be located in available documents.

In 1975, the facility was upgraded to address new environmental, safeguard, licensing and radioactive materials facility operating standards. In May 1977, the reactor research division notified Atomics International to close out the Mixed Carbide Fuel Fabrication Program. Some funding was provided at this time to keep the facility operational and to perform some decommissioning work on excess glove boxes. According to the final decommissioning report, carbide fuel was oxidized at this time and four glove boxes were cleaned to non-TRU levels by a combination of foam cleaning and acid wash. The glove boxes were packaged and shipped for land burial, although the report does not provide information to indicate where the glove boxes were buried.[2,3] It was also reported in a 1977 annual review of radiological controls that all plutonium was removed from Building 4055 in the spring of 1978, and a program using depleted uranium, as uranium carbide, was initiated.[4] The review did not indicate how or where the plutonium was transported to.

In November 1978, Atomics International received funding to fabricate depleted uranium-carbide blanket pellets for Combustion Engineering. Production began in June 1979 and ended in late 1979.[5] Specific information regarding this process could not be located.

Following the combustion engineering operations, decommissioning efforts began in late 1979 beginning with the decontamination of equipment and the treatment of the remaining uranium carbide on site. According to a 4th quarter report in 1981, uranium carbide "scrap" was being converted to an oxidized state, and Advanced Fuels System sodium-bonded fuel pins were being decladded.[6,7] The conversion of waste uranium carbide to the oxidized state was reported to have been completed during the first quarter of 1983.[8]
According to the final decommissioning report, Building 4055 contained radioactive structures, systems, components, concrete, and soil. A summary of contamination in the facility was presented in the final decommissioning report and is presented below:[9]

> **Support Area** – The Chemistry Laboratory in the support area had two HEPA-filtered hoods that were known to have fixed contamination. The Quality Assurance laboratory was used for waste package scanning and was suspected of low levels of contamination. Some alpha activity was released to the room when a plastic bag containing waste leaked. Detectable activity was cleaned at the time of the release.

[1] Remley, M.E., Letter Re: Physical Security of Special Nuclear Materials Docket 70-25, December 22, 1975.
[2] Rockwell International Report, AI-DOE-13559, *Nuclear Materials Development Facility Decommissioning Final Report*, March 31, 1987.
[3] Rockwell International Report, N704SRR990027, *Final Radiation Survey of the NMDF*, December 19, 1986.
[4] Rockwell International, Document No. N001TI000098, *Annual Review of Radiological Controls – 1977*, May 27, 1980.
[5] Rockwell International Report, N704SRR990027, *Final Radiation Survey of the NMDF*, December 19, 1986.
[6] Moore, J.D., Internal Letter Re: Quarterly Review of NMDF (T055) for Radiation Safety , Fourth Calendar Quarter, 1981, February 22, 1982.
[7] Rockwell International Report, AI-DOE-13559, *Nuclear Materials Development Facility Decommissioning Final Report*, March 31, 1987.
[8] Moore, J.D., Internal Letter Re: Quarterly Review of NMDF (T055) for Radiation Safety – First Calendar Quarter, 1983, July 7, 1983.
[9] Rockwell International Report, AI-DOE-13559, *Nuclear Materials Development Facility Decommissioning Final Report*, March 31, 1987.

Glove Box Room – All easily accessible surfaces of the glove box room were kept clean. However, some alpha activity was released to the room when a plastic bag covering a glove box port split as a result of over pressurization caused by a solenoid valve failure. All detectable activity was cleaned up during the decontamination effort that followed this incident. Another known source of contamination was from an oil leak from a vacuum pump that penetrated the floor covering. This resulted in a small portion of the concrete slab becoming contaminated.

Stainless Steel Materials Storage Vault – The vault had no known areas of contamination.

Radioactive Exhaust Filter Room The filter room had no known areas of contamination, but contained the contaminated filter system for the glove box exhaust. The filter system for the glove box room also was in this room and was not known to be contaminated; however, because of the difficulty of demonstrating this by survey measurements, it was assigned a "contaminated" status.

Liquid Radioactive Waste Holdup System This system had low-level contamination from evaporation of contaminated floor mop water that drained from the building into the system. The evaporation was caused by solar heating of the holdup tanks.

In addition, it was noted that contamination was also present inside the glove boxes, the transfer tunnels between glove boxes, the hoods in the controlled area, and the glove box exhaust system.[1] The decontamination plan noted that approximately 98 percent of all the plutonium contamination in Building 4055 was contained within the 38 glove boxes, and ranged from 100 to 10,000,000 dpm/100 cm^2 (removable, per smear paper swipes). The chemical fume hoods had removable smear contamination levels varying between 1,000 to 10,000 dpm/100 cm^2. The low-volume glove box exhaust system ducts were reported to have smear sample contamination levels ranging between 1,000 and 10,000 dpm/100 cm^2. And the high-volume air exhaust system ducts had suspected contamination levels of 0 to 100 dpm/100 cm^2, mostly alpha, from plutonium and its decay products. According to the plan, all areas that were normally accessible to operating personnel had measured contamination levels of less than 2 dpm/100 cm^2, alpha.[2]

The entire building was stripped to the walls, including contaminated equipment and surfaces, drain lines, and ventilation ducts. This material and the retention well were decontaminated, the equipment was disposed of as low-level waste, and the liquid waste and exhaust systems were removed.[3, 4,5] The final decommissioning report indicated that the facility was decontaminated to levels that were "as low as reasonably achievable" at the completion of the decommissioning and release for unrestricted use, and in all cases, below the levels specified in the table below.[6]

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[1] Rockwell International Report, AI-DOE-13559, *Nuclear Materials Development Facility Decommissioning Final Report*, March 31, 1987.

[2] Rockwell International, Document No. AI-78-10, *Decontamination Plan for Atomics International Facilities Licensed Under Special Nuclear Material License SNM-21*, March 10, 1978.

[3] Rockwell International Report, N704SRR990027, *Final Radiation Survey of the NMDF*, December 19, 1986.

[4] Oak Ridge Associated Universities Report, no document number, *Confirmatory Radiological Survey Nuclear Materials Development Facility (Building T-055), Rockwell International, Santa Susana, California*, July 1987.

[5] Rockwell International Report, N704SRR990027, *Final Radiation Survey of the NMDF*, December 19, 1986.

[6] Rockwell International Report, AI-DOE-13559, *Nuclear Materials Development Facility Decommissioning Final Report*, March 31, 1987.

Building 4055
Rockwell International Acceptable Limits for Residual Radioactivity

	Total Average[a]	Total Maximum[b]	Removable
Surface contamination			
Beta-gamma emitters	5,000 dpm/100 cm^2	15,000 dpm/100 cm^2	1,000 dpm/100 cm^2
Alpha emitters	100 dpm/100 cm^2	300 dpm/100 cm^2	20 dpm/100 cm^2
Surface dose rate At 1 cm through 7-mg/ cm^2 absorber	0.1 mrad/hr	0.5 mrad/hr	
Ambient exposure rate At 1 m from surface	4 mR/hr		
Soil contamination Pu-239	25 pCi/gram[c]		
Water Released to unrestricted areas	<110% of local water supply		

[a] Average over a 1-square meter area
[b] Maximum value measured in 1-square meter area, averaged over 100 cm^2
[c] NRC requirement for Building 4055 only

Decontamination and deactivation of Building 4055 was initiated in October 1982 and was completed October 1986. Final surveys, waste shipments, and the final report were completed by March 1987. Decommissioning began with the decontamination and removal of glove boxes and connecting tunnels, including the glove box equipment. The tunnels were decontaminated and removed from the support system in sections that were approximately 5 feet in length. Both the tunnel sections and the glove boxes were packaged for disposal as low specific activity waste. According to the final decommissioning report, hand scrubbing, followed by strippable paint and paint removal, was found to be effective means for reducing contamination levels in the glove boxes and tunnel sections to under the upper limit for low specific activity waste. The upper limits for plutonium surface contamination at Building 4055 are presented in the table below. Some hot spots in the glove boxes required extra decontamination in the form of wet and dry abrasive materials. A flow diagram of the glove box cleaning operations is presented in Figure 2.2.4.m.[1,2]

Building 4055
Rockwell International Surface Contamination Limits for Plutonium

Area	Activity	Upper Limit	Action Limit
Un-posted areas and radiation areas	Total	100 dpm/100 cm^2	Detectable
	Removable	20 dpm/100 cm^2	Detectable
Contamination areas and airborne radioactive area	Total	2,500 dpm/100 cm^2	Detectable
	Removable	500 dpm/100 cm^2	Detectable
Restricted access areas	Total	Unspecified	Detectable
	Removable	Unspecified	Detectable

Personnel then removed utilities and the low-volume exhaust system. The support area was decontaminated and the NaK in the glove box atmosphere purifiers was disposed of. This was

[1] Rockwell International Report, N704SRR990027, *Final Radiation Survey of the NMDF*, December 19, 1986.
[2] Rockwell International Report, AI-DOE-13559, *Nuclear Materials Development Facility Decommissioning Final Report*, March 31, 1987.

followed by the removal of the liquid waste holdup system and the removal of the high-volume exhaust system. According to the final building survey report, the waste generated during cleanup operations was "packaged concurrent with the generating operation and shipped for disposal at the discretion of the [RMHF]."[1,2] Approved facilities included Rockwell Hanford Operations (RHO) for long-term storage of transuranic waste and the Nevada Test Site for the shallow-land burial of low specific activity waste.[3] A transuranic waste handling and packaging plan indicated that transuranic items were packaged into galvanized 55-gallon drums obtained from the RHO. According to the plan, sixty-nine transuranic drums from the Building 4055 decontamination effort were shipped to RHO during August 1984. Additional transuranic waste was packaged in mid-August 1984; however, these 34 55-gallon drum containers were put into storage due to lack of funding and approved shipping containers.[4] Rockwell International requested approval for the shipment of this waste from RHO on February 27, 1987. Rockwell International described the waste as follows:[5]

> . . . 29 are from the shutdown and decontamination of our plutonium R&D facility; four remain from the SEFOR fuel decladding program conducted at our hot laboratory; one contains a radium-beryllium neutron source from our L-85 research reactor and a few radium sources and gauges removed from old fire detection probes. . .
>
> The 29 drums from the plutonium facility include 27 drums of TRU wastes from decontamination of the building, one drum of mixed plutonium-oxide, uranium-oxide scrap from the advanced fuel programs, and one drum containing miscellaneous secondary NDA fuel measurement standards.

As of June 8, 1987, the waste remained at the SSFL in storage at the RMHF.[6]

Additional information regarding the decontamination effort at Building 4055 is provided from the final building survey report below:

> Decontamination of the glove box surfaces was accomplished utilizing ALARA [as low as reasonably achievable] strippable paint... Glove box and tunnel section removal was completed in November 1985. Survey of the decontaminated glove boxes was conducted to assure that there were no transuranic waste and were within the criteria of low specific activity waste.[7]

All components of the low-volume exhaust system, consisting of blowers, absolute filter banks, and associated valves and controls, were removed except for the stack which was still linked to the high-volume exhaust system. This was completed in February 1985. The utilities that were removed and "dispositioned" included those used specifically for glove box operations, including cooling water, argon, helium, dry air, vacuum, and electrical and control wiring. Also included were those utilities that serviced the glove box room, including compressed air, electrical power,

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[1] Rockwell International Report, N704SRR990027, *Final Radiation Survey of the NMDF*, December 19, 1986.
[2] Rockwell International Report, AI-DOE-13559, *Nuclear Materials Development Facility Decommissioning Final Report*, March 31, 1987.
[3] Rockwell International Report, N704SRR990027, *Final Radiation Survey of the NMDF*, December 19, 1986.
[4] Rockwell International, Enclosure 2 to 87RC02380, *Rockwell Division, Rockwell International, Transuranic Waste Handling and Packaging Plan*, February 27, 1987.
[5] Remley, M.E., Rockwell International Letter Re: Disposal of Transuranic Waste, February 27, 1987.
[6] Remley, M.E., Rockwell International Letter Re: Plutonium-Contaminated Waste, June 8, 1987.
[7] Rockwell International Report, N704SRR990027, *Final Radiation Survey of the NMDF*, December 19, 1986.

lighting, PA systems, phones, sprinklers, fire alarm circuits, radiation alarm systems, and intrusion alarms. Removal of the utilities servicing the glove box room was completed in November 1984.[1]

According to the final building survey report, all equipment and materials in the support areas were also surveyed and removed and disposed of according to the level of activity found. This material included furniture, sinks, light fixtures, and other office and laboratory equipment. Decontamination of the support areas was completed in October 1984. The report stated that some material from this area, with no detectable radioactivity, was disposed of as conventional waste.[2]

Disposal of the NaK in the glove box atmosphere purifiers and the NaK bubblers required the installation of a special NaK disposal facility at the building (see Figure 2.2.4n). This incorporated remnants of the facility utilities and liquid waste system. The NaK removal process involved a combination of evaporation of potassium and sodium at approximately 900 degrees Fahrenheit, steaming, and finally, a water rinse. Following cleaning, the NaK bubblers were surveyed to verify their classification as low specific activity waste and were transferred to the RMHF for packaging in 55-gallon drums and staging for shipment to a disposal site. The process water generated during the removal of NaK from the bubblers was neutralized, transferred to the RMHF, and evaporated. The residual solids were packaged and stage for shipment to a disposal site. These activities were completed in June 1986.[3,4]

The removal of the liquid waste system required the removal of all drain lines between the various sources, such as the laboratory sinks and shower drains, and the removal of the process and storage tanks and their associated equipment. According to the final decommissioning report, the removal of the liquid waste system also required the removal of all remaining liquid and sludge waste in the liquid waste retention system, and the removal of the four process and storage tanks and their associated equipment. All the components were packaged and disposed of. It was anticipated that the system was not anticipated to be highly contaminated, which, according to the decommissioning report, was verified by a survey of all the components. The excavation sites for the removal of the drains were surveyed and soil samples were taken. The report did not include the results of the surveys but reportedly indicated that an analysis of the soil samples verified that the soil was not contaminated. The removal of the liquid waste system was completed in May 1986.[5,6]

In August 1986, Rockwell completed the removal of the components of the high-volume exhaust system. Following all removal actions, the following waste volumes were generated during the decontamination and decommissioning for Building 4055.[7,8]

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[1] Rockwell International Report, N704SRR990027, *Final Radiation Survey of the NMDF*, December 19, 1986.
[2] Rockwell International Report, N704SRR990027, *Final Radiation Survey of the NMDF*, December 19, 1986.
[3] Rockwell International Report, N704SRR990027, *Final Radiation Survey of the NMDF*, December 19, 1986.
[4] Rockwell International Report, AI-DOE-13559, *Nuclear Materials Development Facility Decommissioning Final Report*, March 31, 1987.
[5] Rockwell International Report, N704SRR990027, *Final Radiation Survey of the NMDF*, December 19, 1986.
[6] Rockwell International Report, AI-DOE-13559, *Nuclear Materials Development Facility Decommissioning Final Report*, March 31, 1987.
[7] Rockwell International Report, N704SRR990027, *Final Radiation Survey of the NMDF*, December 19, 1986.
[8] Rockwell International Report, AI-DOE-13559, *Nuclear Materials Development Facility Decommissioning Final Report*, March 31, 1987.

Building 4055
Waste Volumes Generated During Decommissioning

Waste Type	Quantity (Cubic Feet)
Low specific activity	10,410
Glove boxes	5,256
Tunnel sections	861
Transuranic	692

According to this survey report, Building 4055 was decontaminated and all radioactive materials were removed from the site. With the exception of the boiler located in Room 128, the emergency diesel generator located in Room 132, and the associated compressors and air conditioning units located outside of the building on concrete foundations, the building interior had been stripped to the walls.[1,2]
Limited information has been located to indicate the operations of the building from 1986 through the present. On October 7, 1987, Building 4055 was officially removed from the Nuclear Regulatory Commission Special Nuclear Material License No. SNM-21 and released for unrestricted use.[3] Monthly progress reports indicate that Building 4055 was included in a surveillance program and underwent continued deactivation. According to the October 1987 monthly progress report, the following TRU waste awaited shipment: 16 drums of dry TRU waste to be shipped to Westinghouse Hanford Company, and eleven drums of TRU contaminated oil to either Westinghouse Hanford Company or EG&G. The report also indicated that Building 4055 was planned to be used to support Rocketdyne's "Space Station and Advance Programs."[4] In December 1987, Rockwell International reported that arrangements were being made to ship the scrap uranium oxide from Building 4055 to the Nevada Test Site. The report did not indicate where this material was being stored prior to shipment.[5]

Based on a December 7, 1987, internal Rockwell International letter, the building required work to be made usable for advanced programs and the Space Station Program. According to the letter, the items that needed to be completed included the following:[6]

- Replace drain system
- Backfill trenches
- Repair pavement
- Repair fence
- Repair concrete floor
- Patch facility walls
- Paint
- Installation of fluorescent fixtures
- Install electrical conduit

[1] Rockwell International Report, N704SRR990027, *Final Radiation Survey of the NMDF*, December 19, 1986.
[2] Rockwell International Report, AI-DOE-13559, *Nuclear Materials Development Facility Decommissioning Final Report*, March 31, 1987.
[3] Rouse, Leland, NRC Letter Re: SNM-21, Amendment No. 1, October 7, 1987.
[4] Kellogg, L.G., Letter Re: Monthly Progress Report, October 1987, November 6, 1987.
[5] Dennison, W.F., Letter Re: Monthly Progress Report, December 1987, January 5, 1988.
[6] Schrag, F.C., Rockwell International Internal Letter Re: Estiamte for Rectification of NMDF, Building 055, December 7, 1987.

- Repair heating and air supply system
- Replace PA speakers
- Replace fire sprinkler system

In June 1988, Rockwell International reported that the fire sprinkler system would be replaced and the drums of TRU-contaminated oil would be shipped; however, a January 1989 progress report indicated that the shipment of the drums could not be achieved as a result of a "waste shipment moratorium" in the state of California and receiving of all wastes in the state of Idaho. Monthly reports in September and October 1988 also noted that the 11 drums of TRU-contaminated oil would be solidified and repackaged to conform to Edgerton, Germeshausen, and Grier (EG&G) Idaho, Inc.'s required criteria. This solidification occurred on October 3 through October 7, 1988, and consolidated nine drums of sludge and liquid into 3 drums using "Petroset." The remaining drums were also solidified, resulting in four drums of TRU-waste requiring disposal.[1,2,3,4,5]

In August 1989, the progress report indicated that in addition to maintenance and surveillance of Building 4055, Rockwell International was also responsible for performing repairs to the building from damage resulting from the decontamination and decommissioning operations. This included the repair of damaged wall sections, the paving of ditches, the replacement of floor tiles, and the replacement of five sprinkler systems that has been removed.[6]

As of the March 1990 progress report, the four 55-gallon drums of TRU waste were to be shipped to the Idaho National Engineering Laboratory; however, shipment continued to remain on hold pending a resolution of disposal issues with the state of Idaho. According to the report, the material was in storage on site at the RMHF.[7] Available documents do not provide information to indicate when the material was finally shipped; however, as of April 1994, the waste remained at the SSFL.[8]

On May 23, 1991, Rockwell International submitted a letter to the Ventura County Air Pollution Control District regarding the activation of Building 4055 in support of new lasers and advanced technology research programs, including diamond coating technology. The letter indicated that the programs were operated out of the Vanowen Building at Canoga Park but were being relocated to Building 4055. Upgrades required to the building included: "insulation of building, HVAC, fire protection and electrical." Rockwell International indicated that hydrogen gas, argon gas, and methane gas would be stored outside the building and piped in for use in the building. There were also a number of chemicals that were proposed for use in bench scale experiments and that would be housed in chemical storage cabinets in the laboratory. The chemicals listed included acetone, IPA, and methanol; H2SO4, HF, HCl, and H2O2 and HNO3.

[1] Dennison, W.F., Letter Re: Monthly Progress Report, June 1988, July 8, 1988.
[2] Dennison, W.F., Letter Re: Monthly Progress Report, September 1988, October 6, 1988.
[3] Dennison, W.F., Letter Re: Monthly Progress Report, October 1988, November 7, 1988.
[4] Dennison, W.F., Letter Re: Monthly Progress Report, January 1989, February 8, 1989.
[5] Moss, T.A., Letter Re: Monthly Progress Report, April 1989, May 15, 1989.
[6] Moss, T.A., Letter Re: Monthly Progress Report, August 1989, September 15, 1989.
[7] Moss, T.A., Letter Re: Monthly Progress Report, March 1990, April 12, 1990.
[8] Kearns, Roy, Memorandum Re: Validation of Rocketdyne Transuranic Waste Data, April 18, 1994.

The acetone and alcohols were to be used to clean laser optics and the acids were to be used in the diamond coating studies.[1]

A September 1991 internal letter provided a listing of chemicals that were planned for use in Building 4055 and were to be stored in the clean room and high bay of the building. The table below provides a listing of the chemicals used and stored in Building 4055.[2]

1991 Chemicals for Building 4055

Chemical Name	Description	Yearly Use	Location
Hydrochloric Acid	Acid	3 gallons	Clean room
Catechol (Pyrocatechin)	Buffer	3 gallons	High bay
Potassium Hydroxide Solution	Base	5 gallons	High bay
Nitric Acid	Acid	10 gallons	Clean room
Hydrofluoric Acid	Acid	10 gallons	Clean room
Hydrogen Peroxide 50%	Oxidizer	3 gallons	Clean room
Ethylenediamine Anhydrous	Base	4 gallons	High bay
Sulfuric Acid	Acid	10 gallons	Clean room
Ethanol	Solvent	3 gallons	Clean room
Acetone	Solvent	5 gallons	High bay
Methanol	Solvent	5 gallons	Clean room
Trichloroethane -TCA	Solvent	3 gallons	High bay
Acetic Acid	Acid	3 gallons	Clean room

A March 16, 1992, Rockwell International letter to the Ventura County Air Pollution Control District indicated that Building 4055 was under the final phase of activation. The final phase included the reconfiguration of the northern third of the building that included the reconstruction of the existing hard-wall offices into six hard-wall laboratories. The construction included wall relocations, new suspended ceilings, lighting, sprinkler system reconfiguration, and air conditioner re-ducting. The letter also indicated that concrete foundations would be added on the east side of the building for the installation of a 20,000 solid cubic feet N_2 gas bottle farm, a 20,000 solid cubic feet Argon gas bottle farm, six H_2 K-bottles, one CH_4 K-bottle, and one O_2 K-bottle. These gases were to be plumbed to the various laboratories.[3] The letter did not indicate the operations to be conducted in Building 4055.

On August 4, 1992, Authorization Number 157 was issued to Rockwell International to assemble and test a 350 kV klystron in Building 4055 in conjunction with the development of a prototype Ground Based Free Electron Laser (GBFEL). The laser program involved the fabrication of a free electron laser and testing the laser to avoid the generation of neutrons by electron interaction with laser materials. The use authorization was set to expire on August 4, 1993. The authorization indicated that the authorized use of the klystron was to be located in a high bay and annex of Building 4055. Based on a review of available documents, the use authorization was not renewed or cancelled.[41]

[1] Melvold, R.W., Letter Re: Activation of Building 055 in Area IV, SSFL to be used as a Research and Development Lab, May 23, 1991.
[2] Jackson, K., Rockwell International Internal Letter Re: Chemicals for Building 055, September 18, 1991
[3] Melvold, R.W., Letter Re: Building 055 Activation, Final Phase, March 16, 1992.
[4] Barnes, J.G., Authorization for Use of Radiological Materials or Radiation Producing Devices, Authorization No. 157, August 4, 1992.

Based on information obtained from Boeing, the building is currently occupied and is operated for non-radiological laser research. Building operations, as of February 2011, were in the process of being ceased and were to have stopped completely by May 2011.

Information from Interviewee: Interviewee 267 had extensive knowledge on the processing and handling of fuel at Building 55. The following are excerpts from that interview:

> *"I worked in Building 55 where plutonium was processed for fuel for field program processes in Idaho as well as for the SRE. I initially helped define the processes and handling. 13 men worked in Building 55, and we all worked rotating shifts. It was AEC-contract work. We used glove boxes to handle the plutonium, which were in the form of fuel pellets. The pellets were nickel plated through the application of nickel carbonyl. The radiological material was also handled with manipulators. This was also known as Building 2345, (because it had Divisions 2, 3, 4 and 5 within), and was Top Secret. Everything that left the building had a red tag indicating Top Secret. As far as I know, I am the last living person who worked on the production line in Building 55."*
>
> *"Building 55 generated low level radioactive waste that was shipped off site for disposal in small boxes. I remember someone putting too much waste in a container, which went critical. I don't remember how it was mitigated."*
>
> *"Across the street from Building 55 was Building 20, which was used for stripping and decladding used fuel rods that came offsite from different contractors. There was also Building 231 nearby which decladded fuel as well. Casts were also prepared there to transfer radiological materials."*
>
> *The difference in Buildings 20 and 231 was that 231 handled Al materials only."*

Radiological Incident Reports: There have been several incidents associated with Building 4055 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 that resulted or may have resulted in releases to the environment are provided following the table, when available.

Building 4055 Incident Report Summary

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A0286	5/9/1970	Glove Box Room	Pu	Hole in Pu glove box glove contaminated employee
A0222	6/26/1973	Glove Box Room	Pu	Glove box controller failure pressurized box releasing contamination to area
A0224	12/21/1977	Glove Box Room	Pu	Contaminated roll of green tape discovered in glove box room
A0063	1/10/1978	Glove Box 26	Pu	Employee contaminated during foam cleaning of glove box

[1] Dix, T.E., Rockwell International Internal Letter Re: Minutes of Radiation Safety Committee Meeting with Free Electron Laser Project Concerning Use Authorization Request, March 2, 1992.

Building 4055 Incident Report Summary (continued)

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A0068*	5/4/1978	Glove box Room	Pu	Leaking glove contaminated employee lab coat and surgeon gloves
A0335	5/10/1978	Glove box Room	Pu	Lost seal during change out caused loss of vacuum and contamination
A0071	6/15/1978	Glove box Room	Pu	RADIOACTIVE Waste Compacted in "Suspect" Waste Compactor
A0225	6/30/1975	Stack Monitor	Pu	Stack Monitor Vacuum Line Disconnected in Plutonium Facility
A0072	7/16/1978	Facility		Failure of Air Sampling Pump and Backup Pump Shut Down Operations
A0226	7/21/1978	Stack Monitor	Pu	Stack Monitor in Plutonium Facility Out of Service 84 Hours
A0073	7/24/1978	Support Lab	Pu	Floor Contamination Found in Waste Handling Area
A0582	6/26/1979	B-55 Glove Box	Pu Am	Maintenance of Glove Box Furnace Caused Airborne Activity
A0081	5/10/1980	Stack Monitor	Pu	Failure of Stack Monitor System in Plutonium Facility
A0250	10/31/1980	Support Lab		Contaminated Green Coveralls Returned with Deconed "Blucline" Coveralls
A0085	5/31/1981	Stack Monitor	Pu	Failure of Stack Monitor System in Plutonium Facility
A0091	11/7/1981	Glove Box Room		False Airborne Alarm in Glove Box Room at Plutonium Facility
A0100	3/24/1982	Compactor Area	Pu	Waste Package with Glass Broke Cutting Hand of Employee
A0113	2/7/1983	Glove Box Room	Pu	Plutonium Oxide Incised Into the Left Index Finger of an Employee
A0114	3/27/1983	Stack Monitor		Response to Stack Monitor Alarm
A0164	8/29/1986	Outside		Overfilled Portable Radioactive Liquid Tank

*The incident report file was reported by Boeing to be missing.

Incidents of known environmental releases:

- On January 4, 1971, a water line to the air-conditioning unit in the attic of Building 4055 leaked, causing water to run into the office areas, change room, support area, and glove box room. Maintenance personnel attempted to pick up the water that had leaked with a vacuum cleaner. According to the internal letter documenting the incident, the radioactive waste system sump tank and the sample tank were both full, causing the water to back up in the support area drains. Personnel opened the valves to the 1,000-gallon holdup tank, which cleared the backed up water condition. According to the ltter, a total of 800 gallons was collected. The water was sampled and measured to be 2.8×10^{-9} µC/cc. The letter indicated that the "water was released to the Rocketdyne pond."[1]

[1] Lane, W.D., North American Rockwell Internal Letter Re: Water Leak at the NMDF, January 14, 1971.

- A December 8, 1976, Rockwell International internal letter documented the release of radioactive sludge during the replacement of the radioactive waste line to the Building 4055 hold up tanks. According to the letter, removal of the old radioactive waste line was started by a contractor on December 6, 1976. The waste line was broken open where it exits Building 4055 and four smears were taken inside the pipe. The smears measured 0 dpm and the contractor was allowed to break out the remainder of the waste line. Approximately 2 hours after the initial start of work, water and sludge was observed running out of the line. Two sludge samples were taken and measured 15 and 53 dpm. Direct readings from inside the removed pipe read 700 dpm.
  Rockwell International surveyed the contractor personnel and instructed the contractor to cease work. Rockwell International staff removed the pipe and dirt where the sludge had run out of the pipes on December 7, 1976. Contaminated materials were put in "burial boxes" for disposal. A survey of the trench on December 7, 1976, indicated that no contamination was detected; however, the internal letter did not provide the results of the survey. The contractor was informed that the trench was released and was allowed to resume work.[1]

- On June 30, 1978, it was discovered that a stack monitor vacuum line had not been monitored for 23 days. Air samples taken directly from the room where the stack monitor was located were about twice the normal activity of the filtered air; however the incident report did not indicate what these levels were (A0225).[2]

- On July 21, 1978, it was discovered that a stack monitor in the plutonium facility was out of service for 84 hours due to an electrical failure. The incident report stated that airflow through a filter was maintained and no uncontrolled release of material occurred (A0226).[3]

- On March 27, 1983, Protective Services Control Center notified the facility health physicist of a stack monitor alarm. Upon investigation, the stack monitor chart showed an increasing count trend for about 1 hour to 26 dpm. The filter was removed and counted for alpha radioactivity. The result was 7 dpm alpha immediate and 3 dpm alpha after 19-hours of decay. After 72-hour decay, the final count on the stack sample was 0 dpm for a 100-minute counting time. The event was attributed to "the effect of atmospheric inversion conditions on naturally occurring airborne radioactivity." The alarm was reset and remained at normal levels. The incident report did not indicate whether the filter was reinstalled in the stack or if it was replaced with a new filter and disposed of (A0114).[4,5]

- On August 29, 1986, an unknown amount of water overflowed from the RMHF transfer tank onto asphalt at Building 4055. A summary of the incident was reported to have been included on an attached flysheet; however, the flysheet was not attached to the file

[1] Bradbury, S.M., Rockwell International Internal Letter Re: Replacement of R/A Waste Line to Hold-up Tanks at Bldg. 055, December 8, 1976.
[2] Owens, D.E., Internal Letter Re: Incident Report, July 26, 1978.
[3] Owens, D.E., Internal Letter Re: Stack Monitor Failure at NMDF, August 1, 1978.
[4] Moore, J.D., Internal Letter Re: Quarterly Review of NMDF (T055) for Radiation Safety – First Calendar Quarter, 1983, July 7, 1983.
[5] Bradbury, S.M., Internal Letter Re: Radiological Safety Incident Report, March 29, 1983.

obtained by the research team. As a result, additional information regarding this incident, including the location, cannot be provided at this time. Additional information may become available upon receipt of additional documents from Boeing's 1.4 million document database.[1]

Current Use: As of May 2005, Building 4055 was being used for non-radiological research; however, information regarding these operations has not been located.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): According to the 1973 annual report for environmental and radioactive effluent monitoring, the gaseous effluent released to unrestricted areas was monitored at Building 4055. Monitoring included the volume of the effluent releases, the average and maximum concentration (µCi/mL), and the total activity released (Ci). The results of this yearly data are presented in the annual environmental monitoring and facility effluent reports from 1973 through 1986.[2,3,4,5,6,7,8,9,10,11]

In addition, a soil sampling station (S-57) was located at Building 4055 at J Street, which was tested for soil plutonium radioactivity. A summary of the available survey results of the soil plutonium radioactivity data is presented in the table below: [12,13,14,15,16,17,18,1,2,3,4]

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[1] Begley, F.E., Internal Letter Re: Radiological Safety Incident Report, October 21, 1986.
[2] Moore, J.D., *Environmental and Radioactive Effluent Monitoring Annual Report 1973*, Undated.
[3] Rockwell International, Report No. ESG-79-7, *Environmental Monitoring and Facility Effluent Annual Report 1978*, April 1979.
[4] Rockwell International, Report No. ESG-81-17, *Environmental Monitoring and Facility Effluent Annual Report 1980*, May 27, 1981.
[5] Rockwell International, Report No. ESG-82-21, *Environmental Monitoring and Facility Effluent Annual Report 1981*, July 15, 1982.
[6] Rockwell International, Report No. ESG-83-17, *Environmental Monitoring and Facility Effluent Annual Report 1982*, June 1983.
[7] Rockwell International, Report No. ESG-84-9, *Environmental Monitoring and Facility Effluent Annual Report 1983*, March 1984.
[8] Rockwell International, Report No. RI/RD85-123, *Environmental Monitoring and Facility Effluent Annual Report De Soto and Santa Susana Field Laboratories Sites 1984*, March 1985.
[9] Rockwell International, Report No. ESG-84-9, *Environmental Monitoring and Facility Effluent Annual Report 1983*, March 1984.
[10] Rockwell International, Report No. RI/RD85-123, *Environmental Monitoring and Facility Effluent Annual Report De Soto and Santa Susana Field Laboratories Sites 1984*, March 1985.
[11] Rockwell International, Report No. RI/RD86-140, *Environmental Monitoring and Facility Effluent Annual Report De Soto and Santa Susana Field Laboratories Sites 1985*,April 1986.
[12] Rockwell International, Report No. ESG-79-7, *Environmental Monitoring and Facility Effluent Annual Report 1978*, April 1979.
[13] Rockwell International, Report No. ESG-81-17, *Environmental Monitoring and Facility Effluent Annual Report 1980*, May 27, 1981.
[14] Rockwell International, Report No. ESG-82-21, *Environmental Monitoring and Facility Effluent Annual Report 1981*, July 15, 1982.
[15] Rockwell International, Report No. ESG-83-17, *Environmental Monitoring and Facility Effluent Annual Report 1982*, June 1983.
[16] Rockwell International, Report No. ESG-84-9, *Environmental Monitoring and Facility Effluent Annual Report 1983*, March 1984.
[17] Rockwell International, Report No. RI/RD85-123, *Environmental Monitoring and Facility Effluent Annual Report De Soto and Santa Susana Field Laboratories Sites 1984*, March 1985.
[18] Rockwell International, Report No. RI/RD86-140, *Environmental Monitoring and Facility Effluent Annual Report De Soto and Santa Susana Field Laboratories Sites 1985*,April 1986.

S-57 (Building 4055) Soil Plutonium Radioactivity Data

Date	Pu-238	Pu-239 + Pu-240
June 8, 1978	(-2.13 ± 2.2) x 10^{-9} µCi/g	(1.04 ± 2.3) x 10^{-9} µCi/g
December 13, 1978	*	(6.21 ± 3.5) x 10^{-9} µCi/g
July 9, 1980	(1.4 ± 3.4) x 10^{-9} µCi/g	(9.5 ± 4.8) x 10^{-9} µCi/g
December 22, 1980	(-0.3 ± 2.3) x 10^{-9} µCi/g	(5.6 ± 3.2) x 10^{-9} µCi/g
July 8, 1981	(-3.7 ± 1.4) x 10^{-9} µCi/g	(0.04 ± 1.7) x 10^{-9} µCi/g
December 17, 1981	(-3.4 ± 1.5) x 10^{-9} µCi/g	(4.8 ± 3.1) x 10^{-9} µCi/g
July 9, 1982	(1.0 ± 0.4) x 10^{-9} µCi/g	(3.9 ± 0.6) x 10^{-9} µCi/g
December 16, 1982	(-8.0 ± 1.5) x 10^{-9} µCi/g	(5.1 ± 2.2) x 10^{-9} µCi/g
June 22, 1983	(1.4 ± 1.9) x 10^{-9} µCi/g	(2.4 ± 2.4) x 10^{-9} µCi/g
December 7, 1983	(0.3 ± 0.6) x 10^{-9} µCi/g	(3.8 ± 2.2) x 10^{-9} µCi/g
June 25, 1984	(0.1 ± 0.1) x 10^{-9} µCi/g	(5.2 ± 0.7) x 10^{-9} µCi/g
December 4, 1984	(0.4 ± 0.1) x 10^{-9} µCi/g	(2.2 ± 0.4) x 10^{-9} µCi/g
June 26, 1985	0 ± 0.0001 pCi/g	0.0038 ± 0.0004 pCi/g
December 4, 1985	0.003 ± 0.0003 pCi g	0.0028 ± 0.0005 pCi/g
June 25, 1986	0.0004 ± 0.0003 pCi/g	0.0005 ± 0.0003 pCi/g
December 8, 1986	0.0003 ± 0.0002 pCi/g	0.0010 ± 0.0004 pCi/g
June 22, 1987	0.0001 ± 0.0001 pCi/g	0.0012 ± 0.0003 pCi/g
December 7, 1987	0.0006 ± 0.0002 pCi/g	0.0031 ± 0.0004 pCi/g
June 29, 1988	0 ± 0.0001 pCi/g	0.0039 ± 0.0005 pCi/g
December 1, 1988	0 ± 0.0001 pCi/g	0.0032 ± 0.0005 pCi/g
July 19, 1989	0.0004 ± 0.0001 pCi/g	0.0049 ± 0.0005 pCi/g
December 5, 1989	0.0002 ± 0.0002 pCi/g	0.0054 ± 0.0006 pCi/g

Note: The above data appears to be below reasonable detection limits at the time.
Minus (-) indicates sample value less than reagent blank.
*Results significantly less than the minimum detection level

A chronology of all remaining available radiological investigations at this building is as follows:

- **1976 Rockwell International Soil, Water, and Sediment Sampling.** On December 14, 1976, Rockwell International collected "several" soil samples at seven on-site locations near Building 4055, and five soil samples at off-site locations of varying distances ranging from approximately 3 to 9 miles from the building. The samples were analyzed for Pu-238 and for total Pu-239 plus Pu-240 by the Health Services Laboratory of ERDA, Idaho Falls, Idaho. The sampling results included data for soil, water, and sediments samples. Soil samples ranged in distance from 50 feet northwest of the Building 4055 exhaust stack at the northwest corner of G and 24th Streets (Pu-238 = -0.03±0.05 x 10^{-8} µCi/g and Pu-239 plus Pu-240 = -0.01±0.06 x 10^{-8} µCi/g) to approximately 2,000 feet southeast of the Building 4055 exhaust stack at the southeast head of Bell Canyon at the

[1] Rockwell International, Report No. RI/RD87-133, *Environmental Monitoring and Facility Effluent Annual Report De Soto and Santa Susana Field Laboratories Sites 1986*, March 1987.
[2] Rockwell International, Report No. RI/RD88-144, *Environmental Monitoring and Facility Effluent Annual Report De Soto and Santa Susana Field Laboratories Sites 1987*, March 1988.
[3] Rockwell International, Report No. RI/RD89-139, *Environmental Monitoring and Facility Effluent Annual Report De Soto and Santa Susana Field Laboratories Sites 1988*, May 1989.
[4] Rockwell International, Report No. RI/RD90-132, *Environmental Monitoring and Facility Effluent Annual Report De Soto and Santa Susana Field Laboratories Sites 1989*, May 1990.

Area II pond (Pu-238 = 0.18±0.09 x 10^{-8} µCi/g and Pu-239 plus Pu-240 = 1.0±0.2 x 10^{-8} µCi/g).[1]

Water samples were taken at the west end of the surface drainage ditch in the ditch approximately 150 feet east of Building 4055 (Pu-238 = 0.0±0.8 x 10^{-11} µCi/g and Pu-239 plus Pu-240 = 0.0±0.6 x 10^{-11} µCi/g) and the north side of the Area II pond at the head of Bell Canyon approximately 2,000 feet from Building 4055 (Pu-238 = 0.0±0.7 x 10^{-11} µCi/g and Pu-239 plus Pu-240 = 0.3±0.7 x 10^{-11} µCi/g).[2]

Sediment samples were also taken at the west end of the surface drainage ditch in the ditch approximately 150 feet east of Building 4055 (Pu-238 = 1.4±0.2 x 10^{-8} µCi/g and Pu-239 plus Pu-240 = 12.8±0.6 x 10^{-8} µCi/g) and the north side of the Area II pond at the head of Bell Canyon approximately 2,000 feet from Building 4055 (Pu-238 = 0.05±0.07 x 10^{-8} µCi/g and Pu-239 plus Pu-240 = 0.03±0.06 x 10^{-8} µCi/g).[3]

- **1986 Rockwell International Soil Survey around Drain Lines.** The 2005 HSA reported results of a 1986 survey of soil surrounding drain lines. The research team has not yet received this survey report, and, as a result, the information provided is summarized from the 2005 HSA. In 1986, Rockwell International performed a survey of the Building 4055 drain lines to determine if any plutonium was left in the soil following removal. The survey concluded that soil from the drain line excavation was below the 1986 acceptable levels identified above; however, some soil samples showed detectable contamination. The maximum measurements were 0.613 pCi/g of Pu-239 and Pu-240 and 0.0421 pCi/g of Pu-238. The 1986 acceptance limit was 25 pCi/g. The NRC took confirmatory soil samples that supported the Rockwell samples.[4]

- **1986 Rockwell International Soil Survey around Drain Lines.** In 1986, Rockwell International also performed a survey of the Building 4055 interior building drain lines to determine if any plutonium was left in the soil following removal. Three soil samples were taken and analyzed for plutonium by liquid scintillation alpha counting. According to the report, the soil samples were taken as a result of the possibility of leaks in the pipes under the building while the building was in operation and as a result of possible leakage during the removal of the pipes. The drain lines had served as drain lines from the sinks, showers, and floor drains in the laboratory support area of Building 4055. The report indicated that significantly contaminated water was not allowed into these drains, but the drains were used for water that may have contained small concentrations of plutonium. The survey concluded that soil from the drain line excavation was below the 1986 acceptable levels of 10 pCi/g; however, some soil samples showed detectable

[1] Moore, J.D., Document No. AI-77-14, *Atomics International Environmental Monitoring and Facility Effluent Annual Report 1976*, Date Unknown.
[2] Moore, J.D., Document No. AI-77-14, *Atomics International Environmental Monitoring and Facility Effluent Annual Report 1976*, Date Unknown.
[3] Moore, J.D., Document No. AI-77-14, *Atomics International Environmental Monitoring and Facility Effluent Annual Report 1976*, Date Unknown.
[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. Citing Rockwell International Report, N704SRR9900124, *Plutonium Concentrations in Soil around Drain Lines at NMDF*, April 3, 1986.

contamination. The upper limit values for plutonium in soil samples from the three sampling locations ranged from 0.07 pCi/g to 0.216 pCi/g.[1]

- **1986 Rockwell International Final Radiation Survey.** Rockwell International also performed a final radiation survey in 1986 to determine the effectiveness of the decontamination effort and to demonstrate that the facility met release criteria for unrestricted use. The following criteria were used by Rockwell to demonstrate that the residual contamination was below acceptable limits:[2]

1986 Building 4055 Release Limits Criteria

Criteria	Alpha (dpm/100 cm^2)	Beta (dpm/100 cm^2)*
Total, averaged over 1 m^2	100	10,000
Total, maximum over 100 cm^2	300	30,000
Removable over 100 cm^2	20	2,000

*According to the final survey report, the acceptable beta contamination limits were derived from alpha contamination limits presented in Annex B of USNRC License SNM-21 for U-nat, U-235, U-238, and associated decay products. The beta values are twice those of the alpha limits reported based on the two beta particles emitted from the decay of Th-234, the first daughter of U-234, and Pa-234. The alpha limits correspond with the license annex limits for transuranics.

The survey divided the building into three sampling areas comprising the office area and Rooms 128, 132, 133, and the air conditioning room (office area and other unposted areas); the glove box room; and Rooms 117, 118, 119, 120, 121, 122, 123, 124, 126, 129, and 130 (posted areas). Each sampling area was overlain with a 3-square meter grid that was superimposed on the wall, floor, and ceiling of each room. Within each 3-square meter grid, a single 1 square meter was surveyed for 5 minutes and a 100 cm^2 area was smeared for removable contamination. Personnel measured for the average alpha surface activity, the average beta surface activity, the removable alpha surface activity, and the removable beta surface activity.

The maximum removable alpha and beta detected in the 141 samples taken from the office area and other unposted areas measured 4 and 34 dpm/100 cm^2, respectively. The maximum removable alpha and beta from 202 samples in the glove box room measured 11 and 36 dpm/100 cm^2, respectively. And the maximum removable alpha and beta from 201 samples in the posted areas measured 15 and 28 dpm/100 cm^2, respectively. The final report survey results detected hot spots in posted areas of the building. The maximum beta measurement in nine sampling locations in the posted areas was 41,664 dpm/100 cm^2. The maximum alpha measurement in 11 sampling location in the same areas was 10,465 dpm/100 cm^2. According to Rocketdyne the report, "in all cases where contamination was detected to be 80% of the acceptable limit, the area was decontaminated to activity levels below the instrument detection limit."

During the survey, the survey team also surveyed various components and features, finding three areas containing observable contamination levels. These included the fire extinguisher mount on the east wall of Room 127, the unpainted tops of the sprinkler

[1] Rockwell International Report, N704T1990066, *Plutonium Concentrations in Soil Samples from the Nuclear Material Development Facility*, August 6, 1986.
[2] Rockwell International Report, N704SRR990027, *Final Radiation Survey of the NMDF*, December 19, 1986.

pipes in Room 127, and the beams in Room 127. These were "cleaned and resurveyed to ensure a complete decontamination of the premises."

Upon completion of the survey, the surveyors also removed the flooring in the posted area, removed the fire extinguishers and mounts in the glove box room, removed the fire protection sprinkler system in the glove box room, scrubbed the beams in the glove box room, remove the lights from Room 130, removed paint from the east wall of the glove box room, and scrubbed the east emergency exit door.

Additionally, during periods of rain, water samples were collected from the area surrounding the building and were analyzed for Am-241 in a gamma spectrometer. The report indicated that all water samples did not contain Am-241. It should be noted the report did not provide the detection limits for Am-241 and did not provide any analytical results.

The report concluded that no residual contamination remained and that the facility met the 1986 release criteria for unrestricted use.[1]

- **1987 ORAU Radiological Survey.** Oak Ridge Associated Universities (ORAU) performed a radiological survey in July 1987 to confirm the 1986 Rockwell International final radiological survey. The survey covered Building 4055 and the surrounding area through a document review and measurements of direct radiation levels, contamination levels and soil contamination.

  The facility survey included the gridding of the floors and lower walls in the posted areas of Building 4055. ORAU performed surface scans, measurement of surface contamination levels, exposure rate measurements, paint sampling, soil sampling of the backfilled subfloor drain line trench, and miscellaneous media sampling. The miscellaneous media sampling included residue from anchor bolt holes in the radiologically controlled area of the building, as well as dust from a trench, air duct, and ceiling area.

  The exterior area survey included surface scans of outside areas adjacent to the building and a survey of the roof, exhaust vents and gutters. Additional exterior areas surveyed included the waste tank area. ORAU also performed exposure rate measurements, soil sampling, and water sampling from the waste tank retention well.

  Smears for the determination of removable contamination were counted for gross alpha and beta activity. Soils were analyzed by gamma spectroscopy for U-235, U-238, Am-241, and "other identifiable photopeaks." Paint samples, soils, and miscellaneous residues were analyzed for isotopic plutonium. The water sample was analyzed for gross alpha and gross beta concentrations. The results of these sampling activities were compared with "guidelines established by the NRC for release of facilities for unrestricted use."

[1] Rockwell International Report, N704SRR990027, *Final Radiation Survey of the NMDF*, December 19, 1986.

Surface scans revealed no areas of elevated beta-gamma or gamma contamination and one small area of elevated alpha contamination inside the building. Surface contamination measurements for alpha contamination were between the minimum detectable activity (MDA) (3 dpm/100 cm^2) and 120 dpm/100 cm^2 (NRC limit was 300 dpm/100 cm^2). All smears for removable alpha contamination taken after cleanup were below the limit for unrestricted use (NRC limit was 20 dpm/100 cm^2). Beta contamination measurements were between the MDA (480 dpm/100 cm^2) and 3,900 dpm/100 cm^2 (NRC limit was 5,000 dpm/100 cm^2). Removable beta contamination smears taken after cleanup was between the MDA (6 dpm/100 cm^2) and 23 dpm/100 cm^2 (NRC limit was 1,000 dpm/100 cm^2). Exposure rates ranged from 12 to 14 µR/hr compared to background levels of 10 to 13 µR/hr (Site criteria is 10 µR/hr above background). Soil samples showed contaminant concentrations of: U-235, <0.36 to <0.41 pCi/g (limit is 35 pCi/g); U-238, 1.7 to 5.1 pCi/g (limit is 35 pCi/g); Am-241, <0.11 to <0.13 pCi/g; Pu-238, <0.01to 0.01 pCi/g (limit is 25 pCi/g); Pu-239/240, <0.01 to 0.06 pCi/g (limit is 25 pCi/g).

The survey concluded that the facility satisfied the 1987 NRC requirements for release for unrestricted use. The document review found that the final survey was consistent with industry-accepted practices and the data supported the conclusions.[1]

- EPA conducted an oversight verification survey in 2001 for alpha, beta, beta-gamma radiation (total and removable) and gamma radiation. Surveys were performed to a quality level equal to a final status survey as defined by MARSSIM. The COCs for Building 4055 were transuranic compounds on the floors, walls, and ceilings. EPA also collected concrete core samples, which were analyzed for photon-emitting isotopes. Acceptable limits for the survey were consistent with NRC Regulatory Guide 1.86 and the proposed site-wide release criteria in the 1996 Area IV survey. None of the field measurements indicated the presence of radionuclides above 2001 acceptable limits. EPA field measurements confirmed the conclusions reached by both Rocketdyne and ORAU.[2,3]

[1] Oak Ridge Associated Universities Report, *Confirmatory Radiological Survey Nuclear Materials Development Facility (Building T-055), Rockwell International, Santa Susana, California*, July 1987.

[2] U.S. EPA Report, no document number, *Final Oversight Verification and Confirmation Radiological Survey Report for Buildings T-011, T-019, T-055, and T-100*, December 20, 2002.

[3] Rocketdyne Document, A4CM-ZR-0011, Rev. A, *Area IV Radiological Characterization Survey*, August 15, 1996.

Surface Contamination Guidelines from DOE Order 5400.5 (1990) and NRC Regulatory Guide 1.86 (1974)

Allowable Total Residual Surface Contamination (dpm/100 cm²)			
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: Atomics International submitted a license application for the NMDF on June 24, 1966.[1] The application indicated the NMDF provided Atomics International the capability to perform research and development in the plutonium materials field in connection with the Fast Breeder Reactor program. Building 4055 was included in Special Nuclear Materials License No. SNM-21 for the possession and use of special nuclear material for the production of test and research reactor fuel elements, the development and testing of both irradiated and unirradiated nuclear fuels, and the associated research and development projects involved. The license required that all potentially contaminated liquid effluents from Building 4055 be analyzed prior to discharge. The license does not clearly provide information on the amount of plutonium that was permitted to be present in Building 4055 or at the SSFL. On December 17, 1982, Rockwell International requested that Building 4055 be removed from the license as a facility authorized for the possession and use of special nuclear materials, specifically for the research and development activities associated with plutonium fuels.[2,3] Building 4055 was removed from the license as an authorized facility to manufacture and perform research and development activities; however, plutonium in the form of Pu-239 remained under the materials license as a result of residual contamination at Building 4055. In addition, the building was retained as a contaminated facility until it could be decontaminated and released for unrestricted use.[4,5] On October 7, 1987, Building 4055 was officially removed from the Nuclear Regulatory Commission Special Nuclear Material License No. SNM-21 and released for unrestricted use.[6]

Use Authorization No. 88 was issued on March 4, 1975, to Rocketdyne for the use of 500 milligrams of plutonium in the form of metal and several chemical compounds (NBS isotopic

[1] Atomics International, *License Application for the Nuclear Materials Development Facility*, June 24, 1966.
[2] U.S. Nuclear Regulatory Commission, *Materials License*, SNM-21, September 15, 1977.
[3] U.S. Nuclear Regulatory Commission, NUREG-1077, *Environmental Impact Appraisal for Renewal of Special Nuclear Material License No. SNM-21*, June 1984.
[4] U.S. Nuclear Regulatory Commission, *Materials License*, SNM-21, June 28, 1984.
[5] Remley, M.E., Letter Re: Renewal of Special Nuclear Materials License No. SNM-21, Docket 70-25, December 17, 1982.
[6] Rouse, Leland, NRC Letter Re: SNM-21, Amendment No. 1, October 7, 1987.

standard – 93% Pu-239, 7% Pu-240) for a "plutonium radwaste combustion test." The license expired March 4, 1976, with no evidence of having been renewed.[1] The application for the use of the 500 mg of plutonium indicated that molten salt radwaste combustion process utilized a molten salt to decompose and burn in situ the organic material in the waste. All inorganic components were retained in the molten ash mixture.[2]

Use Authorization No. 115 was issued to Rocketdyne on March 10, 1979, for 455 kilograms of natural and depleted uranium and an unknown quantity of enriched uranium and plutonium. The approval, according to the initial authorization was based on an application dated March 10, 1978. The authorization indicated that the material would be utilized in a way so as to follow the procedures established for the control of plutonium contamination.[3] According to an internal letter regarding the renewal of Use Authorization No. 115, the major operation conducted at Building 4055 in 1979 was the fabrication of depleted uranium carbide blanket elements for FFTF. The letter indicated that this operation involved only depleted uranium; however portions of the facility, including the glove boxes and associated ventilation exhaust system, were contaminated with plutonium. As a result, the renewed authorization would continue to require radiological control measures for plutonium. The letter indicated that radioactive materials that would still remain present at Building 4055 in 1980 included approximately 19.8 kilograms of depleted uranium in oxide and carbide form, and enriched uranium and plutonium as contamination and gamma scanning standard.[4,5]

According to the internal letter dated February 22, 1982, regarding the renewal of the authorization, it was noted that during 1981, Building 4055 had been used for the decladding, oxidizing and repackaging of the AFS mixed carbide fuel pins and the oxidation of the scrap depleted uranium carbide left from the "blanket fuel project."[6] The use authorization remained unchanged until 1984, when the authorized material was the presence of residual contamination at Building 4055 and the building was being decontaminated and decommissioned. Isotopes listed in the authorization included source material, enriched uranium, and plutonium. The use specifications outlined by the authorization indicated that all procedures established for the control of plutonium contamination would remain in effect. The authorization dated 1986 indicated that the operations for the upcoming year included the disposal of the NaK bubblers, removal of the liquid waste system, and removal of the high volume exhaust system. The final use authorization was dated March 10, 1987, with an expiration date of March 10, 1988.[7,8,9]

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[1] Tuttle, R., Authorization for Use of Radioactive Materials or Radiation Producing Devices, Authorization No. 88, March 4, 1975.
[2] Grantham, L.F., Rockwell International Internal Letter Re: Application to Use Plutonium in Radwaste Combustion Tests, January 21, 1975.
[3] Mountford, L.A., Authorization for Use of Radioactive Materials or Radiation Producing Devices, Authorization No. 115A, March 10, 1979.
[4] Lang, J.F., Rockwell International Internal Letter Re: Renewal of Use Authorization No. 115, February 21, 1980.
[5] Mountford, L.A., Authorization for Use of Radioactive Materials or Radiation Producing Devices, Authorization No. 115B, March 10, 1980.
[6] Lang, J.F., Rockwell International Internal Letter Re: Renewal of Use Authorization No. 115, February 22, 1982.
[7] Horton, P.H., Letter Re: Renewal of Use Authorization No. 115, February 20, 1986.
[8] Mountford, L.A., Authorization for Use of Radioactive Materials or Radiation Producing Devices, Authorization No. 115F, March 10, 1984.
[9] Nagel, W.E., Authorization for Use of Radioactive Materials or Radiation Producing Devices, Authorization No. 115H, March 10, 1986.

Former Radiological Burial or Disposal Locations: According to a radiological contingency plan, wastes generated at Building 4055 may have been in gaseous, liquid, or solid form with the potential radioactive contaminants including uranium and plutonium. As indicated above, Building 4055 was equipped with a dual ventilation and gaseous-effluent control system for the management of gaseous effluents. A description of this system has been presented above.[1]

[redacted][2,3,4]

[redacted][5,6,7]

[redacted][8]

[redacted][9,10]

[1] Rockwell International Report, ESG-81-30, *Onsite Radiological Contingency Plan for Rockwell International Operations Licensed Under Special Nuclear Material License No SNM-21*, March 3, 1982.
[2] Rockwell International Report, AI-DOE-13559, *Nuclear Materials Development Facility Decommissioning Final Report*, March 31, 1987.
[3] Oak Ridge Associated Universities Report, no document number, *Confirmatory Radiological Survey Nuclear Materials Development Facility (Building T-055), Rockwell International, Santa Susana, California*, July 1987.
[4] Rockwell International Report, N001T1000200, *Long-Range Plan for Decommissioning Surplus Facilities at the Santa Susana Field Laboratories*, Date Unknown.
[5] U.S. Nuclear Regulatory Commission, NUREG-1077, *Environmental Impact Appraisal for Renewal of Special Nuclear Material License No. SNM-21*, June 1984.
[6] Rockwell International Report, AI-DOE-13559, *Nuclear Materials Development Facility Decommissioning Final Report*, March 31, 1987.
[7] Moore, J.D., Document No. AI-77-14, *Atomics International Environmental Monitoring and Facility Effluent Annual Report 1976*, Date Unknown.
[8] Rockwell International Report, AI-DOE-13559, *Nuclear Materials Development Facility Decommissioning Final Report*, March 31, 1987.
[9] Rockwell International, ESG-82-33, *Health and Safety Sections for Renewal Application of the Special Nuclear Materials License SNM-21, Docket 70-25, Issued to Energy Systems Group of Rockwell International*, June 5, 1984.
[10] Rockwell International Report, ESG-81-30, *Onsite Radiological Contingency Plan for Rockwell International Operations Licensed Under Special Nuclear Material License No SNM-21*, March 3, 1982.

Solid compactable waste from Building 4055 was compacted into suitable containers, including metals cans and "ice cream cartons." These containers were then transferred via the "transfer tunnel" to the waste-handling box, where all items were bagged out of the glove box into 55-gallon drums. The 55-gallon drums were transferred for storage to Building 4064. Special items of unusual weight or shape such as filters and bulky equipment were bagged out directly from the box where they were used. Used filters were bagged out and treated as solid waste. If a sufficient amount of fuel material was contained on the used filter and required economical recovery, the filter would be transferred to a waste-handling glove box for reclamation. Details on this process were not available in the cited documents. The solid wastes were ultimately packaged in approved containers and shipped off site for commercial land burial or storage.[1,2,3]

Aerial Photographs: The area comprising the future Building 4055 area is agricultural land in 1952. By 1957, the area is under development. Buildings 4373 and 4374 have been constructed to the east of the future Building 4055 area. The building has been constructed by 1967 and a drainage channel is visible along 24th Street. The liquid waste system is also visible in the 1967 aerial photograph. The building is surrounded by a paved area to the north and west of the building. A fence-line is located east of the building around Buildings 4373 and 4374. In 1978, a possible vertical tank appears to be present south of the building near the smoke stack. The vertical tank to the south of the building no longer appears present in 1978; however, a possible vertical tank is located along the west perimeter of the building. A stain is visible on the paved area at the southwest corner of the building. The drainage channel along J Street is clearly defined in 1988 aerial photographs. The immediate area surrounding Building 4055 is very active in 1995. Numerous containers or vehicles are visible to the west and east of the building. In 2005, the site remains active with the presence of vehicles in the parking lots to the north of the building. Documents indicate that the waste system was removed; however, the concrete vault remains visible southeast of the building.[4]

Radionuclides of Concern: The primary special nuclear materials handled in the Building 4055 were plutonium and uranium. Accordingly the radionuclides of concern are uranium, Pu-239, and their decay and daughter products, primarily Am-241.[5,6] Decay products from U-235, U-238, and Th-232 decay chains include Th-234, Th-228, Ac-228, Ra-226, Pb-214, Bi-214, Pb-212, Bi212, and Tl-208. In addition, H-3, Sr-90, Cs-137, Na-24, Co-57, Co-60, Eu-152, and Am-243 would have been formed. All radionuclides of concern listed, with the exception of Na-24 and Co-57 (due to relatively short half-lives), are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. Table 3.3 presents a summary of radionuclides of concern.

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[1] Rockwell International Report, ESG-81-30, *Onsite Radiological Contingency Plan for Rockwell International Operations Licensed Under Special Nuclear Material License No SNM-21*, March 3, 1982.
[2] Rockwell International, ESG-82-33, *Health and Safety Sections for Renewal Application of the Special Nuclear Materials License SNM-21, Docket 70-25, Issued to Energy Systems Group of Rockwell International*, June 5, 1984.
[3] Rockwell International, AI-76-21, *Environmental Impact Assessment of Operations at Atomics International Under Special Nuclear Materials License No. SNM-21*, April 30, 1976.
[4] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[5] U.S. Nuclear Regulatory Commission, NUREG-1077, *Environmental Impact Appraisal for Renewal of Special Nuclear Material License No. SNM-21*, June 1984.
[6] Rockwell International Report, AI-DOE-13559, *Nuclear Materials Development Facility Decommissioning Final Report*, March 31, 1987.

Drainage Pathways: Surface water on the south side of the building drains south into an asphalt lined ditch that is located on the north side of J Street. Surface water on the west side of the building initially flows to the west into an asphalt lined ditch where it is carried to the north. Once surface water enters the ditch it flows to the north into an underground culvert that runs east, in front of the building. The surface water emerges from the culvert on the east side of the building and empties into another asphalt ditch that runs east to 22nd Street. Surface water on the east side of the building drains east into an asphalt lined ditch that runs to the north and also empties into the same east trending asphalt lined ditch. Surface water on the north side of the building drains to the north into the ditch that runs along the south side of G Street. All of the surface water in the vicinity of building 4055 eventually flows to the east via the ditch on the south side of G Street or the ditch on the north side of J Street and then on to Area III.

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4055 area is Class 1 based on previous site activities and incident reports.

Recommended Locations for Soil/Sediment Sampling: 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 4055 area. As discussed above, 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 4055 area were focused on delineating the extent of contamination to standards that were applicable at the time. And because the building remains present at the site, there have been limited site investigations of the area surrounding Building 4055. 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 4055 area. This includes the following Building 4055 areas and appurtenances:

- The former location of the underground drainage line from Building 4055 to the liquid waste holdup tank located southeast of the building. The drainage line ran within the western fenced boundary of Building 4373, discussed below, and ran west to Building 4055. As indicated above, Rockwell International performed a survey of the Building 4055 drain lines in 1986 to determine if any plutonium was left in the soil following removal. According to the 2005 HSA, the maximum measurements were 0.613 pCi/g of Pu-239 and Pu-240 and 0.0421 pCi/g of Pu-238. The 1986 acceptance limit was 25 pCi/g.[1] It is recommended that sampling be conducted along the entire length of the drain line to the former liquid waste holdup system.

- Building 4055 is an existing structure where active operations are occurring. EPA anticipates that Building 4055 will be demolished and removed in accordance with the DTSC/DOE AOC dated December 2010. Therefore, characterization beneath existing

[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. Citing Rockwell International Report, N704SRR9900124, *Plutonium Concentrations in Soil around Drain Lines at NMDF*, April 3, 1986.

structures will not be conducted until after the decontamination and decommissioning activities are complete.

- Sampling is recommended around the perimeter of the concrete parking, driveway, and storage areas specifically in the vicinity of former tanks, septic systems, and drain lines. Additionally, sampling should be conducted at any locations where surface water may drain form the concrete covered surfaces.

- Based on the above, it is also recommended that all adjacent surface drainage ditches in this area be sampled for potential contamination. Environmental monitoring reports indicated that liquid radioactive waste was not discharged to uncontrolled areas at the SSFL; however, information regarding the sampling of the tanks prior to discharge could not be located. [redacted][1,2]

2.2.5 Building 4373 Area

Site Description: The Building 4373 area includes Rockwell-owned Building 4373, pad 4848, a leach field, and the surrounding area at the corner of L Street and 22nd Street outside the boundary of the government-optioned land. Building 4373 was constructed in 1956 and included five bays comprising approximately 2,500 square feet.[3,4] The building served as the first SNAP critical facility. The building was initially connected to a leach field system and was serviced by pad 4848. Figures 2.2.5a through 2.2.5i 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: Constructed in 1956, Building 4373 was originally built for the testing and handling of highly explosive solid rocket fuels (see Figure 2.2.5c). Ownership of the building transferred from Rocketdyne to Atomics International Division in 1957 for use as the first SNAP critical facility. More specifically, a 1957 and 1958 progress report indicated the building's modification was to provide field test facilities for the performance of the "ANN" program.[5] One test cell was modified for critical assembly research supporting the SNAP program in 1957 by adding two feet of additional concrete shielding to two walls and installing a high-efficiency particulate air (HEPA) filter bank (see Figure 2.2.5d).[6,7]

A May 1962 Atomics International evaluation report provides a description of the Building 4373 facilities. According to the report, Building 4373 was constructed on a concrete foundation and floor slab and included 2,500-square feet of floor area. The test areas were separated from the

[1] Rockwell International, ESG-82-33, *Health and Safety Sections for Renewal Application of the Special Nuclear Materials License SNM-21, Docket 70-25, Issued to Energy Systems Group of Rockwell International*, June 5, 1984.
[2] Rockwell International Report, ESG-81-30, *Onsite Radiological Contingency Plan for Rockwell International Operations Licensed Under Special Nuclear Material License No SNM-21*, March 3, 1982.
[3] Ashley, R.L., Atomics International Document No. NAA-SR-7300, *Evaluation of the Atomics International Nuclear Development Field Laboratory as a Location for Reactor Facilities*, May 25, 1962.
[4] ETEC Document, GEN-ZR-0012, *Radiological Survey of Buildings T373 and T375*, August 8, 1988.
[5] Atomics International, Facilities and Data Department, *Progress Report Fiscal Year 195 and Forecast Fiscal Year 1958*, January 1958.
[6] ETEC Document, GEN-ZR-0012, *Radiological Survey of Buildings T373 and T375*, August 8, 1988.
[7] Rockwell International, A4CM-AN-003, *Area IV Characterization Survey Plan*, March 30, 1994.

administrative and general operating areas by a concrete shield wall. The test area building was approximately 62 feet long by 14 feet wide and contained a 14- by 11-foot fuel storage room, a 14- by 12-foot reactor test cell, and three adjacent cells (each 14- by 12-feet), that were used for miscellaneous non-nuclear tests that appear to have changed throughout the operation of the building.[1]

The cells were originally designed as explosion blowout rooms and were provided with 12-inch thick concrete inside walls. An additional 2 feet of magnetite concrete was added to the reactor test cell wall adjacent to the administrative area and 2 feet of ordinary concrete on the wall separating the reactor test cell and adjacent test cell. The facility roof consisted of metal joists and cemesto panels with built-up roofing material and did not include any shielding. The reactor test cell included a gas-tight door and a welded steel lining on all four walls, the ceiling and floor.[2] According to a February 1962 summary hazards report and operations manual for the SNAP 8 critical experiments to be conducted in the building, the location of the critical machine within the test cell had been changed at some time not documented in the report. According to the report, the structures of the previous "critical machines" had been removed from the cell. The document does not provide information to indicate how the previous critical machines had been disposed. A figure of the layout of the test cell shows the critical machine to be located in the center of the test cell.[3]

Based on information included in the 1988 survey report, Building 4373 was reportedly designed to contain radioactivity in the form of fissile material and activation foils; accordingly, no liquid radioactive waste was produced and no liquid radioactive waste holdup tanks were included at Building 4373.[4,5]

The administrative and general operating area, located on the opposite side of the shield wall from the test area, included a 9- by 11-foot change room that led to the fuel storage room and main test cell, a 20- by 20-foot L-shaped control room, a 20- by 32-foot laboratory area, a 7- by 12-foot instrument shop, a 12- by 11-foot equipment room, and a 10- by 41-foot office area. The building was surrounded by a chain-link security fence and included a secondary fence that prevented the use of the areas west and south of the main test cell. According to the report, the walls here "may not provide adequate shielding in the event of an excursion."[6]

The test cell ventilation system used a combination of air-filtration and air-conditioning system that enabled recirculation of the cell atmosphere or discharge of the atmosphere to a stack. During "normal" operations, and with the cell sealed, a fan recirculated the cell atmosphere through a bank of pre- and "absolute" filters and a cooler (or heater). When the reactor test cell door was opened, the ventilation system was converted automatically to a "once-through system.

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[1] Ashley, R.L., Atomics International Document No. NAA-SR-7300, *Evaluation of the Atomics International Nuclear Development Field Laboratory as a Location for Reactor Facilities*, May 25, 1962.
[2] Ashley, R.L., Atomics International Document No. NAA-SR-7300, *Evaluation of the Atomics International Nuclear Development Field Laboratory as a Location for Reactor Facilities*, May 25, 1962.
[3] Thiele, A.W., Atomics International Document NAA-SR-MEMO-7029, *SNAP 8 Critical Experiment Summary Hazards Report and Operations Manual*, February 1, 1962.
[4] ETEC Document, GEN-ZR-0012, *Radiological Survey of Buildings T373 and T375*, August 8, 1988.
[5] Author Unknown, *Facility Information Bldg 373*, Date Unknown.
[6] Ashley, R.L., Atomics International Document No. NAA-SR-7300, *Evaluation of the Atomics International Nuclear Development Field Laboratory as a Location for Reactor Facilities*, May 25, 1962.

Approximately 500 cfm of air [was] drawn through the cell and filters and then mixed with 500 cfm of dilution air prior to discharge to the stack."[1]

According to January 1962 summary hazards report and operations manual, the fuel elements used in the building were stored in the fuel storage room in the shipping bird cages provided by "Fuel Fabrication." Only one bird cage was permitted in the test cell during fuel loading operations. No cages were permitted in the test cell during critical experiments.[2]

The building was initially connected to a leach field system until it was closed and abandoned once the site-wide sewage treatment system was installed and operational in 1960.[3,4]

Former Use(s): Constructed in 1956, Building 4373 was originally built for the testing and handling of highly explosive solid rocket fuels; however, information was not located in available documents to indicate these operations occurred. Ownership of the building transferred from Rocketdyne to Atomics International Division in 1957 for use as the first SNAP critical facility. One test cell was modified for critical assembly research supporting the SNAP program in 1957 by adding two feet of additional concrete shielding to two walls and installing a high-efficiency particulate air (HEPA) filter bank.[5,6] The SNAP critical assembly (SCA) had a pseudo spherical shape with a fixed hydrogen moderator, highly enriched U-235 fuel, and a beryllium and graphite reflector.[7]

According to the May 1962 Atomics International evaluation report, several critical experiments and tests on critical assemblies had been completed since 1957. The summary of the tests provided in the report are provided below: [8]

- SCA-1. Initiated October 1957. This assembly consisted of a pseudo sphere of zirconium hydride-enriched uranium dioxide blocks. Basic reactor parameters of the SNAP 2 reactor concept were determined.
- S2ER Critical Experiment. Initiated June 1959. The S2ER components were assembled and preliminary tests conducted at zero power.
- SCA-2. Initiated about September 1960. A clean, cylindrical geometry core was studied, using the core and reflector components from the conduction-cooled SNAP10 reactor.
- SCA-3. Initiated October 1961. An assembly of about a 1-cubic foot core volume was built to study the characteristics of the SNAP4 reactor. Plate-type fuel elements and a water coolant were used.

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[1] Ashley, R.L., Atomics International Document No. NAA-SR-7300, *Evaluation of the Atomics International Nuclear Development Field Laboratory as a Location for Reactor Facilities*, May 25, 1962.
[2] Brehm, R.L., Atomics International Document No. NAA-SR-7011, *Summary Hazards Report and Operations Manual for SNAP Critical Assemblies 4A and 4C*, January 22, 1962.
[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. Citing Boeing Internal Document, no document number, *Radiation Survey Report, Building B373-Septic Tank*, December 7, 2000.
[4] Rockwell International, A4CM-AN-003, *Area IV Characterization Survey Plan*, March 30, 1994.
[5] ETEC Document, GEN-ZR-0012, *Radiological Survey of Buildings T373 and T375*, August 8, 1988.
[6] Rockwell International, A4CM-AN-003, *Area IV Characterization Survey Plan*, March 30, 1994.
[7] ETEC Document, GEN-ZR-0012, *Radiological Survey of Buildings T373 and T375*, August 8, 1988.
[8] Ashley, R.L., Atomics International Document No. NAA-SR-7300, *Evaluation of the Atomics International Nuclear Development Field Laboratory as a Location for Reactor Facilities*, May 25, 1962.

Future experiments that were planned, but have not been confirmed included the following: [1]

- SCA-4C. This assembly was to use prototype SNAP2/10A core and reflector components, as a final design check on the flight reactor system. The test was tentatively scheduled to begin in mid-1962.
- S8ER Critical Experiment. The S8ER components were to be used to determine the nuclear parameters of the SNAP 8 reactor design. The test was tentatively scheduled to begin in mid-1962.
- SCA-4A. This assembly was to provide a flexible reflector assembly to permit optimum design of the reflector controls for the SNAP2/10A reactor. This test was tentatively scheduled to begin late in 1962.

The evaluation report indicated that following these tests, the facility was to be deactivated and that the critical experiment program would be continued in Building 4012 (discussed in EPA's upcoming HSA-6 TM).[2] Prior to being deactivated, a meeting held in March 1960 discussed the expanded use of Building 4373. According to a letter summarizing the meeting, it was recommended that the "water test room" adjacent to the critical assembly in Building 4373 be used for intermittent liquid metals tests. The letter stated that the measured dose in the room is 1 mrem/hour during operation of the critical assembly.[3] The letter did not indicate the nature of the liquid metals tests to be conducted.

According to numerous documents, SNAP critical tests in Building 4373 ceased in 1962 or 1963. However, an undated facility information sheet for Building 4373 indicated that a log book of the facility operations was kept and maintained in the control room.[4] Documents received to date have included the Building 4373 log book dated January 11, 1962, through May 28, 1965, that appear to indicate operations continued after 1963. A summary of select entries of the log book are presented below under the previous radiological investigations section. However, the log book indicates routine surveys of beryllium and birdcages containing 93% enriched uranium.[5] Additional available information is presented below.

An April 8, 1963, internal letter provided a summary of a March 20, 1963, meeting that provided a review of Building 4373 operations. According to the letter, Building 4373 was being used to test the SCA-4C in early 1963. The meeting summary indicated that the experimental program in Building 4373 was extensive despite previous correspondence indicating that Building 4373 was not recommended for a long-range program of critical experiments, due to "certain undesirable aspects of the ventilation system and the building design." However, it was reported the maximum credible accident for the facility assumed no containment and that changes to the ventilation system would require extensive modification to the building structure. It was recommended that Buildings 4012 and 4024 be used as much as possible for critical tests at the SSFL. The letter also indicated that the meeting recommended that "serious consideration should be given to using a weak source during fuel loading, in order to provide possible additional safety to personnel." The meeting minutes indicated that no source was used during

[1] Ashley, R.L., Atomics International Document No. NAA-SR-7300, *Evaluation of the Atomics International Nuclear Development Field Laboratory as a Location for Reactor Facilities*, May 25, 1962.
[2] Ashley, R.L., Atomics International Document No. NAA-SR-7300, *Evaluation of the Atomics International Nuclear Development Field Laboratory as a Location for Reactor Facilities*, May 25, 1962.
[3] Jarrett, A.A., Letter Re: Expanded Use of Building 373, March 30, 1960.
[4] Author Unknown, *Facility Information Bldg 373*, Date Unknown.
[5] Log Book, Building 373, January 11, 1962 to May 28, 1965.

fuel loading in Building 4373 prior to this time.[1] The research team reviewed the entire collection of available documents provided by Boeing, DOE, and other sources and could not find information to indicate if a radioactive source was used in Building 4373 after March 1963. According to the log book for Building 4373, the SCA-4C was being dismantled in May 1963 for storage at Building 4005.[2]

In addition, Atomics International held a semiannual review of Building 4373 on September 16, 1964. According to the minutes of that meeting, Building 4373 continued to conduct experiments under the SNAP Critical Assembly Program. From March to September 1964, testing was completed in support of the SNAP-10B program. The meeting summary indicated the testing involved "the investigation of the worths of reflector under different arrangements, core critical loading measurements and materials reactivity effect studies." The experiments were classified in more detail, as follows:[3]

> Some experiments were studies involving materials such as samarium, gadolinium, and various fuel element cladding materials. In these experiments, the reactivity effects of the materials placed in the core were measured. Other experiments included studies of different types of control elements, and included the sliding drum, the tapered drum, and the split drum type.

The meeting minutes also indicated that Building 4373 would be used in the next six months in support of the SNAP-10B and SNAP 8 reactor concepts, and experiments would be conducted to obtain data on neutron lifetime, the worth of individual control drums and other reactor constants. The minutes indicated that an addendum to the Summary Hazards Report would be required for experiments relating to the SNAP-8 program, and the building would require modification. Documents were not located to indicate whether the building modifications required to accommodate the SNAP-8 program were made to Building 4373 following this meeting.[4]

The meeting summary indicated that no unusual incidents occurred during the "past survey period." It was reported; however, that a "slight case of U-235 foil contamination did occur." According to the minutes, "contamination levels were of minor concern and were easily cleaned up."[5]

According to a June 24, 1965, internal letter regarding a March 29, 1965, meeting and review of Buildings 4012 and 4373 for the use of poison-loaded Mylar films in critical experiments, Building 4373 had been approved for Mylar film experiments in SCA-4A and SCA-4B. The letter indicated the purpose of the experiments was to use Mylar films to introduce neutron absorbing material in experimental studies of proposed SNAP 2 and SNAP 10 reactor cores. The objective was to develop a reactor core that would be subcritical when immersed in water, but

[1] Remley, M.E., Internal Letter Re: Review of Bldgs 012 and 373 (NDFL) Recommendations and Minutes of Meeting of March 20, 1963, April 8, 1963.
[2] Log Book, Building 373, January 11, 1962 to May 28, 1965.
[3] Remley, M.E., Internal Letter Re: Semiannual Review of Building 373 – Recommendations and Minutes of Meeting of September 16, 1964, September 24, 1964.
[4] Remley, M.E., Internal Letter Re: Semiannual Review of Building 373 – Recommendations and Minutes of Meeting of September 16, 1964, September 24, 1964.
[5] Remley, M.E., Internal Letter Re: Semiannual Review of Building 373 – Recommendations and Minutes of Meeting of September 16, 1964, September 24, 1964.

would have the desired excess reactivity when filled with NaK and surrounded by the reflector and control drum assembly. The experiments were designed to have the fuel elements and core vessel have layers of gadolinium of several thicknesses. The gadolinium was to be attached with Mylar film. The experiments in Building 4373 were to be with dry cores.[1]

On June 8, 1965, Atomics International submitted comments on a draft reactor safety survey report dated April 22, 1965. The report was titled, "SNAP Critical Assembly-4A, Building 373." Atomics International provided the following additional information regarding the Mylar experiments being conducted in Building 4373:

> At the time of the survey an experiment was in progress to provide information that might result in the design of SNAP reactors that would be subcritical when accidentally immersed in water. This reduction in the reactivity of the water flooded and reflected systems as compared to the beryllium reflected system would be achieved through the use of an absorber with a strong low energy resonance, such as gadolinium, which would produce a shift in the effective energy of the neutrons causing fission. In this experiment the poison was in the form of gadolinium oxide applied to a Mylar film which was applied to either the fuel elements or to the core vessel as required by the experiments program.

The letter also stated that Atomics International was in the process of developing and implementing a procedure for the in-place testing of "absolute" filters, including those in Building 4373, which was to be done in the near future.[2] Available documents reviewed by the research team do not provide the results of those tests.

According to the log book, it also appears that Building 4373 served as a monitoring and tagging station for "birdcages" containing various fuels. According to a number of log book entries, birdcages were monitored and tagged at Building 4373 and were then shipped to Building 4064. A log book entry dated July 11, 1963, indicated that personnel "tagged and shipped 8 birdcages containing SNAP 10FS-1 backup fuel" to Building 4064. The same day, it was reported that the SCA-4 fuel would be returned to Building 4373 that day. On July 17, 1963, personnel monitored and tagged 8 birdcages containing SCA4 fuel to be shipped to Building 4064, and personnel received 4 birdcages containing S10FS-1 fuel. The entry that day indicated that "a total of 44 S10FS-1 fuel is now in" Building 4373. There are a number of additional references to the monitoring and tagging of birdcages at Building 4373; however, additional information regarding the nature and extent of these operations could not be located.[3]

At the conclusion of the SNAP critical tests, the facility was modified to include a non-nuclear liquid metal NaK test loop to support the SNAP Experimental Reactor. At this time, industrial planning maps refer to the building as a "critical cell and development test building," and is referred to as such until 1975, when industrial maps refer to the building as development test building. According to the undated facility information sheet for Building 4373, NaK experiments were conducted in the North Laboratory Room 102 and in the North Test Room 113. The small test loop was used to pre-test a NaK/NaK heat exchanger, EM pumps, electrical heaters, valves, piping, and instrumentation. Other non-nuclear test loop programs carried out in

[1] Remley, M.E., Internal Letter Re: Review of Buildings 012 and 373 and the Use of Poison Loaded Mylar Films in the SCA-4A and -4B Experiments, Minutes of Meeting of March 29, 1965, June 24, 1965.
[2] Remley, M.E., Letter Re: Comments on Draft Report of Reactor Safety Survey Report, SNAP Critical Assembly-4A, Building 373, June 8, 1965. (Export Controlled Document)
[3] Log Book, Building 373, January 11, 1962 to May 28, 1965.

Building 4373 were RuK test loops, boiling mercury test loops and boiling potassium loops. The facility has since been used intermittently for storage of non-radiological materials.[1,2,3,4,5,6]

According to a 1988 survey report, Building 4373 had no significant radioactivity releases during its operation. Building 4373 was reassigned for non-nuclear use following a radiological survey of the building to ensure the area was "clean." Documents available to date did not include the referenced radiological survey. The report stated that "most" radioactive materials handled in Building 4373 were totally encapsulated or "in a condition which would not release radioactivity to the environment." Radioactive materials handled at the building included fully encapsulated highly enriched uranium. Activation foils were used for flux mapping in Building 4373.[7]

A July 1966 annual review of Building 4373 indicated that Building 4373 had been shut down "for some time." The review stated that the "SCA-4A machine" remained in Building 4373 and was being considered for transfer to Building 4012 for further operations. Based on a 1969 safety analysis report, the machine remained in Building 4373 in 1969. Atomics International received permission from the AEC to operate the SCA-4A in Building 4012 on February 12, 1970.[8,9,10]

In addition, the July 1966 annual review indicated that following the removal of fuel from the facility, a terminal radioactivity and beryllium survey was performed by Health and Safety. The results of this survey were not presented in the annual review report.[11] However, a 1984 letter regarding environmental assessments indicated that Building 4373 was contaminated with radioactive materials and that decontamination of the facility had been performed.[12] In 1987 the building was reported to be unoccupied, abandoned, and inactive, and to not have been used for over 20 years. It was requested that the building be cleaned out, the trash disposed of, and a post added to designate the building as "inactive."[13,14]

In 1988, Building 4373 was reported as being dilapidated inside with many of the interior walls removed. Conduit and miscellaneous debris was scattered about and hanging from the ceiling. The 1988 survey report described the building as a "mess."[15] In 1989, a search for alkali wastes

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[1] ETEC, Document No. GEN-ZR-0012, *Radiological Survey of Buildings T373 and T375*, August 8, 1988.
[2] Rockwell International, A4CM-AN-003, *Area IV Characterization Survey Plan*, March 30, 1994.
[3] Rockwell International, Document No. N001ER000017, *Nuclear Operations at Rockwell's Santa Susana Field Laboratory – A Factual Perspective*, December 20, 1989.
[4] Author Unknown, *Facility Information Bldg 373*, Date Unknown.
[5] Atomics International, Santa Susana Map , July 14, 1964.
[6] Atomics International, Nuclear Development Field Laboratories, Santa Susana, March 1975.
[7] ETEC, Document No. GEN-ZR-0012, *Radiological Survey of Buildings T373 and T375*, August 8, 1988.
[8] Remley, M.E., Atomics International Letter Re: Annual Review of Buildings 012 and 373 – Minutes of Meeting of May 3, 1966, July 7, 1966.
[9] Lahs, W.R., Atomics International Document SRR-696-13-001, *Review of SNAP Critical Facility Safety Analysis Report – Addendum for SCA-4A Operation: Recommendations and Minutes of Meeting held December 30, 1969*, January 13, 1970.
[10] Stamp, S.R., AEC Letter Re: Approval to Operate SCA-4A in the SNAP Critical Facility, Building 012, February 12, 1970.
[11] Remley, M.E., Atomics International Letter Re: Annual Review of Buildings 012 and 373 – Minutes of Meeting of May 3, 1966, July 7, 1966.
[12] Williams, R.O., Rockwell International Letter Re: Environmental Assessments, January 31, 1984.
[13] Schrag, F.C., Internal Letter Re: Building 373, SSFL, June 19, 1987.
[14] Schrag, F.C., Job Improvement Request, May 22, 1987.
[15] ETEC, Document No. GEN-ZR-0012, *Radiological Survey of Buildings T373 and T375*, August 8, 1988.

was conducted by Rockwell International in Area IV. Sodium, potassium, or lithium were identified as being located in an old loop within Building 4373, indicating that the building had not been cleared of old equipment.[1] As of 1994, the building remained abandoned; however, it is unclear whether the condition of the building had been improved or changed since the 1988 survey report.[2]

In 1995, Rockwell International developed a demolition procedure for the demolition of the rubidium loop still located in Building 4373. According to the procedure report, the original loop was built in the early 1960s to investigate the heat transfer and fluid flow characteristics of boiling rubidium at temperatures of 1,400 to 1,800 °F. The loop had been fabricated of 3/8-inch stainless steel tubing, valves, heaters, condenser, and instrumentation supported within a steel angle iron frame structure. A "dump tank" was located at the bottom of the loop. The report stated that the system was drained in the mid-1960s and remained inactive since that time. As of 1995, the loop had also been cut open in four places and the power and instrument wiring had been disconnected. The report did not state if this occurred in the 1960s as well, or at a later date. The 1995 report provided demolition and removal procedures for the remainder of the loop so that Building 4373 could be released for demolition and removal. Certain components of the loop were placed in a 55-gallon drum and transported to the "Environmental Protection Waste Yard." These components included: the condenser/sub cooler, boiler, pre-heaters, valves, expansion tank, dump tank, tubing connections, and fittings.[3]

The 2005 HSA stated that the facility was demolished in 1999.[4] A January 19, 1999, aerial view of the facility (Figure 2.2.5i) shows the exterior portions of the building removed and the concrete interior walls remaining.[5] The exact date of demolition of the entire facility is unknown based on available documents. According to a December 6, 2000, process hazards analysis for the septic tanks and systems removals at Buildings 4353, 4373, and 4143, the septic tanks holes were to be filled and the area was to be returned to natural terrain.[6] A January 3, 2001, email correspondence from Dan Trippeda indicated that the removal of the Building 4373 septic tank included the removal of the septic tank, distribution box, and leach field clay lines.[7]

Information from Interviewees: There have been no interviews relating to the operations in Building 4373 conducted, to date.

Radiological Incident Reports: There were no reported incident reports during the operational period of Building 4373. However, documents obtained by EPA from Boeing indicate that on September 23, 1963, an incident occurred involving a high airborne activity reading on the air monitor. During this incident, alpha activity was observed to rise from 50 to 200 cpm, and beta activity rose from 1,000 to 10,000 cpm. According to a February 1964 recounting of this incident, the cause of the temporary high reading was unknown, but was believed to have been

[1] Robinson, K.S., Rockwell International Internal Letter Re: Alkali Metal Waste in Area IV, January 22, 1989.
[2] Rockwell International, A4CM-AN-003, *Area IV Characterization Survey Plan*, March 30, 1994.
[3] Pendleberry, S., Document No. EWR-824906, *Demolition Procedure Demolition of Rubidium Loop in B/373*, May 1995. Export Controlled Document
[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.
[5] ETEC, Photo 395784, January 19, 1999.
[6] Unknown Author, *Process Hazards Analysis for the Septic Tanks and Systems Removals at Building 4353, 4373, and 4143*, December 6, 2000.
[7] Trippeda, Dan, Email Correspondence Re: 373 Septic Tank, January 3, 2001.

from naturally-occurring radioactive elements. This, according to the document, was "based on the fact that the incident is qualitatively reproducible by leaving the cell door open with the fan off, during certain weather conditions." The health physicist assigned to Building 4373 at that time, discounted the possibility of a fuel leak or fuel contamination because smear surveys did not show any contamination within the building. It was noted that the incident could have been related to an earthquake that had occurred early during that day.[1] Additional information regarding this incident could not be located.

A September 1964 semiannual review of Building 4373 operations indicated that "a slight case of U-235 foil contamination" occurred, but that "contamination levels were of minor concern and were easily cleaned up." Additional documentation regarding this contaminating incident could not be located in available historical documents.[2]

During the pre-demolition survey of Building 4373, on August 22, 1995, a Health Physicist (HP) found three radioactive prefilters in the ventilation system on the roof of Building 4373. According to the incident report, the filters were thought to have been in continuous use from 1957 to 1962 and were not replaced or removed since building operations ceased. The filters were removed and taken to Building 4020 for storage in a radioactive materials storage area. Following the removal of the prefilters, the ventilation system was surveyed and released, although the incident report did not provide the results of this survey. The survey results of each prefilter indicated 11,250 dpm/100 cm^2 of beta activity. Gamma spectroscopy determined that the activity was predominantly Cs-137. As a result, the incident report summarized that the high levels of Cs-137 were the result of building operations, as well as from atmospheric weapons testing. (Incident Report A0664).[3]

Current Use: The California Department of Health Services (DHS) released Building 4373 for unrestricted use on May 9, 1995.[4] The facility was demolished in 1999, and the septic tank was removed in 2000.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): A chronology of radiolocation investigations at this building is as follows:

- As indicated above, the research team located a log book of Building 4373 dated from January 11, 1962, through May 28, 1965. The following table provides a summary of select entries of the log book. Additional information regarding the log entries could not be located and the information provided is as it was presented.[5]

[1] Remley, M.E., Atomics International Letter Re: Semiannual Survey of the SNAP Critical Facility and Minutes of Meeting of February 17, 1964, February 27, 1964.
[2] Remley, M.E., Atomics International Letter Re: Semiannual Review of Building 373 – Recommendations and Minutes of Meeting of September 16, 1964, September 24, 1964.
[3] Harcombe, Richard, Internal Letter Re: Radiological Incident Report A0664, August 25, 1995.
[4] Wong, Gerard, Letter Re: Release of Building 4373 and 4375, May 9, 1995.
[5] Log Book, Building 373, January 11, 1962 to May 28, 1965.

Building 4373 Select Log Book Entries
January 11, 1962 to May 28, 1965

Date	Log Entry
October 19, 1962	A smear survey was made of the birdcage that was decontaminated. The contamination level was <1 dpm α and <30 dpm βγ
October 19, 1962	A smear survey was made of 6 birdcages, reactor room, storage room, and change room. The results follow: All birdcage 3 dpm/100 cm^2 α to 60 dpm/100 cm^2 α < 30 dpm/100 cm^2 βγ to 250 dpm/100 cm^2 βγ
October 31, 1962	Called operations and told them the results of a smear survey taken on the birdcages and in the reactor vault. Everything was clean except for the tritium source. A smear was taken on the outside of the glass tube. 10,000 dpm tritium
November 5, 1962	Made a smear survey for tritium, beryllium, and βγ. Found four positive tritium smears in the reactor vault, three of these were on the neutron accelerator. 11,700 dpm end plate, 18,050 dpm first glass tube, 600 dpm on the aluminum pipe, 500 dpm on the mockup plate, all were tritium. Found on positive βγ near the outside of the RX vault door, 89 dpm βγ.
November 30, 1962	Monitored and tagged 8 birdcages containing 93% Enr. U. fuel elements. Smears showed <1 dpm α and <30 dpm βγ. All 8 birdcages were shipped to Bldg #064.
December 3, 1962	1100 - Monitored and tagged 6 birdcages containing 93% enriched U fuel elements. Birdcages read 0.8 mR/hr @ the surface. 1530 – Monitored and tagged 6 birdcages containing 93% enriched U fuel elements. All were <1 dpm α and <30 dpm βγ except one birdcage which was 24 dpm α. Fuel was the same batch as above.
December 4, 1962	Smeared out 5 birdcages for shipment to Bldg 64. Smeared critical assembly and components. There were less than 30 dpm. The control drums and drives are going to Bldg. #10 and the core container is going to Bldg 12.
January 22, 1963	A complete smear survey of the building was taken. [Beryllium] smears of the Snap 4 reactor, and tritium smears of the neutron-tritium target accelerator were taken. The results are listed below.* Tritium Smears in cpm** 1-A = 143, 2-A = 103, 3-A = 185, 4-A=Bkg, 5-A=Bkg, 6-A=Bkg
March 6, 1963	A smear survey of Bldg 373 revealed <30 dpm/100 cm^2 βγ. A high bkg level was encountered from Bldg 028, when these smears were being counted (1.83 – 30 dpm). Operations were notified and received their copy of the smear survey. Approx. 5 smears were counted on the manual counter to check the possibility that contamination exists. All smears indicated < 30 dpm/100 cm^2 βγ.
March 7, 1963	A smear survey was conducted on two birdcages containing fuel cladding and fuel. T he smear revealed the following: I. The birdcage containing one fuel rod (no cladding) Bottom of can, sides, and top – 125 dpm/100 cm^2 α, 50 dpm/100 cm^2 βγ Fuel rod – 140 dpm/100 cm^2 α, 50 dpm/100 cm^2 βγ II. The birdcage containing fuel cladding 4 fuel casings (cladding) – 28 dpm/100 cm^2 α, <30 dpm/100 cm^2 βγ
May 1, 1963	A smear survey of two birdcages containing 93% enriched fuel elements to be shipped to Bldg #64 revealed $1.3x10^3$ dpm α inside BC#2 and 30 dpm α on the outside. BC 105 revealed 80 dpm α inside and 9 dpm α outside. The operations crew was requested to decontaminate the cages on the outside prior to shipping.
June 24, 1963	A smear survey was conducted by H&S on 10ea birdcages at Building 373. The birdcages contained 10FS1 fuel elements. The birdcages were shipped to 373 from HQ. Results included:*** Cage #1 – small metal chips were found on the outside of the birdcage in the bottom corner – 3,400 dpm α and 5,000 dpm βγ (approx.)

Building 4373 Select Log Book Entries (continued) January 11, 1962 to May 28, 1965

Date	Log Entry
November 11, 1963	Took Be smear of reactor, inserts, and parts bins. Sent them to HQ, made a radiation survey of a 10 min critical of a loading. The top of the reactor read 100 mR/hr, the center rod 120 mR/hr, the peripheral rods read 50 mR/hr a piece, the highest birdcage (with a load of 5 elements) read 2.5 mR/hr at the surface. Smear results: no βγ activity. However, α contamination was found inside the B of E containers and 18 dpm α was found in the corner of the lattice on a birdcage. No other α smear was over 8 dpm. Bkg was 0.1 cpm.
November 14, 1963	Received verbal results of Be smear survey conducted 11 Nov. 1 parts bin, 2 reflectors and the inserts were over allowable limits.
February 4, 1964	A smear survey at the request of [redacted] of the reactor room following the removal of foils from the reactor yielded the following" Reactor table – $4.4x10^3$ dpm/100 cm^2 α, $6x10^3$ dpm/100 cm^2 βγ Reactor room floor – 60 dpm/100 cm^2 α Change room floor – 15 dpm/100 cm^2 α Control room floor – 100 dpm/100 cm^2 α [Redacted] was notified and a follow-up survey initiated. Immediate decontamination was requested. The request was complied with.
February 25, 1964	A smear survey of Bldg 373 recorded the following: Reactor room and SS storage vault floor – ~ 10 dpm/100 cm^2 α average Change room floor – 12 dpm/100 cm^2 α Control room floor – ~4 dpm/100 cm^2 α average Hall floor ~2 dpm/100 cm^2 α average Decontamination requested.
March 11, 1964	A smear survey of the reactor room, SS vaults, change room, and control room revealed contamination to be within permissible limits with the exception of one spot in the control room which was 2 dpm/100 cm^2 α.
April 14, 1964	Smear survey of reactor room, SS vault, change room, control room, and hall failed to reveal any significant α contamination.
July 31, 1964	Smear survey of reactor room indicated $2x10^2$ dpm/100 cm^2 α on reactor table top. Reactor floor and adjacent area was <5 dpm/100 cm^2 α. Requested decon.

*The log book did not present any results of the beryllium smears.
**The locations (i.e. 1-A, 2-A) corresponded to a position on the neutron-tritium target accelerator.
***The research team did not provide the result of each of the birdcages measured and reported.
Bkg=background

- **1998 Rocketdyne Radiological Survey.** In 1988, Rocketdyne performed a radiological survey at Buildings 4373, 4374, and 4375 to determine if any residual contamination existed. The radiation measurements taken during the survey were compared against the DOE residual radioactivity limits specified in "Guidelines for Residual Radioactivity at FUSRAP and Remote SFMP Sites." The maximum acccptable contamination limits used in 1988 are presented below:[1]

[1] ETEC, Document No. GEN-ZR-0012, *Radiological Survey of Buildings T373 and T375*, August 8, 1988.

1988 Maximum Acceptable Contamination Limits

Criteria	Alpha (dpm/100 cm2)	Beta (dpm/100 cm2)
Total Surface, averaged over 1 m2	5,000	5,000
Maximum Surface, in 1 m2	15,000	15,000
Removable Surface, over 100 cm^2	1,000	1,000
Ambient Gamma Exposure Rate	5 µR/hr above background*	

*The DOE guide recommended a value of 20 µR/hr above background for the ambient gamma exposure rate, however, the NRC required 5 µR/hr. Accordingly, Rockwell used the more stringent requirement

According to the 1988 radiological survey, the survey included ambient gamma exposure rate measurements, surface smears and soil samples at Building 4373. The survey of the interior of the building included the floors, drains, and exhaust systems. The survey for the ambient gamma exposure rate of the exterior of the building included the surface between G and J Streets and from 22nd Street to the west fence. The average ambient gamma exposure rates (not adjusted for background) were 10.3 µR/hr for the Building 4373 interior, 9.3 µR/hr for the Building 4374 interior, and 12.6 µR/hr for the surrounding area compared to background measurements between 14.0 and 16.2 µR/hr (NRC limit is 5.0 µR/hr above background).[1] The removable alpha measurements were -0.063 dpm/100 cm^2 average and 2.8 dpm/100 cm^2 maximum (limit is 1000 dpm/100 cm^2). The removable beta measurements were -0.47 dpm/100 cm^2 average and 10.1 dpm/100 cm^2 maximum (limit is 1000 dpm/100 cm^2). The total beta activity measurements found no detectable activity. Survey results found that the areas were acceptably clean by the DOE and NRC guidelines and that no further inspection was required.[2]

- **1996 Rocketdyne Radiological Characterization.** During the 1996 Area IV Radiological Characterization Survey, soil samples were collected and analyzed as part of the Area IV radiological characterization. Randomly selected, two soil samples were taken in the vicinity of Building 4373 (samples 95-0058 and 95-0059), as well as at the inactive sanitary leach field at Building 4373 (samples 95-0011 and 95-0012). The report stated that the septic tank and a single clay pipe stub from the tank were exposed at the surface as a result of erosion. Personnel dug in the opposite bank of the eroded channel and located the start of gravel. Samples were taken from just downstream of the start of the gravel and approximately 10 feet further downstream. According to the report, none of the measurements were distinguishable from background and all measurements were below the acceptable concentration levels established by Boeing in the 1998 approved site-wide release criteria for remediation of radiological facilities. Additionally, located in the central portion of survey block 113, the ambient gamma survey results in the vicinity of Building 4373 measured between 12.6 and 15.3 µR/hr.[3,4]

- **2000 Boeing Radiological Survey of Soil Surrounding Septic System.** According to the 2005 HSA, Boeing also performed a radiological survey of the soil surrounding the

[1] According to the 1988 survey report, an average of 38 background measurements were taken at three locations at the SSFL – the Building 4309 area, Well #13 Road, and Incinerator Road.
[2] ETEC, Document No. GEN-ZR-0012, *Radiological Survey of Buildings T373 and T375*, August 8, 1988.
[3] Rocketdyne, Report No. A4CM-ZR-0011, *Area IV Radiological Characterization Survey Final Report*, August 15, 1996.
[4] Boeing, Document No. N001SRR140131, *Approved Sitewide Release Criteria for Remediation of Radiological Facility at the SSFL*, February 18, 1999.

septic system in 2000. The research team is in the process of obtaining this report from Boeing; however, according to the information presented in the 2005 HSA, all removable and total contamination measurements of the septic tank were non-detect. As reported in the 2005 HSA, all soil sampled showed no contamination levels above background and all measurements met limits for unrestricted use. Removable alpha measured <20 dpm/100 cm^2, removable beta measured <100 dpm/100 cm^2, total alpha measured no detectable activity, and total beta measured no detectable activity. Ambient gamma was between 8 and 10 μR/hr.[1]

Radiological Use Authorizations: According to a January 11, 1990, letter to the DOE from Rockwell International, at the start of research with nuclear materials at the SSFL, the Atomics International operations were conducted under the authority of the Chicago Operations Office of the AEC. At the time, all work performed for the Chicago Operations Office was considered to be exempt from licensing. Following the transfer of Atomics International programs to the San Francisco Operations Office, only those operations conducted on government-optioned land were determined to be exempt from licensing. The Building 4373 area was not located within the government-optioned land boundaries, but, according to the letter, Building 4373 was "shut down and cleaned out" prior to the transfer of operations from the authority of the Chicago Operations Office to the San Francisco Operations Office.[2] As a result, Building 4373 was never included in any licenses during its period of operations under the SNAP program.

Former Radiological Burial or Disposal Locations: The building was initially connected to a leach field system until it was closed and abandoned once the site-wide sewage treatment system was installed and operational in the early 1960s.[3] No other radiological burial or disposal locations have been identified at the Building 4373 area, with the exception of a liquid waste pit located southwest of Building 4373 and visible in the Building 4373 plot plan. This liquid waste pit was associated with the operations of Building 4055 and is discussed above.

Aerial Photographs: In 1952, the area comprising the future Building 4373 area is agricultural land. By 1957, the building has been constructed and possible standing liquid is seen to the west of the building. In 1959, the building area is more developed and Building 4374 is clearly visible to the north of Building 4373. A fence surrounds the perimeter of the building and a large parking area has been developed to the east of the building, on the other side of 22nd Street at the future location of Building 4015, discussed in the HSA-5C TM. A drainage channel is located north of the building along G Street. The area remains relatively unchanged in the 1962/1963 aerial photograph. In 1965, the Building 4373 area remains unchanged. The 1967 aerial photographs show the addition of the liquid waste pit southwest of Building 4373 within the former fence boundary of the building area. In addition, a parking area has been established north of Building 4373 and 4374, outside the fenced perimeter. 1978 aerial photographs show a possible buried pipeline extending from the liquid waste pit northward through the fenced boundary of the Building 4373 area, and then west toward Building 4055. The aerial photograph

[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. Citing Boeing Internal Document, no document number, *Radiation Survey Report, Building B373-Septic Tank*, December 7, 2000.
[2] Lancet, R.T., Letter Re: DOE Authority for Release of Certain Facilities at SSFL, January 11, 1990.
[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. Citing Boeing Internal Document, no document number, *Radiation Survey Report, Building B373-Septic Tank*, December 7, 2000.

interpretation also notes the presence of a probable stain south of the building along J Street. By 1980, the area surrounding the building is becoming vegetated. The stain appears to remain present along J Street. In 1988, the Building 4373 area shows the presence of dark-toned material at the northeast corner of the building. Also, a new building has been constructed to the north of the Building 4373 area. By 1995, the building appears to be under demolition and a possible stain is located east of the building, just west of 22nd Street. By 2005, the Building 4373 and 4374 area is vegetated and the new building constructed sometime between 1983 and 1988 is no longer present. The only feature remaining in 2005 is the liquid waste pit.[1]

Radionuclides of Concern: Most nuclear or radioactive materials handled at Building 4373 were fully encapsulated. Only fissile material and activation foils produced low levels of radioactivity.[2] Based on available information, the radionuclides of concern are uranium, plutonium, and their decay and daughter products. Decay products from U-235, U-238, and Th-232 decay chains include Th-234, Th-228, Ac-228, Ra-226, Pb-214, Bi-214, Pb-212, Bi212, and Tl-208. In addition, H-3, Sr-90, Cs-137, Na-24, Co-57, Co-60, Eu-152, and Am-243 would have been formed. All radionuclides of concern listed, with the exception of Na-24 and Co-57 (due to relatively short half-lives), are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. Table 3.3 presents a summary of radionuclides of concern.

Drainage Pathways: Drainage around the Building 4373 appears to have been to the north and to the south. 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.[3]

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4373 area is Class 1 because of the building's former operations as a critical facility in support of the SNAP program.

Recommended Locations for Soil/Sediment Sampling: 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 SCA that had a pseudo spherical shape with a fixed hydrogen moderator, highly enriched U-235 fuel, and a beryllium and graphite reflector.[4]

As discussed above, 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.

[1] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[2] ETEC, Document No. GEN-ZR-0012, *Radiological Survey of Buildings T373 and T375*, August 8, 1988.
[3] Atomics International, Drawing No. 303-GEN-C41, Sheet 7 of 14, Santa Susana Facility Plot Plan,
[4] ETEC Document, GEN-ZR-0012, *Radiological Survey of Buildings T373 and T375*, August 8, 1988.

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.[1]
- 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.
- As indicated above, 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.

2.2.6 Building 4374 Area

Site Description: Located north of Building 4373, the Building 4374 area includes Building 4374 and the surrounding area west of 22nd Street, outside the government-optioned area. Building 4374 was constructed in approximately 1957 and was an AEC-owned Butler-type building measuring approximately 420 square feet.[2,3] 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: Building 4374 was an AEC-owned single story steel frame and sheet metal covered Butler-type building measuring approximately 420 square feet located a few feet north of Building 4373.[4,5] Historical information or drawing showing the building layout could not be located; however, a March 15, 1962, facility layout of Buildings 4373 and 4374 shows the

[1] Atomics International, Drawing No. 303-GEN-C41, Sheet 7 of 14, Santa Susana Facility Plot Plan,
[2] ETEC, Document No. GEN-ZR-0012, *Radiological Survey of Buildings T373 and T375*, August 8, 1988.
[3] Stafford, K.T., ETEC, *Site Consolidation Assessment*, April 16, 1987.
[4] ETEC, Document No. GEN-ZR-0012, *Radiological Survey of Buildings T373 and T375*, August 8, 1988.
[5] Stafford, K.T., ETEC, *Site Consolidation Assessment*, April 16, 1987.

building to have included two rooms identified as Room 120 and 122 (see Figure 2.2.6b).[1] The building does not appear, based on a 1964 plot plan, to have been connected to any utilities.[2]

Former Use(s): Limited historical information has been located regarding the operations of Building 4374. Unlike Building 4373, which was owned by Atomics International and Rockwell International, Building 4374 was owned by the AEC.[3,4] Based on SNAP weekly highlight memoranda, Building 4374 appears to have served as a test facility for pumps to be used in a "Mercury Rankine Program." The "Mercury Rankine Program" was reported to have had the objective of developing a broad-based component and system test technology that could be utilized in a space flight application for reliable electrical power generation. Building 4374 was involved in the component test services to perform acceptance, prequalification, and qualification testing of all mercury system components used in the Mercury Rankine Program.[5]

According to memoranda indicated above, Building 4374 included a mercury monitor and a boiler test loop/rig. In April 1965 it was reported that a pump installed in the boiler test rig in Building 4374 had operated upstream of the boiler during 3 Mercury injections. Data indicated the system was stable with the flow regulator upstream of the pump. It was reported that "at steady state conditions, the pump was performing normally as in the acceptance test facility."[6,7,8,9] Memoranda and the 1965 progress report also indicated that the building included the orbital startup component test loop (OSCTL). This loop performed boiler operation tests, boiler flow regulator calibration, boiler conditioning operation, boiler acceptance testing, and "TEM" pump testing.[10]

According to the 1988 survey report, Building 4374 was built to test non-nuclear liquid metal heat transfer loops and was used as a support facility for Building 4373. Industrial planning maps identify the building as a sodium loop enclosure in 1962 and as a test loop enclosure building beginning in 1964.[11,12] The 1987 site consolidation assessment also stated that Building 4374 was used for SNAP program NaK loop testing.[13] According to the 1988 survey report, the handling of radioactive materials in Building 4374 is unknown. The site consolidation assessment states that following the termination of the SNAP program, Building 4374 was used intermittently for miscellaneous storage activities, but mostly remained inactive. The assessment

[1] Unknown Author, Figure 45, *Building Area and Room Numbering Plan, Buildings 373 &374*, March 15, 1962.
[2] Atomics International, Drawing No. 303-GEN-C41, Sheet 7 of 14, Santa Susana Facility Plot Plan,
[3] ETEC, Industrial Planning Maps, 1962 – 1992.
[4] Stafford, K.T., ETEC, *Site Consolidation Assessment*, April 16, 1987.
[5] Atomics International, NAA-SR-11491, Volume 1, *Progress Report SNAP Systems Improvement Program, Mercury Rankine Program, April – June 1965*, August 15, 1965.
[6] Graves, A.W., Hydraulic Equipment and Testing Unit, NAA-SR-MEMO-10203, *SNAP Weekly Highlights for Week Ending 7-10-64*, July 10, 1964.
[7] Poucher, F.W., Mercury Rankine Program Test Planning and Evaluation Unit, NAA-SR-MEMO-10223, *SNAP Weekly Highlights for Week Ending 7-10-64*, July 11, 1964.
[8] Perlow, M.A., Mercury Rankine Program, NAA-SR-MEMO-11125, *SNAP Weekly Highlights for Week Ending 3-5-65*, March 5, 1965.
[9] Perlow, M.A., Mercury Rankine Program, NAA-SR-MEMO-11248, *SNAP Weekly Highlights for Week Ending 4-9-65*, April 9, 1965.
[10] Atomics International, NAA-SR-11491, Volume 1, *Progress Report SNAP Systems Improvement Program, Mercury Rankine Program, April – June 1965*, August 15, 1965.
[11] Atomics International, Industrial Planning Map Nuclear Development Field Laboratories, Santa Susana, March 15, 1962.
[12] Atomics International, Santa Susana SRE Facility Map, July 14, 1964.
[13] Stafford, K.T., ETEC, *Site Consolidation Assessment*, April 16, 1987.

did not indicate the type of material stored in Building 4374. As of 1988, Building 4374 was abandoned and contained an old mercury test loop. Building demolition began in May 1989 and by August 1990, the building had been demolished.[1,2,3,4] Available documents do not indicate that the building required release from either the State of California or the DOE prior to demolition.

Information from Interviewees: There have been no interviews relating to the operations in Building 4374 conducted, to date.

Radiological Incident Reports: There have been no radiological incident reports associated with the operations in Building 4374 located to date.

Current Use: Building demolition began in May 1989 and by August 1990, the building had been demolished.[5,6]

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): In 1988, Rocketdyne performed a radiological survey at Building 4373 and Building 4374 to determine if any residual contamination existed. The radiation measurements taken during the survey were compared against the DOE residual radioactivity limits specified in "Guidelines for Residual Radioactivity at FUSRAP and Remote SFMP Sites." The maximum acceptable contamination limits used in 1988 are presented in Section 2.2.5, above.

According to the 1988 radiological survey, the Building 4374 survey included a survey of the gamma exposure rate of the surface of the building and the grounds between G and J Streets and from 22nd Street to the west fence. A combined total of 29 gamma exposure rate measurements were taken within Buildings 4374 and 4375, and 25 smears were collected in Building 4373. The report indicated that no soil samples were collected because there was no indication of contamination as a result of the gamma exposure rate measurements. As indicated above, the measured ambient gamma limit was < 5 μR/hr above background, which was measured to be between 14 and 16 μR/hr.[7] The maximum measured ambient gamma in Buildings 4374 and 4375 was 9.3 μR/hr, and 12.6 μR/hr for the area surrounding Buildings 4373 and 4374. The survey concluded that survey results were below the 1988 Rocketdyne acceptable limits and no further inspection was required at Building 4374.[8]

During the 1996 Area IV Radiological Characterization Survey, soil samples were collected and analyzed as part of the Area IV radiological characterization. Randomly selected, two soil

[1] ETEC, Document No. GEN-ZR-0012, *Radiological Survey of Buildings T373 and T375*, August 8, 1988.
[2] Stafford, K.T., ETEC, *Site Consolidation Assessment*, April 16, 1987.
[3] Lafflam, S.R., Letter Re: Buildings 028 and 374, Area IV SSFL – Asbestos Removal and Demolition, May 2, 1989.
[4] Gaylord, G.G., Rockwell International Internal Letter Re: Fire Protection Appraisals for DOE Building, August 7, 1990.
[5] Lafflam, S.R., Letter Re: Buildings 028 and 374, Area IV SSFL – Asbestos Removal and Demolition, May 2, 1989.
[6] Gaylord, G.G., Rockwell International Internal Letter Re: Fire Protection Appraisals for DOE Building, August 7, 1990.
[7] According to the 1988 survey report, an average of 38 background measurements were taken at three locations at the SSFL – the Building 4309 area, Well #13 Road, and Incinerator Road.
[8] ETEC, Document No. GEN-ZR-0012, *Radiological Survey of Buildings T373 and T375*, August 8, 1988.

samples were taken in the vicinity of Building 4373 (samples 95-0058 and 95-0059). These samples were also located near Building 4374. As reported above, none of the measurements were distinguishable from background and all measurements were below the acceptable concentration levels established by Boeing in the 1998 approved site-wide release criteria for remediation of radiological facilities. Additionally, located in the central portion of survey block 113, the ambient gamma survey results in the vicinity of Building 4374 measured between 12.8 and 15.0 µR/hr.[1,2]

Radiological Use Authorizations: There have been no radiological use authorizations identified relating to the operations in Building 4374.

Former Radiological Burial or Disposal Locations: No radiological burial or disposal locations have been identified at the Building 4374 area, with the exception of a liquid waste pit located southwest of Building 4373 and visible in the Building 4373 plot plan. This liquid waste pit was associated with the operations of Building 4055 and is discussed in Section 2.2.4, above.

Aerial Photographs: In 1952, the area comprising the future Building 4374 area is agricultural land. By 1957, the building has been constructed and possible standing liquid is seen to the west of the building. In 1959, the building area is more developed and Building 4374 is clearly visible to the north of Building 4373. A fence surrounds the perimeter of the building and a large parking area has been developed to the east of the building, on the other side of 22nd Street at the future location of Building 4015, discussed in the HSA-5C TM. A drainage channel is located north of the building along G Street. The area remains relatively unchanged in the 1962/1963 aerial photograph. In 1965, the Building 4374 area remains unchanged. The 1967 aerial photographs show the addition of the liquid waste pit southwest of Building 4373 within the former fence boundary of the building area. In addition, a parking area has been established north of Building 4374, outside the fenced perimeter. 1978 aerial photographs show a possible buried pipeline extending from the liquid waste pit northward through the fenced boundary of the Building 4373 and 4374 area, and then west toward Building 4055. By 1980, the area surrounding the building is becoming vegetated. In 1988, the Building 4374 area shows the presence of dark-toned material east of the building. Also, a new building has been constructed to the north of the Building 4374 area. By 1995, Buildings 4373 and 4374 appear to be under demolition and a possible stain is located east of the building, just west of 22nd Street. By 2005, the Building 4373 and 4374 area is vegetated and the new building constructed sometime between 1983 and 1988 is no longer present. The only feature remaining is the liquid waste pit.[3]

Radionuclides of Concern: According to the 1988 survey report, the use of radioactive material in Building 4374 is unknown. Building 4374 may have been used to support operations in Building 4373, which, according to the report, may have introduced activation foils and other radioactive materials to Building 4374.[4] However, historical documents have not been located to determine whether radioactive materials were ever used or stored in Building 4374. As a result, the radionuclides of concern at Building 4374 are uranium, plutonium, and their decay and

[1] Rocketdyne, Report No. A4CM-ZR-0011, *Area IV Radiological Characterization Survey Final Report*, August 15, 1996.
[2] Boeing, Document No. N001SRR140131, *Approved Sitewide Release Criteria for Remediation of Radiological Facility at the SSFL*, February 18, 1999.
[3] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[4] ETEC, Document No. GEN-ZR-0012, *Radiological Survey of Buildings T373 and T375*, August 8, 1988.

daughter products.[1,2] Decay products from U-235, U-238, and Th-232 decay chains include Th-234, Th-228, Ac-228, Ra-226, Pb-214, Bi-214, Pb-212, Bi212, and Tl-208. In addition, H-3, Sr-90, Cs-137, Na-24, Co-57, Co-60, Eu-152, and Am-243 would have been formed. All radionuclides of concern listed, with the exception of Na-24 and Co-57 (due to relatively short half-lives), are included in the August 2010 Final Field Sampling Plan for soil sampling in Area IV. Table 3.3 presents a summary of radionuclides of concern.

Drainage Pathways: Similar to Building 4373, drainage around the Building 4374 appears to have been to the north and to the south. 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.[3]

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4374 area is Class 1 because of the building's proximity to Building 4373, which operated as a critical facility, and the unknown nature of operations in Building 4374.

Recommended Locations for Soil/Sediment Sampling: 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 4374 area. Significant historical information is lacking regarding the operations of Building 4374, as well as the demolition of the building.

In addition, previous characterization studies for the Building 4374 area were focused on delineating the extent of contamination to standards that were applicable at the time. In addition, 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 4374 area. This includes the following Building 4374 areas and appurtenances:

- Sampling of the former building footprint is recommended as a result of the limited information on building operations that is presently available.
- Sampling is also recommended in the surrounding drainage pathways; however, these are the same drainage channels identified for Building 4373 above. The sampling of these drainage channels should be included in the Building 4373 and Building 4374 sampling plans.

[1] U.S. Nuclear Regulatory Commission, NUREG-1077, *Environmental Impact Appraisal for Renewal of Special Nuclear Material License No. SNM-21*, June 1984.
[2] Rockwell International Report, AI-DOE-13559, *Nuclear Materials Development Facility Decommissioning Final Report,* March 31, 1987.
[3] Atomics International, Drawing No. 303-GEN-C41, Sheet 7 of 14, Santa Susana Facility Plot Plan,

2.2.7 Building 4173(4865) Area

Site Description: The Building 4173(4865) area comprises Building 4173, former Building 4865, and the surrounding area at the end of 24th Street. Building 4173 is reported to have served as a sodium storage pad and Gammagraph building. Figures 2.2.7a through 2.2.7b provide a current photograph and a plot plan of the building. Building-specific facility drawings for Building 4173(4865) could not be located. Plate 1 presents a summary of all identified features for this site.

Building Features: Industrial planning maps do not show any indication that a permanent building existed at the Building 4173(4865) area. Aerial photographs have shown a pad, unidentified object, and a possible vertical storage tank to have been located at the Building 4173(4865) area. The Building 4173(4865) area was not connected to the sanitary sewer system at the SSFL.[1]

Former Use(s): Industrial planning maps show the presence of a sodium storage pad (Building 4865) in 1962; however, available documents do not indicate the type of storage activities that may have occurred at this time.[2] A July 13, 1965, internal letter indicated Building 4173 included a radiography installation. The letter indicated that in the event of a radiological emergency (e.g., source stuck out of shield, broken cable, etc.), the operator was instructed to leave Building 4173 to reach a telephone in Building 4363 or Building 4020. The letter applied only to the use of a 30 curie Ir-192 source.[3] By 1967, the area was being used as a Gammagraph x-ray site and was identified as Building 4173.[4] The pad, according to the May 2005 HSA, housed a sealed gamma-emitting source for x-ray purposes, which is supported by an incident report documented below.[5] The exact operational time period of this area is unknown; however aerial photographs show the area to be under development beginning in 1957 and the presence of a pad until approximately 1995.[6]

Information from Interviewees: There have been no interviews relating to Building 4173(4865) identified to date.

Radiological Incident Reports: There has been one documented incident associated with Building 4173(4865) 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.

[1] Rocketdyne Document A4CM-AN-0003, Rev. A, *Radiological Characterization Plan*, March 30, 1994, p. 2-11
[2] Atomics International, Nuclear Development Field Laboratories Industrial Planning Map, Santa Susana, March 15, 1962.
[3] Tschaeche, A.N., Atomics International Internal Letter Re: Building 173 – Evaluation for Radiological Emergency Procedure, July 13, 1965.
[4] Atomics International, Nuclear Development Field Laboratories Industrial Planning Map, Santa Susana, January 1, 1967.
[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.
[6] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.

Building 4173(4865) Incident Report Summary

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A0066	4/21/1978	Field	Co-60	Radiographic source projector fell and damaged the source guide tube.

- On April 21, 1978, two weld test samples were being radiographed by two Rockwell International personnel using a Tech/Ops Model 680 source projector, containing approximately 90 Curies of Co-60, with a depleted uranium collimator, Model 719, and stand for the directional 60° beam. During the placement of the film under the test samples, the stand supporting the uranium collimator was accidentally pushed over on its side, causing damage to the source guide tube. The source guide tube was removed, red tagged, and replaced with a new source tube. According to the incident summary, the two employees received two mrem of exposure in the process (Incident Report A0066).[1] The incident report does not provide information to indicate where the damaged source guide tube was disposed of, or if it was contaminated at the time of disposal.

Current Use: According to the May 2005 HSA, the sodium pad is empty and the Gammagraph is no longer in use.[2] Aerial photographs from 2005 do not show the presence of any structures in the former Building 4173(4865) area. The area comprising this former area includes a dirt road, but no other evidence of previous activities remains.[3]

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): Radiological surveys specific to Building 4173 have not been conducted; however, according to the Area IV Radiological Characterization Survey, the area was included in the survey conducted in 1994 and 1995. Located in survey block F12, the Building 4173(4865) area ambient gamma survey results measured between 15.2 and 15.5 µR/hr. The survey found background to be 15.6 µR/hr, and the acceptable limit was identified by Rocketdyne as being less than 5 µR/hr above background. Accordingly, survey results in the vicinity of the Building 4173(4865) area were found to be below the then-acceptable limits.[4]

Radiological Use Authorizations: No radiological use authorizations associated with the operations of Building 4173(4865) have been located to date.

Former Radiological Burial or Disposal Locations: There have been no on-site radiological burial or disposal locations identified during the operational period of the Building 4173(4865) area operations. However, aerial photographs show excavation activities north of the Building 4173(4865) area. These features were identified by the aerial photograph interpretation as relating to a pond dredge area. Additional information regarding these features is presented below.[5]

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[1] Vandervort, P.S., Rockwell International Internal Letter Re: Field Radiography at LMEC-Damaged Source Tube, A0066, April 25, 1978.
[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.
[3] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[4] Rocketdyne Document A4CM-ZR-0011, Rev. A, *Area IV Radiological Characterization Survey*, August 15, 1996.
[5] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.

Aerial Photographs: In 1952, the area comprising Building 4173(4865) is agricultural land. By 1957, 24th Street has been graded, and the future area of Building 4173(4865) has been excavated and is under development. Directly to the west of the Building 4173(4865) area, ground scarring is visible from the buried water pipeline originating from tanks located at the top of the hill located south of Building 4173(4865). The area east of Building 4173(4865) is under development with a number of roadways intersecting the area. By 1959, a number of the roadways are vegetated and are no longer present. The area of Building 4173(4865) shows the presence of a pad and an "unidentified object" in the 1959 aerial photographs. The ground scarring from the buried water pipeline remains visible to the west, and two possible crates and light toned material are visible north-northeast of the Building 4173(4865) area east of 24th Street at the end of a short dirt road. In 1959, outside storage is also visible east of the Building 4173(4865) area, just south of L Street and the location of Building 4353, which appears to be under development. A trench is also present in 1959 that extends from H Street to the west, past the Building 4173(4865) area, then east-southeast toward Area III. The trench appears to originate from the access road leading to Site 4885, discussed in the HSA-8 Technical Memorandum.

In 1962, the pad remains visible and two light-toned objects are observed. Ground scarring from the buried water pipeline remain visible and the short dirt road visible north-northeast of the Building 4173(4865) area remains present. The end of the dirt road appears to contain disturbed ground, two small light-toned objects and possible dark-toned material. The area of outside storage from 1959 south of Building 4353 is no longer present. The 1965 aerial photographs show 24th Street to be more defined (possibly recently paved), and a probable vertical tank at the Building 4173(4865) area. The short dirt road is no longer visible and appears to have been graded. The trench remains visible. A roadway extends from the Building 4173(4865) area westward to H Street and follows the curve of the base of the hill.

In 1967, the Building 4173(4865) area is relatively unchanged. However, the area surrounding the buildings appears to be under development. There are numerous linear ground scars north, west, and east of the Building 4173(4865) area. By 1972, these ground scars are partially re-vegetated. A possible shed is also present at the Building 4173(4865) area in 1972. In 1978 the shed remains visible and the area surrounding the Building 4173(4865) area remains vegetated. The roadway first visible in 1965 remains present and is more defined by 1978. The area remains unchanged until 1995, when the pad is no longer visible and the area immediately north of the facility includes excavated areas with light-toned mounded material and scattered vegetation. The aerial photograph analysis identifies this area as part of the pond dredge area. According to the analysis, the volume of light-toned mounded material increased through 1993 and dark-toned mounded material also appears. In 1994 and 1995, light-toned mounded material and mounded material covered with scattered vegetation are observed. By 1998, the excavation is filled with material and remained undisturbed through 2005.[1]

Radionuclides of Concern: As indicated in an April 1978 incident report, two radiographers used approximately 90 Curies of Co-60, with a depleted uranium collimator at the Building 4173(4865) area.[2] Information regarding the use of the uranium collimator at the Building 4173(4865) area has not been located in available historical documents. As a result, the

[1] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[2] Vandervort, P.S., Rockwell International Internal Letter Re: Field Radiography at LMEC-Damaged Source Tube, A0066, April 25, 1978.

radionuclides of potential concern at the Building 4173(4865) area include Co-60, U-234, U-235, and U-238. All radionuclides of concern are included in the August 2010 Final Field Sampling Plan for soil sampling in Area IV. Table 3.3 presents a summary of radionuclides of concern.

Drainage Pathways: Building 4173(4865) was located at the terminus of 24th Street at the base of the hill leading to the water tanks, 4701 and 4702. The pad containing Building 4173(4865) was relatively level with a gentle downward grade to the north and east. Drainage in this area would have flowed north along 24th Street and then along L Street, and into Area III, which is also the current drainage pathway.

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4173(4865) area is Class 2 because of the former use of Building 4173(4865), incident reports, aerial photograph features, and gaps in operational information regarding use of the building and surrounding areas.

Recommended Locations for Soil/Sediment Sampling: 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 4173(4865) area. As discussed above, there was a radiological incident at Building 4173(4865) involving a Co-60 radiograph source.

In addition, there have been no previous characterization studies for the Building 4173(4865) area. Therefore, additional characterization is recommended for the Building 4173(4865) area. This includes the following Building 4173(4865) areas and appurtenances:

- The footprint of the former building foundation is recommended for sampling. Limited information has been located regarding the presence of any permanent structures at the Building 4173(4865) area. In addition, aerial photographs note the possible presence of tanks at the Building 4173(4865) area.
- Drainage pathways leading from Building 4173(4865) are also recommended for sampling. The pad containing Building 4173(4865) was relatively level with a gentle downward grade to the north and east. Drainage in this area would have flowed north along 24th Street and east toward Area III.
- A trench visible in 1959 aerial photographs extends from H Street to the west, past the Building 4173(4865) area, then east-southeast toward Area III. The trench appears to originate from the access road leading to Site 4885, discussed in the HSA-8 Technical Memorandum. It is recommended this trench is included in the sampling program.

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-5D Group 3 are presented. HSA-5D Group 3 includes eleven building areas including Building 4353, Organics Reactor Development Building, the facilities associated with the hydraulic test facility, Buildings 4473, 4863, and 4873, and Building 4363, the Mechanical Component Development and Counting Building.

2.3.1 Building 4353 Area

Site Description: The Building 4353 area includes Building 4353, concrete pad 4853, a leach field, and the surrounding area on L Street. Building 4353 was a laboratory with galvanized steel walls and roof that were anchored to a concrete slab floor. The building measured approximately 1,450 square feet.[1] 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 4353 was approximately 1,450 square feet and was constructed in the "early 1950s."[2] However, according to a 1957-1958 progress report, construction and occupancy of Building 4353 was between July 1957 and January 1958, and the building appears fully constructed in aerial photographs in 1957.[3,4] The 1957-1958 progress report indicated that Building 4353 included 1,711 square feet of laboratory space, a 224-square foot covered dock, and 2,335-square foot concrete pad.[5] The building included a 500-gallon steel underground storage tank (UT-75) that stored diesel. The tank was removed on June 13, 2001.[6] A March 15, 1962, facility layout shows the presence of seven rooms, a pad, and dock in the southeast corner of the building (Figure 2.3.1b). The building contained five internal concrete walls of unknown thickness.[7]

As indicated above, the Building 4353 area included a leach field and a septic tank, Septic Tank 4353. According to an October 15, 2001, printout titled "Septic Tank 4353," the excavation of the septic tank and leach field at Building 4353 was performed with the oversight of a health physics technician. The printout did not provide information to indicate when the excavation occurred; however, a February 5, 2001, email regarding the pumping of contents of Septic Tank 4353, would appear to indicate the removal and excavation occurred in 2001. The printout did indicate that a health physics technician performed instrument measurements and wipe tests on the concrete septic tank, the distribution box, and the field lines leading to the leach field. The measurements and wipes are documented in the printout to have not had any detectable activity. Additionally, the printout indicates that seven soil samples were taken beneath the septic tank, the distribution box, and in the leach field for analysis for gamma emitting radionuclides. These samples were reported to have not detected any man-made radionuclides. In addition, two sludge samples were taken in the septic tank for analysis of gamma emitting radionuclides, with no man-made radionuclides being detected. However, the printout did not provide the analytical data to support these findings, but indicated this data was "attached."[8,9]

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[1] ERDA Document, LR-03026, Part 1, *Site Development Plan: 1977-1981*, June 1975.
[2] Lafflam, S.R., Rockwell International letter Re: Building 353, Area IV SSFL -- Asbestos Removal, January 6, 1989.
[3] Atomics International, Facilities and Data Department, *Progress Report Fiscal Year 195 and Forecast Fiscal Year 1958*, January 1958.
[4] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[5] Atomics International, Facilities and Data Department, *Progress Report Fiscal Year 195 and Forecast Fiscal Year 1958*, January 1958.
[6] Camp Dresser & McKee Inc., *Underground Storage Tank Closure Report: UT-75, Building B/353, Santa Susana Field Laboratory*, July 12, 2001.
[7] Unknown, Building Area and Room Numbering Plan, Building 353, March 15, 1962.
[8] Unknown Author, Printout Re: Septic Tank 4353, October 15, 2001.
[9] Trippeda, Dan, Email Correspondence Re: 353-Septic Pumping, February 5, 2001.

Former Use(s): Information regarding the operations in Building 4353 is limited. The 1957-1958 progress report indicated the purpose of the building to be to provide field test facilities for the performance of organic materials testing. A June 24, 1960, Atomics International technical data record indicated that an Advanced OMR Heat Transfer Loop was located at Building 4353 to obtain information on the fouling tendencies of organic coolants. The loop was constructed of ½-inch carbon steel pipe and was comprised of a forced circulation system that moved coolant by means of a pump through an in-line filter, a pre-heater, a rotameter, test heater, temperature control valve, a cooler, and a flow control valve. Components of the system were reported to have included:[1]

1. A dump and fill tank for holding the test coolant.
2. A totally enclosed centrifugal pump of the canned rotor type manufactured by Chempump Corporation.
3. An in-line filter containing a 5-10 micron cartridge to remove particulate matter.
4. A hot-trap similar in construction to the test heater for removing film formers.
5. A trim heater for adding sensible heat to the circulating test medium.
6. A surge tank connected to the system and used to maintain system operating pressure.
7. A boiling Dowtherm reflux cooler incorporated to remove the heat generated in the test heater and subsequently transferred to the test medium, thus controlling bulk temperature.
8. Control instrumentation to maintain constant flow rate, bulk temperature, and power input to the test heater.
9. Safety devices and other protective instrumentation to insure safe loop operation during the absence of operating personnel.
10. Manual pressure control only.
11. An in-line sampler is included to obtain coolant samples.
12. Coolant replenishment tanks for compositional control.

A second loop, an OMR degasifier loop was also located in Building 4353, and was constructed to study the degasification of organic coolants. The equipment of this loop was divided into two sections that comprised the main loop and the degasification train.[2]

According to a 2003 interview, Building 4353 was constructed in 1956 as a research and development laboratory for the Organic Moderate Reactor Program. A March 15, 1962, facility layout identifies the building as an Organics Reactor Development Building.[3,4] According to a January 6, 1989, Rockwell International correspondence, Building 4353 was used for miniature solid fuels engine development.[5] Another document, a 1992 Environmental Monitoring Program Plan, indicates the building was used for sodium testing until the late 1960s.[6] Based on a August 31, 1960, incident report, the building contained a "Impurification Removal Loop" that contained 30% High Boiler (HB) coolant.[7]

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[1] Huber, D.A., Atomics International Technical Data Record, *Advanced OMR, Convective Heat Transfer*, June 24, 1960.
[2] Huber, D.A., Atomics International Technical Data Record, *Advanced OMR, Convective Heat Transfer*, June 24, 1960.
[3] Personnel Interview, Dan Trippeda, September 8, 2003.
[4] Unknown, Building Area and Room Numbering Plan, Building 353, March 15, 1962.
[5] Lafflam, S.R., Rockwell International letter Re: Building 353, Area IV SSFL – Asbestos Removal, January 6, 1989.
[6] Rocketdyne, Document No. ER-AN-006, *Environmental Monitoring Program Plan Santa Susana Field Laboratory Area IV*, April 30, 1992.
[7] Atomics International, Internal Letter Re: Radiological Safety Incident Report, Building 353 Bay 3, August 31, 1960.

On February 28, 1968, an Atomics International internal letter authorized the use of Building 4353 for the storage of up to 100 pounds of "Class A explosives." According to the letter, it was required that different storage bins be used for each different class of explosive stored in the facility.[1] A September 24, 1971, Atomics International report titled "Safety Analysis Report for L-85 Nuclear Examination Reactor" indicated that some of the neutron radiography work performed at the L-85 reactor involved explosive devices. The devices included squibs, cutters, trains, initiators, shaped charges, and detonating cords. The explosives were described as being small, and designed to actuate, separate, or trigger some operations, and were not "capable of producing damage to the surroundings." The shipment, storage, and handling of explosives at the SSFL were governed by the Atomics International Explosives Safety Procedures. According to the report, Building 4353 served as a special explosives storage building to store the devices described above.[2] It is unknown how long this material was stored in Building 4353, or the quantity of the material stored during the duration of these operations. 1989 partial facility drawings identify the building as a hypersonic flow test facility.[3] Information regarding the use of the building as a hypersonic flow test facility has not been located.

The Building 4353 demolition is described in a December 2000 work plan. According to the work plan, the concrete walls of Building 4353 were to be removed and resized by an excavator. The work plan did not indicate the requirement for any surveys during the removal process. The only requirements were for the use of water mist to mitigate any lead dust from becoming airborne.[4]

The steel portion of the structure was removed in the late 1970s and the concrete pad was removed in 2001 during the removal of the septic tank.[5]

Information from Interviewees: There have been no interviews associated with the operations of Building 4353 identified, to date.

Radiological Incident Reports: There has been one documented incident associated with Building 4353 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 4353 Incident Report Summary

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A0375	7/29/1960	Bldg 353 Bay 3	Activated Corrosion Product	HB Coolant Test Loop Leak, Sprayed HB on Employee's Face and Hair[6]

[1] Ashley, R.L., Internal Letter Re: Storage of Explosives in Building 353, Santa Susana, February 28, 1968.
[2] Atomics International, Report No. AI-70-73, Revision 1, *Safety Analysis Report for L-85 Nuclear Examination Reactor*, September 24, 1971.
[3] HDMSP01714258 and HDMSP01714259
[4] Schleck, Lennie, *Lead Work Plan for Construction Project, Project Title B4363 & 4353 Demolition*, December 8, 2000.
[5] Personnel Interview, Dan Trippeda, September 8, 2003.
[6] Mandel, H., *Heavy Water Organic Cooled Reactor, Physical Properties of Some Polyphenyl Coolants*, April 15, 1966.

- On July 29, 1960, while inspecting a hissing noise from the "Impurification Removal Loop" in Building 4353, Bay 3, an employee was exposed to 30% HB coolant from which over 90 percent of the radioactivity had been removed. A survey of the inside of the hood containing the "Impurification Removal Loop" detected contamination of 194 dpm/100 cm^2. (Incident Report A0375).[1,2]

Current Use: As indicated above, the steel portion of the structure was removed in the late 1970s.[3]

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): A chronology of radiological investigations at this building is as follows:

- **1959 Atomics International Environmental Survey.** On February 27, 1959, a special survey of the Building 4353 area was made in conjunction with a routine environmental survey of the Santa Susana area. According to the survey, Atomics International established ten sampling stations around Building 4353. The samples collected at each station consisted of young green vegetation, and alluvial soil from "dry rivulets remaining from recent rainfall." Atomics International presented that the activity levels were comparable with the routine survey of the Santa Susana area, with no apparent localized activity increase. Figure 2.3.1d provides a view of the sampling locations and the analytical results. The source document did not provide the methods used for analysis.[4]

- **1959 Atomics International Radiological Survey.** A radiological survey of the surrounding grounds was conducted in 1959. There was no evidence suggesting an incident was causal for this survey. The release levels from this survey range from 32.0 to 527.5 dpm/cm^2, below the 1,000 dpm/cm^2 limit.[5]

- **1976 Atomics International Soil Sampling.** According to an Atomics International 1976 environmental monitoring and facility effluent annual report, Atomics International personnel collected several soil samples on December 14, 1976, near the Nuclear Materials Development Facility, Building 4055, for analysis of Pu-238 and total Pu-239 plus Pu-240. The analysis of the sample was performed by the Health Services Laboratory of ERDA, Idaho Falls, Idaho. According to the report, a sample was taken south of Building 4353, on the south side of L Street, approximately 700 feet southeast of the Building 4055 stack exhaust.[6] The annual report noted the Pu-238 concentration to be $(0.23 \pm 0.09) \times 10^{-8}$ µCi/g, and the Pu-239 plus Pu-240 concentration to be $(1.2 \pm 0.2) \times 10^{-8}$ µCi/g.[7]

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[1] Atomics International, Internal Letter Re: Radiological Safety Incident Report, Building 353 Bay 3, August 31, 1960.
[2] The location of Bay 3 within Building 4353 could not be identified in available documents and facility drawings. The only available facility layout of Building 4353 is dated March 15, 1962, and does not identify any areas of the building as Bay 3.
[3] Personnel Interview, Dan Trippeda, September 8, 2003.
[4] Moore, J.D., Inter-Office Letter Re: Environmental Survey of Building 353 Area, April 21, 1959.
[5] Atomics International Internal Document, no document number, *Special Survey of Building 353 Area.*
[6] The report did not indicate the distance south of Building 4353.
[7] Atomics International, Document No. AI-77-14, *Environmental Monitoring and Facility Effluent Annual Report 1976*, Undated.

According to the 1978 annual environmental monitoring and facility effluent reports, Building 4353 served as sample station, S-58, for monthly soil sampling to determine the "concentrations of radioactivity" and semiannual soil sampling for plutonium analysis. Sampling at S-58 appears to have been conducted through 1989. A summary of the available survey results of the soil plutonium radioactivity data is presented in the table below: [1,2,3,4,5,6,7,8,9,10,11]

[1] Rockwell International, Report No. ESG-79-7, *Environmental Monitoring and Facility Effluent Annual Report 1978*, April 1979.
[2] Rockwell International, Report No. ESG-81-17, *Environmental Monitoring and Facility Effluent Annual Report 1980*, May 27, 1981.
[3] Rockwell International, Report No. ESG-82-21, *Environmental Monitoring and Facility Effluent Annual Report 1981*, July 15, 1982.
[4] Rockwell International, Report No. ESG-83-17, *Environmental Monitoring and Facility Effluent Annual Report 1982*, June 1983.
[5] Rockwell International, Report No. ESG-84-9, *Environmental Monitoring and Facility Effluent Annual Report 1983*, March 1984.
[6] Rockwell International, Report No. RI/RD85-123, *Environmental Monitoring and Facility Effluent Annual Report De Soto and Santa Susana Field Laboratories Sites 1984*, March 1985.
[7] Rockwell International, Report No. RI/RD86-140, *Environmental Monitoring and Facility Effluent Annual Report De Soto and Santa Susana Field Laboratories Sites 1985*,April 1986.
[8] Rockwell International, Report No. RI/RD87-133, *Environmental Monitoring and Facility Effluent Annual Report De Soto and Santa Susana Field Laboratories Sites 1986*, March 1987.
[9] Rockwell International, Report No. RI/RD88-144, *Environmental Monitoring and Facility Effluent Annual Report De Soto and Santa Susana Field Laboratories Sites 1987*, March 1988.
[10] Rockwell International, Report No. RI/RD89-139, *Environmental Monitoring and Facility Effluent Annual Report De Soto and Santa Susana Field Laboratories Sites 1988*, May 1989.
[11] Rockwell International, Report No. RI/RD90-132, *Environmental Monitoring and Facility Effluent Annual Report De Soto and Santa Susana Field Laboratories Sites 1989*, May 1990.

S-58 (Building 4353) Soil Plutonium Radioactivity Data

Date	Pu-238	Pu-239 + Pu-240
June 8, 1978	(-3.59 ± 2.3) x 10^{-9} µCi/g	(1.46 ± 3.0) x 10^{-9} µCi/g
December 13, 1978	*	(5.54 ± 2.8) x 10^{-9} µCi/g
July 9, 1980	(-0.2 ± 2.4) x 10^{-9} µCi/g	(1.6 ± 2.0) x 10^{-9} µCi/g
December 22, 1980	(0.4 ± 3.1) x 10^{-9} µCi/g	(9.9 ± 4.6) x 10^{-9} µCi/g
July 8, 1981	(-2.2 ± 2.0) x 10^{-9} µCi/g	(4.2 ± 2.7) x 10^{-9} µCi/g
December 17, 1981	(-3.6 ± 0.8) x 10^{-9} µCi/g	(0.3 ± 1.4) x 10^{-9} µCi/g
July 9, 1982	(-3.2 ± 1.2) x 10^{-9} µCi/g	(7.1 ± 2.3) x 10^{-9} µCi/g
December 16, 1982	(0.8 ± 2.9) x 10^{-9} µCi/g	(7.3 ± 2.8) x 10^{-9} µCi/g
June 22, 1983	(1.5 ± 4.3) x 10^{-9} µCi/g	(10.6 ± 8.6) x 10^{-9} µCi/g
December 7, 1983	(0.2 ± 0.5) x 10^{-9} µCi/g	(4.3 ± 2.1) x 10^{-9} µCi/g
June 25, 1984	(0.1 ± 0.1) x 10^{-9} µCi/g	(2.9 ± 0.4) x 10^{-9} µCi/g
December 4, 1984	(0.1 ± 0.1) x 10^{-9} µCi/g	(3.6 ± 0.6) x 10^{-9} µCi/g
June 26, 1985	0.0001 ± 0.0001 pCi/g	0.002 ± 0.0004 pCi/g
December 4, 1985	0 ± 0.0001 pCi/g	0.0048 ± 0.0006 pCi/g
June 25, 1986	0.0003 ± 0.0003 pCi/g	0.0031 ± 0.0009 pCi/g
December 8, 1986	0.003 ± 0.0002 pCi/g	0.0032 ± 0.0006 pCi/g
June 22, 1987	0.0002 ± 0.0001 pCi/g	0.0022 ± 0.0003 pCi/g
December 7, 1987	0.0032 ± 0.0007 pCi/g	0.0071 ± 0.0010 pCi/g
June 29, 1988	0.0004 ± 0.0001 pCi/g	0.0022 ± 0.0003 pCi/g
December 1, 1988	0 ± 0.0001 pCi/g	0.0033 ± 0.0004 pCi/g
July 19, 1989	0.0001 ± 0.0001 pCi/g	0.0025 ± 0.0003 pCi/g
December 5, 1989	0.0002 ± 0.0002 pCi/g	0.0042 ± 0.0005 pCi/g

Minus (-) indicates sample value less than reagent blank.
*Results significantly less than the minimum detection level

As indicated above, these measurements appear to have ceased in 1989 and were replaced with annual exposure rates monitored on site with calcium sulfate dosimeters that were provided by the Radiologic Health Branch of the State of California Department of Health Services. These dosimeters, according to a 1990 annual report, provided independent monitoring of radiation levels at the SSFL. The dosimeters were reported to have been returned to the RHB for evaluation by an RHB vendor laboratory. SS-6, located at the northeast corner of Building 4353, was sampled quarterly. The results of these surveys are presented in the table below:[1,2,3,4,5,6,7,8]

[1] Rockwell International, Report No. RI/RD91-136, *Environmental Monitoring Annual Report Santa Susana Field Laboratory, De Soto, and Canoga Sites 1990*, June 20, 1991.
[2] Rockwell International, Report No. RI/RD92-138, *Environmental Monitoring Annual Report Santa Susana Field Laboratory and De Soto Sites 1991*, September 30, 1992.
[3] Rockwell International, Report No. RI/RD93-125, *Environmental Monitoring Annual Report Santa Susana Field Laboratory and De Soto Sites 1992*, December 14, 1993.
[4] Rockwell International, Report No. RI/RD94-126, *Annual Site Environmental Report Santa Susana Field Laboratory and De Soto Sites 1993*, October 21, 1994.
[5] Rockwell International, Report No. RI/RD95-153, *Annual Site Environmental Report Santa Susana Field Laboratory and De Soto Sites 1994*, September 30, 1995.
[6] Rockwell International, Report No. RI/RD96-140, *Annual Site Environmental Report Santa Susana Field Laboratory and De Soto Sites 1995*, Date Unknown.
[7] Boeing, Report No. RD97-134, *Rocketdyne Propulsion & Power DOE Operations Annual Site Environmental Report 1996*, November 10, 1997.
[8] Boeing, Report No. A4CM-ZR-0012, *Rocketdyne Propulsion & Power DOE Operations Annual Site Environmental Report 1997*, November 23, 1998.

SS-6 (Building 4353) Ambient Radiation Dosimetry Data

Year	Quarterly Exposure (mrem)				Annual Exposure (mrem)	Annual Average Exposure Rate (µR/hr)	
	1st	2nd	3rd	4th		Rocketdyne	State DHS
1990	10.0	10.0	15.0	10.0	45.0	5.1	11.7
1991	10.0	30.0	30.0	10.0	80.0	9.1	12.0
1992	10.0	15.0	30.0	10.0	65.0	7.4	11.9
1993	20.0	15.0	10.0	10.0	55.0	6.3	10.6
1994	33.0	33.0	33.0	33.0	132.0	15.1	12.7
1995	46.2	46.2	41.3	55.2	188.8	21.5	12.9
1996	26.3	26.3	21.5	35.4	109.6	12.5	12.9
1997	27.8	27.1	26.9	23.8	105.6	12.0	12.4

- **1994-1995 Area IV Radiological Characterization Survey**. According to the Area IV Radiological Characterization Survey, Building 4353 area was included in the survey conducted in 1994 and 1995. Located in northern portion of survey block G14, the Building 4353 area ambient gamma survey results measured between 11.3 and 17.0 µR/hr. The Rocketdyne survey found background to be 15.6 µR/hr, and the acceptable limit was identified as being less than 5 µR/hr above background. Accordingly, survey results in the vicinity of the Building 4353 area were found to be below the then-acceptable limits. In addition to the ambient gamma survey, the 1996 characterization also included soil sampling in the vicinity of Building 4353. This included one 6-inch soil sample taken along the L Street drainage channel south of Building 4353. According to the report, none of the measurements were distinguishable from background and all the measurements were below the acceptable concentration levels established by Boeing and presented in the 1999 Approved Sitewide Release Criteria for Remediation of Radiological Facilities at the SSFL.[1],[2]

- **2001 Boeing Radiological Survey of Septic Tank, Piping, and Leach Fields.** The 2005 HSA documented the results of the radiological survey of the septic tank and associated pipes and leach field discussed above that was conducted in 2001 during the removal process. According to the 2005 HSA, with two exceptions, the results were below minimum detectable activity (MDA) for both removable alpha and beta (alpha range 9-11 dpm/ cm^2, beta 18-20 dpm/ cm^2). One sample on the outside of the tank registered a level of beta 20 dpm/ cm^2, the MDA for the sample. The second exception was the clay field pipes and distribution box. These samples also registered an MDA result of 11dpm/ cm^2 alpha, 18dpm/ cm^2 beta. Direct frisk tests were performed on all samples as well with a consistent no detectable activity (NDA) result.[3]

Radiological Use Authorizations: There are no known radiological use authorizations associated with the operations in Building 4353.

[1] Rocketdyne Document A4CM-ZR-0011, Rev. A, *Area IV Radiological Characterization Survey*, August 15, 1996.
[2] Boeing, Document No. N001SRR140131, *Approved Sitewide Release Criteria for Remediation of Radiological Facility at the SSFL*, February 18, 1999.
[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. Citing Boeing Internal Document, no document number, *Radiation Survey, Building 353.*

Former Radiological Burial or Disposal Locations: The building was connected to a septic tank measuring approximately 60 by 54 by 96 inches with a capacity of 1,500 gallons. There was an associated 200-foot leach field located 50 feet directly east of the northeast corner of the building.[1]

Aerial Photographs: In 1952, the area comprising the future Building 4353 area is agricultural land. By 1957, the area has been developed and Building 4353 has been constructed. In 1959, outside storage appears south of Building 4353 south of L Street. The future location of Building 4854 is under constructions to the east of the building. A linear ground scar appears in 1959 and remains visible in 1962 leading from the north end of the building to a point northwest at the southern boundary of J Street. The outside storage south of L Street is no longer visible in 1962. By 1965, two small linear structures are located at the northeast corner of the building and the linear ground scar remains visible. In 1967, the linear ground scar is more defined and a parking area appears to have been constructed south of L Street. The site remains relatively unchanged in 1972; however, the linear ground scar is less defined. In 1978, the linear ground scar is no longer visible, but a newly defined drainage channel appears to be present north of the Building 4353 area. The drainage channel is no longer obvious in 1980 aerial photographs and the immediate area surrounding the buildings appears to becoming vegetated. The site remains relatively unchanged until 1995 when the building is no longer present. The original building foundation remains, but the above-grade structure has been removed. An access road connects the former building location northward to J Street. In 2005, ground scarring is visible where the former building was located. The 2005 aerial photograph appears to show the building foundation to have been removed; however, light-toned material that appears to be concrete rubble remains visible in the northwest corner of the former building location.[2]

Radionuclides of Concern: Based on the limited available information regarding the Building 4353 operations, the radionuclides of concern cannot be defined for this facility based on actual building operations. Based on the single incident report discussed above, it appears the building may have contained some quantities of activation corrosion products and HB. Based on information received from Boeing in January 2011, activation products typically include Co-60, Mn-54, Ni-59, Ni-63, and Fe-55.[3] All radionuclides of concern are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. Table 3.3 presents a summary of radionuclides of concern.

Drainage Pathways: Based on a 1964 plot plan of the Building 4353 area, it appears the drainage pathways surrounding Building 4353 were along L Street, to the east, toward Area III. A 1978 aerial photograph shows a drainage channel to the east immediately north of the building.[4,5] Currently, the surface water run-off from the former Building 4353 area flows to the southeast then east, into Area III.

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4353 area is Class 1 because of the building's previous use, apparent radiological use, and incident report.

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[1] Boeing Data Package, no document number, *Septic and Leachfield Survey Data 011, 353, and 373.*
[2] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[3] Rutherford, Phil, Email Correspondence to Craig Cooper (EPA), January 4, 2011.
[4] Atomics International, Drawing 303-GEN-C-42, Santa Susana Facility Plot Plan, Sheet 8 of 14, 1964.
[5] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.

Recommended Locations for Soil/Sediment Sampling: Plate 1 and Figure 2.3 provide a convenient reference for the following recommendations.

Based on the available information, soil sampling is recommended in the Building 4353 area. As discussed above, there were radiological incidents involving activation corrosion products at Building 4353 and documented evidence of radiological releases. Significant information is lacking regarding the demolition of Building 4353 and the building's associated septic tank and leach field.

In addition, previous characterization studies for the Building 4353 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 4353 area. This includes the following Building 4353 areas and appurtenances:

- Sampling is recommended at the former Building 4353 footprint. An incident report dated July 29, 1960, indicated that an employee was exposed to 30% HB coolant from which over 90 percent of the radioactivity had been removed. A survey of the inside of the hood containing the "Impurification Removal Loop" detected contamination of 194 dpm/100 cm^2.[1,2] Limited information regarding these type of operations has been located.
- As indicated above, the building was connected to a 1,500-gallon septic tank and an associated 200-foot leach field located 50 feet directly east of the northeast corner of the building. Sampling is recommended at the former leach field and septic tank locations[3]
- The drainage channel located northeast of the Building 4353 area and drainage channels along K Street. Should radioactive materials have drained from facilities associated with Building 4353 to the east-southeast, residual contamination not consistent with the DTSC/DOE December 2010 AOC may exist.

2.3.2 Parking Lot 4553 Area

Site Description: The Parking Lot 4553 area comprises the parking lot near Buildings 4353 and 4854, and the surrounding area. This area is located just north of L Street. This area is never identified as an established parking lot in any of the available industrial planning maps. The 2005 HSA identified Parking Lot 4553 as a site investigation area, and as a result, it has been included in this TM. Figure 2.3.2a provides a current photograph. Drawings specific to Parking Lot 4553 could not be located. Plate 1 presents a summary of all identified features for this site.

Building Features: There are no building features to report for Parking Lot 4553. There is limited information available to indicate when this parking lot was constructed. As indicated above, available industrial planning maps do not identify this area as an established parking lot.

[1] Atomics International, Internal Letter Re: Radiological Safety Incident Report, Building 353 Bay 3, August 31, 1960.
[2] The location of Bay 3 within Building 4353 could not be determined based on available documents or facility drawings. The only available facility layout of Building 4353 is dated March 15, 1962, and does not identify any areas of the building as Bay 3.
[3] Boeing Data Package, no document number, *Septic and Leachfield Survey Data 011, 353, and 373.*

As a result, it is uncertain whether this area was paved. The area identified by the 2005 HSA as Parking Lot 4553 is located between Building 4353, discussed above, and Building 4854, discussed below.[1]

Former Use(s): Parking Lot 4553 appears to have been mainly used for its intended purpose of serving personnel working in Buildings 4353 and 4854.[2]

Information from Interviewees: None to date.

Radiological Incident Reports: There have been no incident reports associated with operations at Parking Lot 4553 identified to date.

Current Use: Based on aerial photographs, the area comprising the former Parking Lot 4553 area appears to be graded. An unpaved roadway extends from J Street and makes a loop around the former Building 4854 location.[3]

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): Radiological surveys specific to Parking Lot 4553 have not been conducted; however, according to the Area IV Radiological Characterization Survey, the area was included in the survey conducted in 1994 and 1995. Also located in northern portion of survey block G14 with Building 4353, the Parking Lot 4553 area ambient gamma survey results measured between 11.3 and 17.0 µR/hr. The survey found background to be 15.6 µR/hr, and the acceptable limit was identified by Rocketdyne as being less than 5 µR/hr above background. Accordingly, survey results in the vicinity of the Parking Lot 4553 area were found to be below the then-acceptable limits.[4,5]

Radiological Use Authorizations: None.

Former Radiological Burial or Disposal Locations: None.

Aerial Photographs: In 1952, the area comprising the Parking Lot 4553 area is agricultural land. By 1957, the area has been developed and Building 4353 has been constructed, and a graded area is visible to the east of the building. In 1959, outside storage appears south of the Parking Lot 4553 area, south of L Street. The future location of Building 4854 is under constructions to the east of the parking lot. In 1965, two unidentified linear structures are visible to the north of the Parking Lot 4553 area. In 1967, the two linear structures are no longer present, and a parking area appears to have been constructed south of L Street; however this is not confirmed in industrial planning maps. The site remains relatively unchanged in 1972. In 1978, a newly defined drainage channel appears to be present north of the Parking Lot 4553 area. The drainage channel is no longer obvious in 1980 aerial photographs and the Parking Lot 4553 appears to becoming vegetated. The site remains relatively unchanged until 1995 when Building 4353 is no longer present. An access road connects the former building and parking lot areas

[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.
[2] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[3] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[4] Rocketdyne Document A4CM-ZR-0011, Rev. A, *Area IV Radiological Characterization Survey*, August 15, 1996.
[5] Boeing, Document No. N001SRR140131, *Approved Sitewide Release Criteria for Remediation of Radiological Facility at the SSFL*, February 18, 1999.

northward to J Street. In 2005, ground scarring is visible where Building 4353 and Parking Lot 4553 were located.[1]

Radionuclides of Concern: None.

Drainage Pathways: Based on a 1964 plot plan of the Building 4353 area, including the area identified in the 2005 HSA as Parking Lot 4553, it appears the drainage pathways surrounding this area were along L Street, to the east, toward Area III. A 1978 aerial photograph also shows a drainage channel to the east immediately north of the Parking Lot 4553 area.[2,3] Currently, the surface water run-off from the former Building 4353 area drains to the southeast then east, into Area III.

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Parking Lot 4553 area is Class 3 because of the parking lots use for intended purposes and no evidence of any outside storage activities at or near Parking Lot 4553.

Recommended Locations for Soil/Sediment Sampling: Plate 1 and Figure 2.3 provide a convenient reference for the following recommendations.

Based on the available information, soil sampling is recommended in the Parking Lot 4553 area. As indicated above, there were no building features to report for Parking Lot 4553. Industrial planning maps do not show an established parking area in the vicinity, and as a result, it is uncertain whether this area was paved.

In addition, there have been no previous characterization studies for the Parking Lot 4553 area. Therefore, additional characterization is recommended for the Parking Lot 4553 area. This includes the following areas and appurtenances:

- The perimeter of the former Parking Lot 4553, including the drainage channel located northeast of the parking lot. Should radioactive materials have drained from facilities associated with Building 4353 to the east to the parking lot, residual contamination not consistent with the DTSC/DOE December 2010 AOC may exist along the northeast perimeter of the former Parking Lot 4553.

2.3.3 Building 4854 Area

Site Description: The Building 4854 area includes Building 4854 and the surrounding area. Building 4854, the radiation gauge test structure, was a single building owned by the U.S. Navy. It was located to the east of Building 4353, discussed above, just north of L Street along the Area IV eastern border. The building first appears in 1959 aerial photographs as a probable construction area and is visible in the 1962/1963 photos.[4] Figure 2.3.3a provides a current photograph of the former building location and Figure 2.3.3b provides a plot plan of the building. To date, the research team has not located any drawings of the Building 4854 layout.

[1] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[2] Atomics International, Drawing 303-GEN-C-42, Santa Susana Facility Plot Plan, Sheet 8 of 14, 1964.
[3] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[4] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.

Building Features: Information regarding the features of Building 4854 could not be located in available documents. A 1969 plot plan shows the location of the building, but does not show any utility connections to or from the building (see Figure 2.3.3b).[1]

Former Use(s): Based on industrial planning maps, Building 4854 was a U.S. Navy-owned building. The building first appears in 1959 aerial photographs as a probable construction area and is visible in the 1962/1963 photos. The building remains visible through 1983 and appears to have been removed some time between 1983 and 1988. Industrial planning maps identify the building as a radiation gauge test structure. According to the 2005 HSA, the building was used to test radiation fuel gauges, although it is unknown the source of this information. The building is referenced in numerous annual environmental monitoring reports as having included a thermo luminescent dosimeter (TLD) location. These are discussed below.[2,3,4]

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: Based on aerial photographs, and as indicated above, the building appears to have been demolished sometime between 1983 and 1988. The former location of the Building 4854 area is currently vegetated.[5]

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): As indicated above, Building 4854 is referenced in numerous annual environmental monitoring reports as having included a TLD sampling location. In the 1973 annual environmental monitoring report, the TLD location for Building 4854 is identified as TLD-10 and appears to be located at the southeast corner of the building. By 1978, the TLD location was renumbered to TLD-6 and in 1985 was renumbered again to SS-6. 1976 is the first year that ambient radiation dosimetry data is presented in the available annual reports. The data presented in the annual reports initially included only the average dose rate for the year each quarterly measurement was taken. Beginning in 1981, the annual reports included the data for each quarter's measurements. A summary of the available TLD data is presented in the table below.[6,7,8,9,10,11,12,1,2,3,4,5,6,7]

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[1] Atomics International, Drawing 303-GEN-C-42, Santa Susana Facility Plot Plan, Sheet 8 of 14, 1964.
[2] Atomics International, Industrial Planning Map Nuclear Development Field Laboratories, May 1972.
[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.
[4] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[5] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[6] Moore, J.D., *Environmental and Radioactive Effluent Monitoring Annual Report 1973*, Undated.
[7] Rockwell International, Document No. AI-76-21, *Environmental Impact Assessment of Operations at Atomics International Under Special Nuclear Materials License No. SNM-21*, April 30, 1976.
[8] Moore, J.D., Document No. AI-77-14, *Atomics International Environmental Monitoring and Facility Effluent Annual Report 1976*, Undated.
[9] Moore, J.D., Document No. ESG-79-7, *Energy Systems Group Environmental Monitoring and Facility Effluent Annual Report 1978*, April 1979.
[10] Moore, J.D., Document No. ESG-81-17, *Energy Systems Group Environmental Monitoring and Facility Effluent Annual Report 1980*, May 27, 1981.
[11] Moore, J.D., Document No. ESG-82-21, *Energy Systems Group Environmental Monitoring and Facility Effluent Annual Report 1981*, July 15, 1982.
[12] Moore, J.D., Document No. ESG-83-17, *Energy Systems Group Environmental Monitoring and Facility Effluent Annual Report 1982*, June 1983.

Beginning in 1990, the SS-6 sampling station is identified as being at the northeast corner of Building 4353. As a result, the results for the SS-6 ambient radiation dosimetry data after 1989 are presented above in Section 2.3.1.

TLD-10/TLD-6/SS-6 (Building 4854) Ambient Radiation Dosimetry Data

Year	Quarterly Exposure (mR)				Average Dose Rate (mR/hr)	Annual Exposure (mR)	Equivalent Exposure at 1,000 feet above sea level	
	1st	2nd	3rd	4th			mR	µR/hr
1973*	NR	NR	NR	NR	0.012	NR	105	NR
1974*	NR	NR	NR	NR	0.013	NR	114	NR
1975*	NR	NR	NR	NR	0.011	NR	96	NR
1976	NR	NR	NR	NR	0.010	NR	89	NR
1978	NR	NR	NR	NR	0.016	NR	140	NR
1980	NR	NR	NR	NR	0.018	NR	158	NR
1981	37	31	30	39	NR	137	NR	16
1982	25	27	28	28	NR	108	NR	12
1983	26	27	29	26	NR	108	97	11
1984	**	34	22	22	NR	104	93	11
1985	26	37	30	32	NR	125	114	13
1986	23	32	36	31	NR	122	111	13
1987***	30	54	38	32	NR	154	143	16
1988	25	19	29	21	NR	94	82	9
1989****	23	23	42	20	NR	108	NR	12.3

NR– not reported
*The data from the 1973, 1974, and 1975 dosimetry readings was not presented in annual environmental monitoring reports, but rather a 1976 environmental impact assessment.
**Dosimeter was missing and annual exposure based on data for three quarters.
***According to the 1987 report, the TLD exposure data was higher than expected during the second, third, and fourth quarters for the on-site and the off-site dosimeters. No specific causes were identified and because the higher results were noted for the on- and off-site dosimeters, the report attributed the values to "an intermittent bias in the dosimeter readout instrumentation."
****Similar to the results in 1987, the 1989 report indicated the TLD exposure data was higher than expected during the third quarter of 1989 for both on- and off-site locations.

Based on the annual environmental reports, the TLD data was used to compare the radiation dose rates and equivalent annual doses monitored at the SSFL with three widely separated off-site locations. The data included "the natural background radiation component which exists as a consequence of cosmic radiation, radionuclides in the soil, and radon and thoron in the atmosphere, in addition to radiation fallout from nuclear weapons tests." According to the 1978 report, this level ranged yearly from approximately 100 to 150 mrem/year locally. For the available data presented in the annual reports, the reports summarized that there were "no

[1] Moore, J.D., Document No.ESG-84-9, *Energy Systems Group Environmental Monitoring and Facility Effluent Annual Report 1983*, March 1984.
[2] Moore, J.D., Document No. RI/RD85-123, *Rocketdyne Division Environmental Monitoring and Facility Effluent Annual Report 1984*, March 1985.
[3] Moore, J.D., Document No. RI/RD86-140, *Rocketdyne Division Environmental Monitoring and Facility Effluent Annual Report 1985*, April 1986.
[4] Moore, J.D., Document No. RI/RD87-133, *Rocketdyne Division Environmental Monitoring and Facility Effluent Annual Report 1986*, March 1987.
[5] Moore, J.D., Document No. RI/RD88-144, *Rocketdyne Division Environmental Monitoring and Facility Effluent Annual Report 1987*, March 1988.
[6] Moore, J.D., Document No. RI/RD89-139, *Rocketdyne Division Environmental Monitoring and Facility Effluent Annual Report 1988*, May 1989.
[7] Moore, J.D., Document No. RI/RD90-132, *Rocketdyne Division Environmental Monitoring and Facility Effluent Annual Report 1989*, May 1990.

measureable radiation doses to the general population or to individuals in uncontrolled areas" resulting from operations in Area IV.

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Locations: None.

Aerial Photographs: In 1952, the area comprising the future Building 4854 area is agricultural land. By 1957, the area has been developed and Building 4353 has been constructed to the west of the future Building 4854 location. In 1959, outside storage appears south of Building 4854 south of L Street. The future location of Building 4854 is under constructions. The outside storage south of L Street is no longer visible in 1962. By 1965, two small linear structures are located north of the building. The site remains relatively unchanged in 1972. In 1978, a newly defined drainage channel appears to be present north of the Building 4854 area and appears to flow southeast toward Area III. The drainage channel is no longer obvious in 1980 aerial photographs and the immediate area surrounding the buildings appears to becoming vegetated. A ground scar is visible at the northwest corner of the building. In 1983 the site appears to be less active as a result of increased vegetation surrounding the area and by 1988 the building is no longer visible. In 1988, directly east of the former building, in Area III, a large area of medium-toned mounded material is visible. Similar medium-toned mounded material is visible south of the Building 4854 area along the Area IV and Area III border. In 2005 the area is most vegetated with a ground scar showing the former locations of both Building 4854 and 4353.[1]

Radionuclides of Concern: Given the limited information available regarding the operations of this building, there are no radionuclides of concern associated with the Building 4854 building operations. However, it is likely that numerous gauges and other instruments possibly containing radium dials were used at this building.

Drainage Pathways: Aerial photographs show the presence of at least two drainage channels at or near Building 4854. One drainage channel extends from the southeast corner of the building to the southeast and into Area III. Another drainage channel, clearly visible in 1978 aerial photographs extends past Building 4854 from the northwest to the southeast into Area III. A 2007 site map identifies two drainage channels in this approximate area as "Drainage 6."[2,3] Currently, only the drainage that extended from the southeast corner of the building in present.

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4854 area is Class 2 because of the unknown nature of the operations conducted in Building 4854 by the U.S. Navy, and because of the building's close proximity to Building 4353.

Recommended Locations for Soil/Sediment Sampling: Plate 1 and Figure 2.3 provide a convenient reference for the following recommendations.

Based on the available information, soil sampling is recommended in the Building 4854 area. Significant information is lacking regarding the operations of Building 4854.

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[1] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[2] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[3] Montgomery Watson Harza, *Group 8 – Western Portion of Area IV RCRA Facility Investigation Report, Santa Susana Field Laboratory, Ventura County, California, Volume I – Text, Tables, and Figures*, September 2007, pp. 2-6 - 2-8.

In addition, there have been no previous characterization studies for the Building 4854 area. Therefore, additional characterization is recommended for the Building 4854 area. This includes the following Building 4854 areas and appurtenances:

- The former Building 4854 footprint. As indicated above, Building 4854 was a U.S. Navy-owned building. The building first appears in 1959 aerial photographs as a probable construction area and is visible in the 1962/1963 photos. The building remains visible through 1983 and appears to have been removed some time between 1983 and 1988.
- The drainage channel located southeast of the Building 4854 area along L Street. Should the building have been involved with the use or storage of radioactive materials and the radioactive materials drained from the building to the southeast, residual contamination not consistent with the DTSC/DOE December 2010 AOC may exist along these drainage channels. The storage and use of radioactive materials in Building 4854 could not be determined from available historical documents.

2.3.4 Building 4363 Area

Site Description: The Building 4363 area includes Building 4363, parking lot 4573 (1981 to 1992), and the surrounding area just north of L Street and east of 24th Street. Building 4363 was constructed between October 1957 and January 1958, and was located in an area identified in plot plans as the "SETF area."[1] The building was a 1,400-square foot structure with four work bays. Figures 2.4.5a through 2.4.5f 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 4363 was a 1,400-square-foot structure with four work bays (240 square feet each) placed side by side, a rest room, a small utility room, and an "experimental neutron physics" room on the eastern half of the building. Each bay had double-door access at both the front and back ends of the rooms, and measured approximately 240 square feet. Concrete walls separated the bays with no direct access from one bay to the other. The north and south walls were sheet metal with partial wall panels on the inside wall surfaces. The roof was constructed from composition panels with asphalt base topping. The building sat on a concrete foundation that extended around the building to form a perimeter walkway and loading dock. Building 4363 had an associated leach field measuring 100 by 4 by 3 feet with a septic tank capacity of 1,500 gallons.[2,3,4,5]

According to a 1964 plot plan, the northeast corner of the building was connected to a 6-inch vitrified clay sanitary sewer pipe. The building received water through a 6-inch pipe and also provided water to Building 4375.[6] Prior to this connection to the sanitary sewer system,

[1] Atomics International, Facilities and Data Department, *Progress Report Fiscal Year 195 and Forecast Fiscal Year 1958*, January 1958.
[2] Rocketdyne Report, 363-AR-0001, *Decontamination and Decommissioning of Building T363*, September 25, 1997.
[3] Atomics International, Drawing 303-363-A3, *Floor Plans & Details, Building 363 Remodel*, Date illegible.
[4] Atomics International, Drawing 303-363-P3, *Water Line Location – Bldg 363 Fire Protection Modification*, October 7, 1957.
[5] Rocketdyne, Report No. SSWA-ZR-0002, *Final Radiological Survey Report for Building T363*, June 21, 1996.
[6] Atomics International, Drawing 303-GEN-C-42, Santa Susana Facility Plot Plan, Sheet 8 of 14, 1964.

Building 4363 had an associated leach field to the north of the building. The Building 4363 leach field had an associated sampling location in the 1992 environmental monitoring program plan, which identified the leach field as a RCRA area of concern location.[1]

Former Use(s): Limited operational information for Building 4363 has been located. According to a 1957 and 1958 progress report, the facility was referred to as a mechanical component development and counting room and was designed to provide field test facilities for the performance of OMR mechanical component development tests.[2] Numerous documents indicate that Building 4363 was transferred from the Rocketdyne Division to the Atomics International between 1956 and 1957 to support expansion of the Atomics International activities at the SSFL. It is unknown how Rocketdyne utilized the building prior to the transfer to Atomics International; however, 1957 drawings appear to show the building was modified prior to Atomics International use of the building. The modification included the addition of parking to the east of the building, and a modification to the building's drainage system.

A June 24, 1960, Atomics International technical data record indicated that a Piqua heat transfer loop was located at Building 4363 to obtain data on the heat transfer characteristics of organic fluids over a wide range of Reynolds and Prandtl numbers for various fuel elements and fuel element surface configurations. The major components of the loop included:[3]

1. A drain tank for holding the test coolant
2. A centrifugal pump for circulating the test coolant capable of producing a flow rate of 150 GPM against a 120 foot head
3. 3-inch carbon steel pipe with ring joint flange connections
4. A 10 KW immersion heater
5. A turbine flow meter to measure coolant flow rate
6. Various test section configurations
7. A surge tank for maintaining system pressure by the admission of nitrogen gas
8. An air cooled Dowtherm heat exchanger to remove the heat generated in the test section, controlling bulk temperature
9. In-line filters containing elements of 2 to 12 micron, 10 to 25 micron, and 70 microns in size
10. A 60 KVA, a.c., poer shource for heating the fuel element heater sections.

In addition, a 1969 as-built electrical wiring construction drawing noted the presence of an OMR heat transfer loop within Building 4363.[4]

In September 1994, R.J. Tuttle conducted a study of the possible source of radioactive contamination in Bay 4 of Building 4363. In the study, Mr. Tuttle summarized surveys from 1992 and 1993 that showed spotty contamination within Bay 4 in Building 4363 consisting of Cs-137, uranium, and Sr-90. Mr. Tuttle reviewed the survey information, and site records to attempt to determine the possible source of the contamination. According to Mr. Tuttle, the Mechanical Component Development and Counting Building was used for sodium systems in

[1] Rocketdyne, Report ER-AN-0006, *Environmental Monitoring Program Plan, Santa Susana Field Laboratory, Area IV*, September 30, 1992.
[2] Atomics International, Facilities and Data Department, *Progress Report Fiscal Year 195 and Forecast Fiscal Year 1958*, January 1958.
[3] Huber, D.A., Atomics International Technical Data Record, *Advanced OMR, Convective Heat Transfer*, June 24, 1960.
[4] Atomics International Drawing No. 303-363-E6, Electrical Plan – OMR Heat Trans. Loop – Bldg 363, Santa Susana, February 17, 1969.

support of the Sodium Reactor Experiment (SRE) from before 1959 until 1963. Mr. Tuttle summarized that the "counting" part in the name of the building may have "referred to a radioactivity counting room" that may have been moved from the Engineering Test Building Annex in 1957. According to Mr. Tuttle:[1]

> My suspicion is that some work was done on a valve or pump that contained some small amount of the directly contaminated sodium coolant, in 1962, based on dosimetry of two people assigned to that building. The total amount of activity in the measured contamination spots at present is about 0.1 μCi, or about 0.2 μCi in 1962. If this were inside a valve or pump, it would not have been detected by a portable instrument survey at the time.

A review of the termination of film badges led Mr. Tuttle to believe that the building was no longer active "much after 1963." Since 1963, Mr. Tuttle surmised that Building 4363 had been used primarily for storage.[2]

However, historical documents appear to indicate that operations involving radioactive materials may have continued beyond 1963 in Building 4363. According to an Atomics International internal letter, on May 3, 1965, Building 4363 received "three moderator can samples" from the SRE to be "potted." According to the letter, one of the samples had a beta gamma dose rate of 17.0 rad/hr, and a gamma dose rate of 3.0 r/hr, and, as a result, should not be handled at Building 4363. The letter stated that the samples were warmer than any others that had been handled in Building 4363 in "quite a while," and "contamination during polishing may be more of a problem."[3] As a follow up to this letter, a June 3, 1965, Atomics International internal letter provided that materials that have a surface gamma dose rate of 200 mr/hr or less gamma, and 2 rad/hr or less beta gamma, could be handled in Building 4363 with no special precautions. The letter further stated that "no materials will be handled in Building 363 if the surface dose rates exceed 1 r/hr (gamma) or 10 rad/hr (beta gamma).[4] Additional information regarding the nature or duration of these operations in Building 4363 could not be located in the documents obtained to date.

A July 1965 nuclear operations technical progress report indicated that tests designed to detect possible vibration in a simulated bundle of fuel rods was conducted in the hydraulic test loop in Building 4363. The experiments used "specially designed conductivity cells as vibration sensors."[5]

In April 1992, during the removal of materials being stored in Building 4363, Rocketdyne personnel found fixed beta contamination in Bay 4 of the building. Rocketdyne performed a more detailed radiological survey of Building 4363 in April 1993, confirming the presence of contamination in Bay 4. In May 1995, Rocketdyne completed a radiological assessment report

[1] Tuttle, R.J., Internal Letter Re: Study of Possible Source of Radioactive Contamination in T363, September 9, 1994.
[2] Tuttle, R.J., Internal Letter Re: Study of Possible Source of Radioactive Contamination in T363, September 9, 1994.
[3] Tschaeche, A.N., Internal Letter Re: Dose Rates from Moderator Can Samples from SRE at Building 363, May 5, 1965.
[4] Tschaeche, A.N., Internal Letter Re: Dose Rates for Handling Materials in Building 363, June 3, 1965.
[5] Henock, W.W., *Nuclear Operations Department Technical Progress Report July 1965*, August 26, 1965.

and D&D plan for the building.[1] The D&D plan described the work plan required to decontamination and decommission Bay 4 of Building 4363 in order to release Building 4363 for demolition and removal from the SSFL. These D&D activities included those associated with the removal of electrical conduit and wire, light fixtures, piping systems, ventilation systems and ducting, wall paneling, and paint and concrete surfaces.[2]

The 1995 annual site environmental report indicated that Rocketdyne completed D&D activities at Building 4363 in 1995.[3] A decontamination effort was conducted in 1995.[4] This included the decontamination of Bay 4, including the removal of fixtures, plumbing and ducting, and decontamination of surfaces within the building. According to the D&D plan, previous radiological surveys found loose and fixed radiological contamination on the walls of Bay 4. As a result, contamination was believed to also be present under the paint. Accordingly, the paint was to be removed and the surfaces decontaminated, as necessary.[5]

According to the 2005 HSA, Building 4363 was demolished in 2001 and the sanitary leach field system was removed in 2002.[6] The demolition report for Building 4363 has not yet been obtained; however, a 2000 and 2001 addendum to the demolition contract for Building 4363, indicated that the demolition of the building included the unearthing and removal of approximately 90 feet of 6-inch sanitary sewer line, located on the northeast side of the building, to the cleanout port adjacent to Building 4363. The drain run was to be capped with concrete leaving the cleanout functional.[7,8] And similar to the demolition described above in a December 2000 work plan for Building 4353, the concrete walls of Building 4363 were to be removed and resized by an excavator. The work plan did not indicate the requirement for any surveys during the removal process. The only requirements were for the use of water mist to mitigate any lead dust from becoming airborne.[9]

Information from Interviewees: There have been no interviews conducted recently relating to the operations of Building 4363. Boeing documents included handwritten notes by an unknown author, however, that indicated a former employee recalled that SNAP components were stored in Building 4363. The employee also recalled that one of the middle rooms was set up as a lab, maybe with a fume hood.[10]

Radiological Incident Reports: A review of documented incident reports at the SSFL did not locate any incidents at Building 4363. However, according to the 1994 Area IV Radiological Characterization Plan, a small explosion occurred in the building in the late 1960s that resulted in the spread of low-level radioactive contamination throughout one room of the building. The plan

[1] Rocketdyne, Report No. SSWA-ZR-0002, *Final Radiological Survey Report for Building T363*, June 21, 1996.
[2] Pendleberry, S., ETEC Document No. SSWA-AN-0005, *D&D Plan for Building 363*, May 12, 1995.
[3] Rockwell International, Report No. RI/RD96-140, *Annual Site Environmental Report Santa Susana Field Laboratory and De Soto Sites 1995*, Date Unknown.
[4] Rocketdyne Report, 363-AR-0001, *Decontamination and Decommissioning of Building T363*, September 25, 1997.
[5] Rocketdyne, Report No. 363-SP-0001, *Decontamination Procedure for Bay Four, Building 363*, May 8, 1995.
[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. Citing an August 12, 2003, personnel interview with Dan Trippeda.
[7] Boeing, *Specification Buildings 4363, 4375, and 4873 Addendum to Demolition Contract*, November 15, 2000.
[8] Boeing, *Specification Buildings 4363, 4375, and 4873 Addendum to Demolition Contract*, September 4, 2001.
[9] Schleck, Lennie, *Lead Work Plan for Construction Project, Project Title B4363 & 4353 Demolition*, December 8, 2000.
[10] Unknown Author, Notes Re: T363, April 6, 1992.

stated that the building was decontaminated and returned to normal use.[1] The survey plan does not provide a reference for this incident. An August 6, 1965, health and safety section monthly progress report indicated that a small sodium-water explosion occurred on July 26, 1965, in a hood in Building 4363 that resulted in the spread of radioactive contamination to the laboratory in the building. The maximum level of contamination was reported to have been 50,000 dpm/100 cm^2 beta-gamma.[2] An August 10, 1965, Atomics International internal letter also makes reference to the incident, indicating that Room 106 of Building 4363 had to be decontaminated. According to the letter, the room was decontaminated to a general average level of approximately 200 dpm/100 cm^2 with the exception of "certain items" that had surface and internal contamination levels of approximately 8,000 dpm/100 cm^2 and radiation levels of between 5 and 15 mrad/hr. During decontamination, according to the letter, the sink, hood, exhaust fan, and duct work were removed and prepared for disposal. As a result of the radiation and contamination levels, Room 106 in Building 4363 was reclassified as a "red tag area."[3] No 1965-era building drawings that refer to any of the rooms in Building 4363 as Room 106 were located; however, drawings do show the presence of an "experimental neutron physics" room. The purpose of the "experimental neutron physics" room could not be determined from available historical information.

Current Use: The California Department of Health Service (DHS) released the facility for unrestricted use July 9, 1998.[4] The building was demolished in 2001 and the sanitary leach field was removed in 2002.[5]

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): According to the 1973 annual report for environmental and radioactive effluent monitoring, Building 4363 was part of the sample station monitoring program for soil and vegetation (SV-5), as well as for process water (W-11) and air (A-9), through 1989. The 1973 report, or any subsequent reports, did not include analytical data for each of these sampling stations, but provided averages for the entire site.[6] In 1983, a thermo luminescent dosimeter location (TLD-7), later referred to as SS-7, was added on the north side of Building 4363 to the sampling stations. The results of this quarterly data are presented in the annual environmental monitoring and facility effluent reports from 1983 through 1997.[7,8,9,10,11,1,2,3,4,5,6,7,8,9,10]

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[1] Rocketdyne, Report A4CM-AN-003, Rev. A, *Radiological Characterization Plan*, March 30, 1994.
[2] Lang, J.C., Atomics International Internal Letter Re: Health and Safety Section Monthly Progress Report – Period Ending August 4, 1965, August 6, 1965.
[3] Young, L.N., Internal Letter Re: Reclassification of Room 106, Building 363, August 10, 1965.
[4] Wesley, David, DHS/RHB, Untitled Letter Re: Release of Building 363, July 9, 1998.
[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. Citing an August 12, 2003, personnel interview with Dan Trippeda.
[6] Moore, J.D., *Environmental and Radioactive Effluent Monitoring Annual Report 1973*, Undated.
[7] Rockwell International, Report No. ESG-84-9, *Environmental Monitoring and Facility Effluent Annual Report 1983*, March 1984.
[8] Rockwell International, Report No. RI/RD85-123, *Environmental Monitoring and Facility Effluent Annual Report De Soto and Santa Susana Field Laboratories Sites 1984*, March 1985.
[9] Rockwell International, Report No. RI/RD86-140, *Environmental Monitoring and Facility Effluent Annual Report De Soto and Santa Susana Field Laboratories Sites 1985*,April 1986.
[10] Rockwell International, Report No. RI/RD87-133, *Environmental Monitoring and Facility Effluent Annual Report De Soto and Santa Susana Field Laboratories Sites 1986*, March 1987.
[11] Rockwell International, Report No. RI/RD88-144, *Environmental Monitoring and Facility Effluent Annual Report De Soto and Santa Susana Field Laboratories Sites 1987*, March 1988.

TLD-7/SS-7 (Building 4363) Ambient Radiation Dosimetry Data

Year	Quarterly Exposure (mR)				Annual Exposure (mR)	Equivalent Exposure at 1,000 feet above sea level	
	1st	2nd	3rd	4th		mR	µR/hr
1983	38	34	35	29	136	124	13
1984	35	31	39	21	126	114	12
1985	19	36	26	29	110	98	11
1986	22	29	33	33	117	105	12
1987	22	41	58	30	151	139	16
1988	27	14	31	14	86	82	10
1989	28	15	35	13	91	NLR	NLR
1990	15	10	10	15	50	NLR	NLR
1991	20	35	30	10	95	NLR	NLR
1992	10	10	30	10	60	NLR	NLR
1993	20	20	10	10	60	NLR	NLR
1994	33	33	33	33	132	NLR	NLR
1995	46	46	44	50	186	NLR	NLR
1996	26	26	25	30	107	NLR	NLR
1997	28	28	25	24	104	NLR	NLR

NLR = no longer reported

A chronology of all remaining available radiological investigations at this building is as follows:

- The June 1996 final radiological survey report for Building 4363 provided a summary of previously conducted radiological surveys. According to the report, in April 1992, stored equipment was removed from Bay 4 of Building 4363 and fixed beta contamination was detected on the floor. A more comprehensive survey conducted in April 1993 detected additional radioactive contamination on the west wall and overhead horizontal surfaces in Bay 4, including, but not limited to ducting, piping and light fixtures. Gamma spectrometry results of wall scraping indicated the presence of Cs-137 and low enrichment uranium (2.75%), and "presumed Sr-90 activity." According to Rocketdyne, these results indicated that the activity resulted from work being performed on

[1] Rockwell International, Report No. RI/RD89-139, *Environmental Monitoring and Facility Effluent Annual Report De Soto and Santa Susana Field Laboratories Sites 1988*, May 1989.
[2] Rockwell International, Report No. RI/RD90-132, *Environmental Monitoring and Facility Effluent Annual Report De Soto and Santa Susana Field Laboratories Sites 1989*, May 1990.
[3] Rockwell International, Report No. RI/RD91-136, *Environmental Monitoring Annual Report Santa Susana Field Laboratory, De Soto, and Canoga Sites 1990*, June 20, 1991.
[4] Rockwell International, Report No. RI/RD92-138, *Environmental Monitoring Annual Report Santa Susana Field Laboratory and De Soto Sites 1991*, September 30, 1992.
[5] Rockwell International, Report No. RI/RD93-125, *Environmental Monitoring Annual Report Santa Susana Field Laboratory and De Soto Sites 1992*, December 14, 1993.
[6] Rockwell International, Report No. RI/RD94-126, *Annual Site Environmental Report Santa Susana Field Laboratory and De Soto Sites 1993*, October 21, 1994.
[7] Rockwell International, Report No. RI/RD95-153, *Annual Site Environmental Report Santa Susana Field Laboratory and De Soto Sites 1994*, September 30, 1995.
[8] Rockwell International, Report No. RI/RD96-140, *Annual Site Environmental Report Santa Susana Field Laboratory and De Soto Sites 1995*, Date Unknown.
[9] Boeing, Report No. RD97-134, *Rocketdyne Propulsion & Power DOE Operations Annual Site Environmental Report 1996*, November 10, 1997.
[10] Boeing, Report No. A4CM-ZR-0012, *Rocketdyne Propulsion & Power DOE Operations Annual Site Environmental Report 1997*, November 23, 1998.

components containing contaminated sodium from the SRE. Detectable activity on the floor area in April 1993 ranged from 25,000 to 142,000 dpm/100 cm^2 beta and hot spots on the west wall ranged from 25,000 to 730,000 dpm/100 cm^2 beta. Contamination on overhead horizontal surfaces (piping, ducts light fixtures, etc.) ranged from 7,300 to 33,000 dpm/100 cm^2 beta. According to Rocketdyne, the remaining portions of Building 4363 were not surveyed "because process knowledge at that time did not indicate that contaminated materials were worked on or transported into other parts of the building."[1] The June 1996 report did not indicate whether any building controls were initiated following the April 1993 survey and the decontamination activities in July 1995.

- Prior to the decontamination of Bay 4, Rockwell performed a radiological assessment of "the known and suspect" radiologically contaminated areas and components in Bay 4 of Building 4363. The assessment revealed both fixed and removable contamination on the walls, fire sprinkler piping, ducting, phone wires, north door handle and ceiling trusses inside bay four. Contamination ranged from 100 dpm/100 cm^2 on the west wall to 4,000 dpm/100 cm^2 in front of the north wall door. One smear location on the vent supply measured 42,000 dpm/100 cm^2.[2]

- Following a decontamination effort, Rocketdyne performed a final radiological survey for all of Building 4363 and the surrounding area in 1995. The entire area was divided into two sample lots and was surveyed for total and removable alpha and beta contamination, and ambient gamma. Sample Lot 1 comprised Bay 4, and Sample Lot 2 comprised Bays 1, 2, and 3, and the outside areas surrounding the building.

  Rocketdyne established the total and removable alpha and beta limits to be 5,000 and 1,000 dpm/100 cm^2, respectively. The ambient gamma limit was < 5 µR/hr above background with the average background exposure rate having been established to be 13.1 µR/hr. According to the report, the background exposure rates were measured "near" Building 4363; however, the report does not provide additional information to indicate where the measurement was taken. Rocketdyne reported the maximum total alpha measurements of Lot 1 and Lot 2 were 7.32 and 23.9 dpm/100 cm^2, respectively. The maximum removable alpha of Lot 1 and Lot 2 were 4.68 and 6.88 dpm/100 cm^2, respectively. The maximum total beta measured was 263 and 805 dpm/100 cm^2 for Lots 1 and 2, respectively. Lots 1 and 2 maximum removable beta measurements were 29.9 and 28.7 dpm/100 cm^2, respectively. The maximum ambient gamma at Lot 2 was 1.31 µR/hr above background. Rocketdyne summarized that "all tests for surface contamination showed that the facility [was] suitable for release without radiological restrictions."[3]

- During the 1996 Area IV Radiological Characterization Survey, soil and water samples were collected and analyzed as part of the Area IV radiological characterization. Randomly selected, two soil samples were taken in the vicinity of Building 4363. According to the report, none of the measurements were distinguishable from background and all the measurements were below the acceptable concentration levels established by Boeing in the 1998 approved site-wide release criteria for remediation of radiological

[1] Rocketdyne, Report No. SSWA-ZR-0002, *Final Radiological Survey Report for Building T363*, June 21, 1996.
[2] Waite, P., Internal Letter Re: Radiological Assessment of Building 363, Bay Four, May 11, 1995.
[3] Rocketdyne, Report No. SSWA-ZR-0002, *Final Radiological Survey Report for Building T363*, June 21, 1996.

facilities. Additionally, the ambient gamma survey results in the vicinity of Building 4363 measured 11.8 µR/hr on the east side of the building and 15.4 µR/hr on the northwest corner of the concrete pad surrounding Building 4363.[1]

- ORISE performed an independent verification survey of Building 4363 during the period of July 29, thru July 31, 1996. Surface scans for alpha, beta, and gamma activity and direct measurements for total alpha and total beta activity were performed on 100 percent of floor and lower wall surfaces, and five percent of upper surfaces using NaI scintillation, gas proportional, and/or ZnS detectors. Direct measurement for total alpha and total beta activity were performed at 36 randomly selected floor, lower wall, and upper surface locations. ORISE used the 1996 Rockwell-determined average interior background exposure rate of 13 µR/hr for building exposure rate comparisons.

  In addition to the interior of the building, ORISE also performed a verification survey of the loading dock and concrete slab located on the north, south, and west sides of Building 4363. Surface scans of exterior areas for alpha, beta, and gamma activity were performed using NaI scintillation and gas proportional detectors. Direct measurement for total alpha and total beta activity were also performed at ten randomly selected locations.

  According to the ORISE findings, surface scans of the interior of the building identified one area of total maximum direct beta radiation on the north door of Bay 4, but all other areas were within the range of "ambient site background." The total activity levels in the building ranges from less than 34 to 61 dpm/100 cm^2 and less than 230 to 4,600 dpm/100 cm^2 for alpha and beta, respectively. The 1-square meter average activity surrounding the location of the maximum direct beta radiation was 420 dpm/100 cm^2. The removable activity levels were less than 9 dpm/100 cm^2 for gross alpha and less than 15 dpm/100 cm^2 for gross beta. The site exposure rates measured ranged from 10 to 13 µR/hr.[2]

  Surface scans of the exterior of the building identified one area of elevated direct beta radiation on the concrete slab adjacent to the north door of Bay 4. The total activity levels of exterior surfaces ranged from less than 34 to 110 dpm/100 cm^2 and 330 to 6,200 dpm/100 cm^2 for alpha and beta, respectively. The 1-square meter average activity level was 79 dpm/100 cm^2 for alpha and 1,300 dpm/100 cm^2 for beta in the area of elevated direct radiation identified outside of Bay 4. The removable activity levels were less than 9 dpm/100 cm^2 for gross alpha and less than 15 dpm/100 cm^2 for gross beta.[3]

  Acceptable contamination limits and gamma exposure rates for releasing a facility for unrestricted use are prescribed in the DOE, the 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

[1] Rocketdyne, Report No. A4CM-ZR-0011, *Area IV Radiological Characterization Survey Final Report*, August 15, 1996.
[2] ORISE Document, no document number, "Verification Survey of Building T363, SSFL, Rockwell International, Ventura County, California," Vitkus, T. J., and J. R. Morton, October 1996.
[3] ORISE Document, no document number, "Verification Survey of Building T363, SSFL, Rockwell International, Ventura County, California," Vitkus, T. J., and J. R. Morton, October 1996.

Dismantling Order because at 5 micro roentgens 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]

Surface Contamination Guidelines from DOE Order 5400.5 (1990 and 1993)

Allowable Total Residual Surface Contamination (dpm/100 cm²)			
Radionuclides	**Average**	**Maximum**	**Removable**
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. Department of Energy Order 5400.5, Radiation Protection of the Public and the Environment, February 8, 1990, p. IV-6, and Change 2, January 1993

- DHS also performed a verification survey of Building 4363 on July 30, 1996. According to the survey report, the survey results and the laboratory analysis results of the wipe samples in Building 4363, the building met the requirements of DECON-1 for release without radiological restriction. The DHS performed a general survey with "Ludlum model 19 Micro R meters" in an open field area surrounding the Building 4363 structure. The report indicated that dose rate measurements ranged from 11 μR/hr to 15 μR/hr in the open field, as well as within the building structure. The State team also performed contact measurements at fifteen locations within the structure with a concentration in Bay 4. The background measurement for the concrete slab in the interior of the building was taken at the northwest corner of the building slab, and was consistent with the background measurements taken by Rocketdyne personnel. The background measurement established an average reading of 10 μR/hr. The results of the contact survey measurements within the building ranged from 8 to 12 μR/hr, with the highest measurement being in Bay 4.

  DHS summarized the results to be less than twice background for the surrounding area, and the interior of Building 4363. And, as indicated above, the results of the contact measurements had activity levels below the acceptable surface contamination levels listed in DECON-1.[2]

- Tetra Tech EM Inc. (Tetra Tech), under contract with EPA, conducted an oversight verification and confirmation radiological survey in 2000 to perform independent measurements of areas not previously surveys, perform measurements of areas previously surveyed to establish comparability of survey methods and results, and to perform biased sampling of surfaces and areas that may retain radioactivity. Tetra Tech performed radiation surveys for alpha and beta-gamma radiation at Building 4363. According to the report, "no field measurements made by Tetra Tech indicated the presence of

[1] ORISE Document, no document number, "Verification Survey of Building T363, SSFL, Rockwell International, Ventura County, California," Vitkus, T. J., and J. R. Morton, October 1996.
[2] Kocul, Henry, and Lupo, Roger, *Confirmation Survey of Building T363*, July 30, 1996.

contamination at concentrations greater than the criteria contained in NRC Regulatory Guide 1.86." Additionally, none of the fixed-point measurements exceeded the "most restrictive, allowable, average surface contamination limits," and none of the removable contamination samples contained radioactivity greater than the criteria contain in the regulation noted above.[1]

The surveys of Building 4363 included scans and fixed point measurements for alpha and beta. In addition, the survey included swipe samples for removable contamination and concrete samples for isotopic analysis. The COCs for Building 4363 were mixed fission products and uranium on the floors and walls, based on previous survey results. Fixed point measurements of the building identified one point of elevated alpha and beta-gamma readings (alpha was 49.8 ± 38 dpm/100 cm^2 and beta gamma was 4,753 ± 565 dpm/100 cm^2) in Bay 4. The beta-gamma activity was reported to have exceeded one-half of the surface activity release limit. Tetra Tech reported that all other results were below the 1974 NRC acceptable limits as well as the proposed site-wide release criteria documented in Rocketdyne's 1996 Final Radiological Survey Report for Building 4364.[2,3]

Radiological Use Authorizations: One use authorization relating to operations at Building 4363 has been identified. Use Authorization No. 166 related to the surveillance of existing contamination in Building 4363 and was issued on December 1, 1993. The use authorization was renewed on December 7, 1994, December 23, 1995, and on February 11, 1997. The use authorization specified that the building could not be "divested from company ledgers until the building [was] decontaminated to meet State of California release criteria."[4,5,6,7]

Former Radiological Burial or Disposal Locations: According to the 2005 HSA, citing a 1997 decontamination and decommissioning report, Building 4363 had an associated leach field measuring 100 by 4 by 3 feet with a septic tank capacity of 1,500 gallons (see Figure 2.3.4e).[8] The research team is in the process of acquiring the 1997 report.

Aerial Photographs: In 1952, the area comprising the future Building 4363 area is agricultural land. By 1957, two buildings have been constructed in the Building 4363 area. In August 1959, the Building 4363 area remained relatively unchanged with the exception of the appearance of a linear ground scar from the northeast corner of the building to a point at J Street. The linear ground scar appears to correspond with the 6-inch vitrified clay pipe sanitary sewer line depicted in 1964 plot plans of the facility. The area remains unchanged until 1978 with the appearance of

[1] Tetra Tech, *Final Oversight Verification and Confirmation Radiological Survey Report for Buildings T-012, T-029, and T-363*, December 20, 2002.
[2] Rocketdyne, Report No. SSWA-ZR-0002, *Final Radiological Survey Report for Building T363*, June 21, 1996.
[3] Tetra Tech, *Final Oversight Verification and Confirmation Radiological Survey Report for Buildings T-012, T-029, and T-363*, December 20, 2002.
[4] Barnes, J.G., Authorization for Use of Radioactive Materials or Radiation Producing Devices, Authorization Number 166, December 1, 1993.
[5] Barnes, J.G., Authorization for Use of Radioactive Materials or Radiation Producing Devices, Authorization Number 166A, December 7, 1994.
[6] Barnes, J.G., Authorization for Use of Radioactive Materials or Radiation Producing Devices, Authorization Number 166B, December 23, 1995.
[7] Barnes, J.G., Authorization for Use of Radioactive Materials or Radiation Producing Devices, Authorization Number 166C, February 11, 1997.
[8] Rocketdyne Report, 363-AR-0001, *Decontamination and Decommissioning of Building T363*, September 25, 1997.

probable storage tanks, stains, and probable overhead pipelines. Identified by the 2010 aerial photograph interpretation as a processing area, this area remained active through the early 1990s. In 1995 the area appears to no longer be active, and by 2003 all structures related to this processing area have been removed. By 2005 the former Building 4363 area is vegetated.[1]

Radionuclides of Concern: Based on the limited, available historical documents, Building 4363 was used to support the SRE. As indicated above, based on a review of dosimetry data and available historical documents in 1994, Mr. Tuttle reported that contamination of Building 4363 may have resulted from work on a component containing contaminated sodium from the SRE Core I accident, which occurred in Building 4143 in 1959. The SRE accident dispersed low enriched uranium and mixed fission products in the sodium, which was the same type of contamination found at Building 4363.[2] Therefore, the primary radionuclides of concern for this site are uranium, mixed fission and activation products.[3]

Drainage Pathways: 1957 site drawings and plot plans show a drainage ditch beginning at the southwest corner of the building, then flowing north along the west end of the building, then flowing east along the northern boundary of the building to an area east of the building where the drawing indicates that the ditch should be run "so drainage will discharge to south of building."[4] (See Figure 2.3.4e.) Currently, surface water within the vicinity of former Building 4363 drains to the southeast into the ditch on the north side of former L Street. Surface water then runs east along former L Street till it dead ends, where it then flows southeast into Area III.

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4363 area is Class 1 because of the high levels of radioactive contamination found in the building and the limited operational information available regarding the processes employed in Building 4363. In addition, an Atomics International internal letter, on May 3, 1965, stated that Building 4363 received three moderator can samples from the SRE to be "potted."[5] Available documents did not provide information regarding this process or its duration.

Recommended Locations for Soil/Sediment Sampling: Plate 1 and Figure 2.3 provide a convenient reference for the following recommendations.

Based on the available information, soil sampling is recommended in the Building 4363 area. As discussed above, there were no reported radiological incidents at Building 4363; however, secondary documents provide information regarding an explosion that may have occurred resulting in the decontamination of Room 106. In addition, significant information is lacking regarding the disposal and demolition of Building 4363 and the building's sanitary leach field.

Previous characterization studies for the Building 4363 area were focused on delineating the extent of contamination to standards that were applicable at the time. This characterization was not conducted to delineate the extent of contamination consistent with the DTSC/DOE December

[1] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[2] Tuttle, R.J., Internal Letter Re: Study of Possible Source of Radioactive Contamination in T363, September 9, 1994.
[3] ORISE Document, no document number, "Verification Survey of Building T363, SSFL, Rockwell International, Ventura County, California," Vitkus, T. J., and J. R. Morton, October 1996.
[4] Atomics International, Drawing No. 303-363-C13, *Grading and Plot Plan, Building 363 Remodel*, 1957.
[5] Tschaeche, A.N., Internal Letter Re: Dose Rates from Moderator Can Samples from SRE at Building 363, May 5, 1965.

2010 AOC. Therefore, additional characterization is recommended for the Building 4363 area. This includes the following Building 4363 areas and appurtenances:

- The former Building 4363 footprint should be sampled. R.J. Tuttle identified possible sources of radioactive contamination in Bay 4 of Building 4363 as having been a result of the building's use in support of the SRE. Bay 4 showed spotty contamination consisting of Cs-137, uranium, and Sr-90.[1]

- The former location of Room 106 of Building 4363 should be evaluated. An August 10, 1965, Atomics International internal letter references an incident report dated July 26, 1965, whereby Room 106 of Building 4363 had to be decontaminated. According to the letter, the room was decontaminated to a general average level of approximately 200 dpm/100 cm^2 with the exception of "certain items" that had surface and internal contamination levels of approximately 8,000 dpm/100 cm^2 and radiation levels of between 5 and 15 mrad/hr.[2]

- The drainage channels surrounding Building 4363 should be sampled. 1957 site drawings and plot plans show a drainage ditch beginning at the southwest corner of the building, then flowing north along the west end of the building, then flowing east along the northern boundary of the building to an area east of the building where the drawing indicates that the ditch should be run "so drainage will discharge to south of building."[3]

2.3.5 Building 4375 Area

Site Description: The Building 4375 area includes Building 4375 and the surrounding area located outside of the government-optioned portion of Area IV east of 24th Street and south of J Street. Building 4375 was a 400-square foot steel-framed building constructed in 1959 that was adjacent to control rod test tower Buildings 4874 and 4875, discussed below. Figures 2.3.5a through 2.3.5d 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: Limited information regarding the construction of this building has been located, to date. Building 4375 was a test shelter for testing SNAP control rod assemblies. The building measured 400 square feet in size and had a steel frame with steel roof and siding. In 1988, the surrounding area was cluttered with debris and metal components.[4]

A 1958 engineering drawing shows the installation of a drain tank pit at the Building 4375 area. According to the drawing, the pit was located near the southeast corner of Building 4375 along the eastern boundary of the existing concrete slab. The drawing shows the addition of 40 feet of 4-inch vitrified clay drain line from the pit to "terminate at existing drainage ditch."[5]

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[1] Tuttle, R.J., Internal Letter Re: Study of Possible Source of Radioactive Contamination in T363, September 9, 1994.
[2] Young, L.N., Internal Letter Re: Reclassification of Room 106, Building 363, August 10, 1965.
[3] Atomics International, Drawing No. 303-363-C13, *Grading and Plot Plan, Building 363 Remodel*, 1957.
[4] ETEC, Document No. GEN-ZR-0012, *Radiological Survey of Buildings T373 and T375*, August 8, 1988.
[5] Atomics International, Drawing 303-375-C1, *Drain Tank Pit and 15HP Pump Installation Bldg #375 Area*, April 4, 1958.

Former Use(s): Operational information for Building 4375 is limited. According to a June 1960 Atomics International technical data record, an environmental test loop was located at Building 4375 and was originally designed to perform creep tests on full-size OMR Piqua-type fuel elements. In 1960, the loop was used for the environmental testing of proposed fuel elements for organic reactors. The environmental test loop, or "Loop B," was constructed primarily of 4-inch carbon steel pipe with a test chamber fabricated from 10-inch pipe. The proper rearrangement of piping was reported to allow the "reversal of flow of organic through the test chamber." A stainless steel centrifugal pump was used as the prime mover, and a durametallic seal was used to seal the pump shaft. The seal was cooled with de-ionized water.[1]

A surge tank, common to both the loop and the test chamber, was used for pressurization during testing and operation. A drain tank located in a pit was utilized for coolant storage and was connected to the main system through an air-operated dump valve. The operational and shutdown controls were mounted on a control instrument rack. When the loop achieved steady-state operation, the loop was operated and controlled automatically. The technical data record indicated that the following tests had been conducted at Building 4375: [2]

1. OMRE fuel element environmental and pressure drop tests
2. OMRE fuel element hot wire anemometer calibration
3. Flat-finned pate Piqua element environmental test
4. Circular-finned Piqua element environmental and pressure drop tests

A second loop located at Building 4375 was the AOMR fouling test loop, which determined the long-term heat transfer characteristics of various heat transfer configurations. The loop was constructed of welded 2-inch mild steel pipe with flanged components. Circulation of the organic coolant was accomplished by a centrifugal, hot-oil process-type pump. The technical data record indicated that limited nucleate boiling tests may also be conducted in the loop; however, evidence of these operations has not been located.[3]

The available information regarding Building 4375 operations is presented in the 1988 radiological survey report. According to that report, Building 4375 was constructed in 1959 and served as a test shelter for outside control-rod test towers (Buildings 4874 and 4875). Building 4375 was used as a non-nuclear control center for testing SNAP control rod assemblies in support of the SNAP program. Building 4375, as indicated above, was located outside of the government-optioned portion of Area IV and was owned by Atomics International. Test operations at Building 4375 proceeded through 1968. Following completion of the SNAP program, Buildings 4373, 4374, and 4375 were cleared of SNAP components. These included the outside test tower, Building 4874, as well as tanks, piping, valves, instrumentation, and controls. According to the 1988 radiological survey, a radiological survey was performed to clear the building for non-nuclear use; however the referenced survey has not been located in the available documents.[4]

[1] Huber, D.A., Atomics International Technical Data Record, *Advanced OMR, Convective Heat Transfer*, June 24, 1960.
[2] Huber, D.A., Atomics International Technical Data Record, *Advanced OMR, Convective Heat Transfer*, June 24, 1960.
[3] Huber, D.A., Atomics International Technical Data Record, *Advanced OMR, Convective Heat Transfer*, June 24, 1960.
[4] ETEC, Document No. GEN-ZR-0012, *Radiological Survey of Buildings T373 and T375*, August 8, 1988.

The 1988 radiological survey indicated that handling of radioactive material at Building 4375 was unknown. As of 1988, it was reported the building was "abandoned and dilapidated," and the surrounding area was cluttered with debris in certain locations. The report stated that after the building was abandoned, barrels were stored in the surrounding areas.[1] The contents of the barrels or from where they originated is unknown. It is also unknown the duration of these storage activities.

According to the 2005 HSA, the building was demolished in 1999.[2] However, on November 15, 2000, and on September 4, 2001, Boeing issued addenda to the demolition contract specifying that the contractor "shall provide all labor, materials, and equipment to remove all remaining structural walls, concrete foundations, retaining walls, pits and asphalt concrete drives associated with Building(s) 4375, 4363, and 4873." The addenda did not specify the specific activities relating to the demolition of Building 4375.[3,4] Boeing continued to issue addenda for the demolition of Building 4375 through April 2003.[5] The 2010 aerial photograph interpretation indicates that all structures in the Building 4375 area are removed by 2003.[6]

Information from Interviewees: None to date.

Radiological Incident Reports: None found.
Current Use: DHS released the facility for unrestricted use on May 9, 1995.[7] The exact demolition date of Building 4375 is unknown at this time; however, the 2010 aerial photograph interpretation indicates that all structures in the Building 4375 area are removed by 2003.[8] The site is presently vegetated.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): In 1988, Rocketdyne performed a radiological survey at Building 4375 to determine if any residual contamination existed. The radiation measurements taken during the survey were compared against the DOE residual radioactivity limits specified in "Guidelines for Residual Radioactivity at FUSRAP and Remote SFMP Sites." The maximum acceptable contamination limits used in 1988 are presented below:

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 above background*	

*The DOE guide recommended a value of 20 µR/hr above background for the ambient gamma exposure rate; however, the NRC required 5 µR/hr. Accordingly, Rockwell used the more stringent requirement.

[1] ETEC, Document No. GEN-ZR-0012, *Radiological Survey of Buildings T373 and T375*, August 8, 1988.
[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.
[3] Boeing, *Building(s) 4363, 4375, and 4873 Addendum to Demolition Contract*, November 15, 2000.
[4] Boeing, *Building(s) 4353, 4363, 4375, and 4873 Addendum to Demolition Contract*, September 4, 2001.
[5] Boeing, *Building(s) 4353, 4363, 4375, and 4873 Addendum to Demolition Contract*, April 23, 2003.
[6] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[7] Wong, Gerard, DHS/RHB Letter Re: ETEC's Radiological Survey Report of Buildings T373 and T375, May 9, 1995.
[8] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.

According to the 1988 radiological survey, the Building 4375 survey included a survey of the gamma exposure rate of the surface of the building and the grounds from J to L Streets and from 24th to 22nd Streets. Seventy-nine gamma exposure rate measurements were taken surrounding Building 4375, and a combined total of 29 gamma exposure rate measurements were taken within Buildings 4374 and 4375. The report indicated that no soil samples were collected because there was no indication of contamination as a result of the gamma exposure rate measurements. As indicated above, the measured ambient gamma limit was < 5 µR/hr above background, which was measured to be between 14 and 16 µR/hr.[1] The maximum measured ambient gamma in Buildings 4374 and 4375 was 9.3 µR/hr, and 13.7 µR/hr for the area surrounding Building 4375. The survey concluded that survey results were below the Rocketdyne 1988 acceptable limits and no further inspection was required at Building 4375.[2]

The Building 4375 area was also included in the Area IV Radiological Characterization Survey conducted in 1994 and 1995. Located in the central portion of survey block H12, the Building 4873 area ambient gamma survey result measured between 13.0 and 14.1 µR/hr. The survey found background to be 15.6 µR/hr, and the acceptable limit was identified by Rocketdyne as being less than 5 µR/hr above background. Accordingly, survey results in the vicinity of the Building 4375 area were found to be below the then-acceptable limits.[3,4]

Radiological Use Authorizations: Based on the review of currently available documents, there was no radiological use authorization associated with the operations at Building 4375.

Former Radiological Burial or Disposal Locations: As indicated above, a 1958 engineering drawing shows the installation of a drain tank pit near the southeast corner of Building 4375 along the eastern boundary of the existing concrete slab. The drawing shows the addition of 40 feet of 4-inch vitrified clay drain line from the pit to "terminate at existing drainage ditch."[5] Based on the available historical information regarding the building's operations, the purpose of the drain tank pit at Building 4375 is unknown and it cannot be stated whether radiological materials entered this drainage system as a result of building operations.

Aerial Photographs: In 1952, the area comprising the future Building 4375 is agricultural farmland. By 1957, the area has become developed with the construction of a building, Building 4363, South of the Building 4375 area. The 1957 area photographs shows a linear ground scar leading from the future Building 4375 area to the intersection of 22nd and L Street. This ground scar appears to correspond to a drainage channel referenced in Building 4375 construction drawings. In 1959, the Building 4375 area has been developed and the building structure is visible. The aerial photograph interpretation notes the presence of three "square objects" located immediately south of Building 4375. The aerial photographs marked 1962/1963 in the aerial photograph interpretation clearly show Building 4874 north of Building 4375; however, few additional features are visible as a result of the increased site development.[6] The site appears to

[1] According to the 1988 survey report, an average of 38 background measurements were taken at three locations at the SSFL – the Building 4309 area, Well #13 Road, and Incinerator Road.
[2] ETEC, Document No. GEN-ZR-0012, *Radiological Survey of Buildings T373 and T375*, August 8, 1988.
[3] Rocketdyne Document A4CM-ZR-0011, Rev. A, *Area IV Radiological Characterization Survey*, August 15, 1996.
[4] Boeing, Document No. N001SRR140131, *Approved Sitewide Release Criteria for Remediation of Radiological Facility at the SSFL*, February 18, 1999.
[5] Atomics International, Drawing 303-375-C1, *Drain Tank Pit and 15HP Pump Installation Bldg #375 Area*, April 4, 1958.
[6] The date of the 1962/1963 aerial photographs has been determined to be approximately 1960 plus or minus a year.

be unchanged through 1967 with the appearance of dark-toned material to the north of Building 4874. Limited detail is visible in the 1972 aerial photographs; however, it appears there are construction activities to the east of the Building 4375 area in the future location of Buildings 4473 and 4863, discussed below. Beginning in 1978, the aerial photograph interpretation begins to refer to the area as process area 5. Stains, as well as probable storage tanks are visible in this area, comprising Buildings 4363, 4873, 4875, 4375, 4874, 4473, and 4863. A stain is clearly visible to the east of Building 4375 in May 1978. In 1980, Building 4874 no longer appears to be present; however, a concrete pad remains. The area to the east of Building 4375 appears to be an area of increased activity. This area continues to contain more materials in subsequent photographs until 1995 when the area, according to the aerial photograph interpretation, appears to be abandoned. By 2003, all structures related to process area 5 have been removed from the location, and by 2005, the area is vegetated.[1]

Radionuclides of Concern: Evidence that high activity radioactive materials were used or stored at Building 4375 could be located. As indicated above, Building 4375 was used to support the SNAP program, but does not appear to have been involved in nuclear work. After the building was abandoned, barrels that may have contained radioactive material were stored in the surrounding area; however, information regarding these barrels could not be located.

Drainage Pathways: According to a 1958 engineering drawing, a drainage ditch was located to the east of the Building 4375 area. The drawing depicted a 4-inch drain line that originated from a drain tank pit near the southeast corner of Building 4375 and terminated at an "existing drainage ditch."[2] Currently, surface water in the vicinity of former Building 4375 flows to the south-southeast to former L Street, then east until former L Street ends, where it then flows southeast into Area III.

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4375 area is Class 2, due to the unknown nature of its operations in support of the SNAP program and its proximity to Building 4055.

Recommended Locations for Soil/Sediment Sampling: Plate 1 and Figure 2.3 provide a convenient reference for the following recommendations.

Based on the available information, soil sampling is recommended in the Building 4375 area. Limited information regarding the operations of Building 4375 could be located; however, it was reported the building served as a non-nuclear facility. Following the building operations, the area surrounding the building appears to have served as an outside storage area.

Previous characterization studies for the Building 4375 area were focused on delineating the extent of contamination to standards that were applicable at the time. This 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 4375 area. This includes the following Building 4375 areas and appurtenances:

[1] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[2] Atomics International, Drawing 303-375-C1, *Drain Tank Pit and 15HP Pump Installation Bldg #375 Area*, April 4, 1958.

- The area surrounding the former Building 4375 location is recommended for sampling. The area appears to have served as an outside storage area of numerous barrels after operations ceased; however, the contents of the barrels are unknown.

- Based on a 1958 engineering drawing, a drain tank pit was installed near the southeast corner of Building 4375 along the eastern boundary of the existing concrete slab. The drawing shows the addition of 40 feet of 4-inch vitrified clay drain line from the pit to "terminate at existing drainage ditch."[1] Based on the available historical information regarding the building's operations, the purpose of the drain tank pit at Building 4375 is unknown. It is also unknown whether radiological materials entered this drainage system as a result of building operations. The drain tank pit and vitrified clay drain line are recommended for sampling.

- The former Parking Lot 4575 area is recommended for sampling. The parking lot is discussed below; however, given its proximity to Building 4375, it is recommended the parking lot be included in the sampling plan for Building 4375. More specifically, sampling is recommended surrounding the perimeter of Parking Lot 4575 along 24th Street and J Street.

- The former locations of Buildings 4874 and 4875 are recommended for sampling. Given their proximity to Building 4375, it is recommended these buildings be included in the sampling plan for Building 4375.

2.3.6 Parking Lot 4575 Area

Site Description: The Parking Lot 4575 area comprises the parking lot near Buildings 4375 and 4473, and the surrounding area. This area is located at the southeast corner of J and 24th Streets and appears to extend down along 24th Street to L Street. This area is never identified as an established parking lot in any of the available industrial planning maps. The 2005 HSA identified Parking Lot 4575 as a site investigation area, and as a result, it has been included in this TM. Figures 2.3.6a provides a current photograph. Plate 1 presents a summary of all identified features for this site.

Building Features: There are no building features to report for Parking Lot 4575. There is limited information available to indicate when this parking lot was constructed. As indicated above, available industrial planning maps do not show the presence of an established parking lot in this area; however the area surrounding the Building 4375 area appears to be paved in aerial photographs. The area identified by the 2005 HSA as Parking Lot 4553 is located northwest of the Building 4375 area, discussed above, at the southwest corner of J and 24th Streets and appears to extend down along 24th Street to L Street.[2,3]

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[1] Atomics International, Drawing 303-375-C1, *Drain Tank Pit and 15HP Pump Installation Bldg #375 Area*, April 4, 1958.
[2] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, 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.

Former Use(s): Parking Lot 4575 appears to have been mainly used for its intended purpose of serving personnel working in the facilities at and around Building 4375.[1]

Information from Interviewees: None to date.

Radiological Incident Reports: There have been no incident reports associated with operations at Parking Lot 4575 identified to date.

Current Use: Based on aerial photographs, the area comprising the former Parking Lot 4575 is vegetated.[2]

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): Radiological surveys specific to Parking Lot 4575 have not been conducted; however, the area surrounding Building 4375, including the former parking lot area, was surveyed in 1988 by Rocketdyne. The area, as indicated above in the description of previous radiological investigations for Building 4375, was surveyed for mixed fission products by measuring the ambient gamma exposure rates.

According to the 1988 radiological survey, the Building 4375 survey included a survey of the gamma exposure rate of the grounds from J to L Streets and from 24th to 22nd Streets. Seventy-nine gamma exposure rate measurements were taken surrounding Building 4375. The report indicated that no soil samples were collected because there was no indication of contamination as a result of the gamma exposure rate measurements. As indicated above, in Section 2.3.5, the measured ambient gamma limit was < 5 µR/hr above background, which was measured to be between 14 and 16 µR/hr.[3] The maximum measured ambient gamma surrounding Building 4375 was 13.7 µR/hr. The survey concluded that survey results were below the 1988 acceptable limits and no further inspection was required at Building 4375.[4]

Additionally, according to the Area IV Radiological Characterization Survey, the area was included in the survey conducted in 1994 and 1995. Located in the northwestern portion of survey block H12 with Building 4375, the Parking Lot 4575 area ambient gamma survey results measured between 14.7 and 16.6 µR/hr. The survey found background to be 15.6 µR/hr, and the acceptable limit was identified by Rocketdyne as being less than 5 µR/hr above background. Accordingly, survey results in the vicinity of the Parking Lot 4575 area were found to be below the then-acceptable limits.[5,6]

Radiological Use Authorizations: None.

Former Radiological Burial or Disposal Locations: None.

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[1] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[2] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[3] According to the 1988 survey report, an average of 38 background measurements were taken at three locations at the SSFL – the Building 4309 area, Well #13 Road, and Incinerator Road.
[4] ETEC, Document No. GEN-ZR-0012, *Radiological Survey of Buildings T373 and T375*, August 8, 1988.
[5] Rocketdyne Document A4CM-ZR-0011, Rev. A, *Area IV Radiological Characterization Survey*, August 15, 1996.
[6] Boeing, Document No. N001SRR140131, *Approved Sitewide Release Criteria for Remediation of Radiological Facility at the SSFL*, February 18, 1999.

Aerial Photographs: In 1952, the area comprising the future Parking Lot 4575 is agricultural farmland. By 1957, the area has become developed with the construction of a building, Building 4363, South of the future parking lot area. The 1957 area photographs shows a linear ground scar leading from the future Building 4375 area to the intersection of 22nd and L Street. This ground scar appears to correspond to a drainage channel referenced in Building 4375 construction drawings.[1] In 1959, the Building 4375 area has been developed and the area surrounding the building appears to be paved and vehicles are visible on the paved areas. The aerial photographs marked 1962/1963 in the aerial photograph interpretation clearly show the area to be paved with ingress and egress to the parking area available from J Street and 24th Street.[2] The site appears to be unchanged through 1967 with the appearance of dark-toned material to the north of Building 4874. Limited detail is visible in the 1972 aerial photographs. Beginning in 1978, the aerial photograph interpretation begins to refer to the area comprising the buildings to the east of the Parking Lot 4575 area as process area 5. Stains, as well as probable storage tanks are visible in this area, comprising Buildings 4363, 4873, 4875, 4375, 4874, 4473, and 4863. By 1988, the area comprising the Parking Lot 4575 area has become vegetated. By 2003, all structures related to process area 5 have been removed from the location, and by 2005, the area, including the parking lot, is vegetated.[3]

Radionuclides of Concern: None.

Drainage Pathways: According to a 1958 engineering drawing and aerial photographs, a drainage ditch was located to the east of the Parking Lot 4575 area.[4,5] In addition, a drainage channel was located on the south side of J Street on the northern boundary of the Parking Lot 4574 area, and carried surface water east toward 22nd Street.[6] Currently, surface water in the vicinity of former Parking Lot 4575 drains to the north into the ditch that runs along the south side of J Street. The surface water then flows east along J Street into Area III.

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Parking Lot 4575 area is Class 3 because of the parking lots use for intended purposes and no evidence of any outside storage activities at or near Parking Lot 4553.

Recommended Locations for Soil/Sediment Sampling: It is recommended this area be evaluated for sampling as part of Building 4375, discussed above.

2.3.7 Building 4874 Area

Note: To date, limited historical documents relating to the construction and operation of Building 4874 has been located. As a result, the information provided below is limited and is based mostly on information from Building 4375, which was the test shelter for Building 4874.

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[1] Atomics International, Drawing 303-375-C1, *Drain Tank Pit and 15HP Pump Installation Bldg #375 Area*, April 4, 1958.
[2] The date of the 1962/1963 aerial photographs has been determined to be approximately 1960 plus or minus a year however, the research team will continue to use the dates as they are marked on the aerial photograph figures in the attached report.
[3] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[4] Atomics International, Drawing 303-375-C1, *Drain Tank Pit and 15HP Pump Installation Bldg #375 Area*, April 4, 1958.
[5] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[6] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.

Additional information may become available when the documents from Boeing's 1.4 million document database are reviewed.

Site Description: The Building 4874 area includes Building 4874 and the surrounding area and is located north of Building 4375 at the southeast corner of J and 24th Streets, outside the boundaries of the government-optioned portion of Area IV. Building 4874 was constructed in the late 1950s and served as a test tower in support of Building 4375. Figures 2.3.7a through 2.3.7d provide a current photograph and the best available building-specific drawings and photographs that the research team could find. Plate 1 presents a summary of all identified features for this site.

Building Features: Limited information is available regarding the features of Building 4874. Building 4874 was located outside of the government-optioned portion of Area IV and was owned by Atomics International. The site is identified on industrial planning maps as a control rod test tower and pad. The height of the tower was 90 feet high (Figure 2.3.7d). The 1988 survey report indicated that the facility included tanks, piping valves, instrumentation, and controls that were all removed following the completion of testing operations. A bridge crane inside the structure permitted the handling of the full-scale control rods, which were suspended inside of tubular electric furnaces that duplicated reactor operating temperatures.[1,2,3,4]

Former Use(s): Operational information for Building 4874 is limited. According to the 1988 radiological survey report, Building 4874 was a control rod test tower. The survey report stated that Building 4375 was constructed as a test shelter for outside control-rod test towers (Buildings 4874 and 4875). These tests were reported to have been non-nuclear testing of SNAP control rod assemblies in support of the SNAP program. Test operations at Building 4375 proceeded through 1968, according to the survey report. Following completion of the SNAP program, Buildings 4373, 4374, and 4375 were cleared of SNAP components, which included the outside test tower, Building 4874, as well as tanks, piping, valves, instrumentation, and controls. According to the 1988 radiological survey, a radiological survey was performed to clear Building 4375 for non-nuclear use; however, available documents did not include a summary of the referenced survey. Additionally, it is unknown if the survey included Building 4375, or only related to Buildings 4373 and 4374, discussed above.[5,6]

The 1988 radiological survey indicated that handling of radioactive material at the Building 4375 area, including Building 4874, was unknown. As of 1988, it was reported the building was "abandoned and dilapidated," and the surrounding area was cluttered with debris in certain locations. The report stated that after the building was abandoned, barrels were stored in the surrounding areas.[7] The contents of the barrels or from where they originated is unknown. It is also unknown the duration of these storage activities.

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[1] ETEC, Document No. GEN-ZR-0012, *Radiological Survey of Buildings T373 and T375*, August 8, 1988.
[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.
[3] Atomics International, Nuclear Development Field Laboratories, January 1, 1967.
[4] Atomics International, Document No. AI-5316, *A Materials Research Proposal for Advanced Nuclear Space Systems*, June 13, 1960.
[5] Atomics International, Document No. AI-5316, *A Materials Research Proposal for Advanced Nuclear Space Systems*, June 13, 1960.
[6] ETEC, Document No. GEN-ZR-0012, *Radiological Survey of Buildings T373 and T375*, August 8, 1988.
[7] ETEC, Document No. GEN-ZR-0012, *Radiological Survey of Buildings T373 and T375*, August 8, 1988.

According to the 2005 HSA, Building 4874 was demolished in the early 1970s. The building remains visible on industrial planning maps until 1973.[1,2,3]

Information from Interviewees: There have been no interviews conducted to date regarding Building 4874.

Radiological Incident Reports: None found.

Current Use: As indicated above, the 2005 HSA stated that Building 4874 was demolished in the early 1970s. Aerial photographs from 1972 do not provide enough detail to determine whether the facility has been demolished; however by 1978, it is clear the facility has been removed and concrete pads remain.[4,5] Presently, the area comprising the former Building 4874 area is vegetated.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): In 1988, Rocketdyne performed a radiological survey at Building 4375 and the surrounding area to determine if any residual contamination existed. The radiation measurements taken during the survey were compared against the DOE residual radioactivity limits specified in "Guidelines for Residual Radioactivity at FUSRAP and Remote SFMP Sites." The maximum acceptable contamination limits used in 1988 are presented in Section 2.2.5., above.

According to the 1988 radiological survey, the Building 4375 survey included a survey of the gamma exposure rate of the grounds from J to L Streets and from 24th to 22nd Streets, including the former location of Building 4874. Seventy-nine gamma exposure rate measurements were taken surrounding Building 4375. The report indicated that no soil samples were collected because there was no indication of contamination as a result of the gamma exposure rate measurements. As indicated above, the measured ambient gamma limit was < 5 µR/hr above background, which was measured to be between 14 and 16 µR/hr.[6] The maximum measured ambient gamma surrounding Building 4375 was 13.7 µR/hr. The survey concluded that survey results were below the Rocketdyne 1988 acceptable limits and no further inspection was required at Building 4375.[7]

As reported in the Area IV Radiological Characterization Survey, the area was included in the survey conducted in 1994 and 1995. Located in the central portion of survey block H12, the Building 4874 area ambient gamma survey result measured between 13.0 and 16.2 µR/hr. The survey found background to be 15.6 µR/hr, and the acceptable limit was identified by Rocketdyne as being less than 5 µR/hr above background. Accordingly, survey results in the vicinity of the Building 4874 area were found to be below the then-acceptable limits.[8,1]

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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.
[2] Atomics International, Nuclear Development Field Laboratories, March 1973.
[3] Atomics International, Nuclear Development Field Laboratories, March 1975.
[4] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 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.
[6] According to the 1988 survey report, an average of 38 background measurements were taken at three locations at the SSFL – the Building 4309 area, Well #13 Road, and Incinerator Road.
[7] ETEC, Document No. GEN-ZR-0012, *Radiological Survey of Buildings T373 and T375*, August 8, 1988.
[8] Rocketdyne Document A4CM-ZR-0011, Rev. A, *Area IV Radiological Characterization Survey*, August 15, 1996.

Radiological Use Authorizations: Based on the review of currently available documents, there was no radiological use authorization associated with the operations at Building 4874.

Former Radiological Burial or Disposal Locations: None.

Aerial Photographs: In 1952, the area comprising the future Building 4874 is agricultural farmland. By 1957, the area has become developed with the construction of a building, Building 4363, South of Building 4874. In 1959, the Building 4375 area has been developed and the building structure is visible. The aerial photographs marked 1962/1963 in the aerial photograph interpretation clearly show Building 4874; however, few additional features are visible as a result of the increased site development.[2] The site appears to be unchanged through 1967 with the appearance of dark-toned material to the north of Building 4874. Limited detail is visible in the 1972 aerial photographs; however, it appears there are construction activities to the east of the Building 4874 area in the future location of Buildings 4473 and 4863, discussed below. Beginning in 1978, the Building 4874 structure is no longer visible and a concrete pad remains. The aerial photograph interpretation begins to refer to the area as process area 5. Stains, as well as probable storage tanks are visible in this area, comprising Buildings 4363, 4873, 4875, 4375, 4874, 4473, and 4863. A stain is clearly visible to the east of Building 4375 in May 1978. The area to the east of Building 4375 appears to be an area of increased activity. This area continues to contain more materials in subsequent photographs until 1995 when the area, according to the aerial photograph interpretation, appears to be abandoned. By 2003, all structures related to process area 5 have been removed from the location, and by 2005, the area is vegetated.[3]

Radionuclides of Concern: Evidence that radioactive materials were used or stored at Building 4874 could not be located. As indicated above, Building 4874 was used to support the SNAP program, but does not appear to have been involved in nuclear work. After the building was abandoned, barrels that may have contained radioactive material were stored in the surrounding area; however, information regarding these barrels could not be located.

Drainage Pathways: According to a 1958 engineering drawing, a drainage ditch was located to the east of the Building 4375 and Building 4874 area. The drawing depicted a 4-inch drain line that originated from a drain tank pit near the southeast corner of Building 4375 and terminated at an "existing drainage ditch."[4] Currently, surface water in the vicinity of former Buildings 4375 and 4874 flows to the south-southeast into the ditch on the north side of former L Street, then east until former L Street ends, where it then flows southeast into Area III.

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4874 area is Class 2, due to the unknown nature of its operations in support of the SNAP program and its proximity to Building 4055.

Recommended Locations for Soil/Sediment Sampling: It is recommended this area be evaluated for sampling as part of Building 4575, discussed above.

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[1] Boeing, Document No. N001SRR140131, *Approved Sitewide Release Criteria for Remediation of Radiological Facility at the SSFL*, February 18, 1999.

[2] The date of the 1962/1963 aerial photographs has been determined to be approximately 1960 plus or minus a year however, the research team will continue to use the dates as they are marked on the aerial photograph figures in the attached report.

[3] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.

[4] Atomics International, Drawing 303-375-C1, *Drain Tank Pit and 15HP Pump Installation Bldg #375 Area*, April 4, 1958.

2.3.8 Building 4875 Area

Note: To date, limited historical documents relating to the construction and operation of Building 4875 has been located. As a result, the information provided below is limited and is based mostly on information from Building 4375, which was the test shelter for Building 4875.

Site Description: The Building 4875 area includes Building 4875 and the surrounding area and is located west of Building 4375 at the southeast corner of J and 24th Streets, outside the boundaries of the government-optioned portion of Area IV. Building 4875 was constructed in the late 1950s and served as a "creep loop tower" in support of Building 4375. Information could not be located in available documents to indicate the functions of a "creep loop tower." Figure 2.3.8a provides a current photograph of the site, and Figure 2.3.8b provides an aerial view of the site in 1958. Facility drawings for Building 4875 have not been located. Plate 1 presents a summary of all identified features for this site.

Building Features: Limited information is available regarding the features of Building 4875. Building 4875 was located outside of the government-optioned portion of Area IV and was owned by Atomics International. The site is identified on industrial planning maps as a control pad and creep loop tower. The height of the tower is unknown; however, aerial oblique photographs of the site in 1958 included in the 2005 HSA show the tower to be slightly shorter than Building 4874, but still taller than surrounding utility poles (Figure 2.3.8b). Additional details regarding the structure could not be located.[1,2,3]

Former Use(s): Operational information for Building 4875 is limited. According to the 1988 radiological survey report, Building 4375 was constructed as a test shelter for outside control-rod test towers (Buildings 4874 and 4875). These tests were reported to have been non-nuclear testing of SNAP control rod assemblies in support of the SNAP program. Test operations at Building 4375 proceeded through 1968, according to the survey report. According to the 1988 radiological survey, a radiological survey was performed to clear Building 4375 for non-nuclear use; however, the referenced survey was not located in the available documents received to date. Additionally, it is unknown if the survey included Building 4375 and the control towers (Buildings 4875 and 4874), or only related to Buildings 4373 and 4374, discussed above.[4]

The 1988 radiological survey indicated that handling of radioactive material at the Building 4375 area, including Building 4874, was unknown. As of 1988, it was reported the building was "abandoned and dilapidated," and the surrounding area was cluttered with debris in certain locations. The report stated that after the building was abandoned, barrels were stored in the surrounding areas.[5] The contents of the barrels or from where they originated is unknown. It is also unknown the duration of these storage activities.

[1] ETEC, Document No. GEN-ZR-0012, *Radiological Survey of Buildings T373 and T375*, August 8, 1988.
[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.
[3] Atomics International, Nuclear Development Field Laboratories, January 1, 1967.
[4] ETEC, Document No. GEN-ZR-0012, *Radiological Survey of Buildings T373 and T375*, August 8, 1988.
[5] ETEC, Document No. GEN-ZR-0012, *Radiological Survey of Buildings T373 and T375*, August 8, 1988.

According to the 2005 HSA, Building 4875 was demolished in the early 1970s; however, the report does not provide a citation for this information. The building remains visible on industrial planning maps until 1973 and is removed from maps in 1975.[1,2,3]

Information from Interviewees: There have been no interviews conducted to date regarding Building 4875.

Radiological Incident Reports: None found.

Current Use: As indicated above, the 2005 HSA stated that Building 4874 was demolished in the early 1970s. Aerial photographs from 1972 do not provide enough detail to determine whether the facility has been demolished; however by 1978, it is clear the facility has been removed and concrete pads remain.[4,5] The site is currently vegetated (Figure 2.3.8.a).

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): In 1988, Rocketdyne performed a radiological survey at Building 4375 and the surrounding area to determine if any residual contamination existed. The radiation measurements taken during the survey were compared against the DOE residual radioactivity limits specified in "Guidelines for Residual Radioactivity at FUSRAP and Remote SFMP Sites." The maximum acceptable contamination limits used in 1988 are presented in Section 2.2.5, above.

According to the 1988 radiological survey, the Building 4375 survey included a survey of the gamma exposure rate of the grounds from J to L Streets and from 24th to 22nd Streets, including the former location of Building 4875. Seventy-nine gamma exposure rate measurements were taken surrounding Building 4375. The report indicated that no soil samples were collected because there was no indication of contamination as a result of the gamma exposure rate measurements. As indicated above, the measured ambient gamma limit was < 5 µR/hr above background, which was measured to be between 14 and 16 µR/hr.[6] The maximum measured ambient gamma surrounding Building 4375 was 13.7 µR/hr. The survey concluded that survey results were below the Rocketdyne 1988 acceptable limits and no further inspection was required at Building 4375, including Building 4875.[7]

As reported in the Area IV Radiological Characterization Survey, the area was included in the survey conducted in 1994 and 1995. Located in the central portion of survey block H12, the Building 4875 area ambient gamma survey result measured between 13.0 and 16.2 µR/hr. The survey found background to be 15.6 µR/hr, and the acceptable limit was identified by Rocketdyne as being less than 5 µR/hr above background. Accordingly, survey results in the vicinity of the Building 4875 area were found to be below the then-acceptable limits.[8,1]

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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.
[2] Atomics International, Nuclear Development Field Laboratories, March 1973.
[3] Atomics International, Nuclear Development Field Laboratories, March 1975.
[4] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 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.
[6] According to the 1988 survey report, an average of 38 background measurements were taken at three locations at the SSFL – the Building 4309 area, Well #13 Road, and Incinerator Road.
[7] ETEC, Document No. GEN-ZR-0012, *Radiological Survey of Buildings T373 and T375*, August 8, 1988.
[8] Rocketdyne Document A4CM-ZR-0011, Rev. A, *Area IV Radiological Characterization Survey*, August 15, 1996.

Radiological Use Authorizations: Based on the review of currently available documents, there was no radiological use authorization associated with the operations at Building 4875.

Former Radiological Burial or Disposal Locations: None.

Aerial Photographs: In 1952, the area comprising the future Building 4875 is agricultural farmland. By 1957, the area has become developed with the construction of a building, Building 4363, South of Building 4875. In 1959, the Building 4375 area has been developed and the building structure is visible. The aerial photographs marked 1962/1963 in the aerial photograph interpretation clearly show Building 4875 to the west of Building 4375; however, few additional features are visible as a result of the increased site development.[2] The site appears to be unchanged through 1967 with the appearance of dark-toned material to the north of Building 4874. Limited detail is visible in the 1972 aerial photographs; however, it appears there are construction activities to the east of the Building 4375 area in the future location of Buildings 4473 and 4863. Beginning in 1978, the Building 4875 structure is no longer visible and a concrete pad remains. The aerial photograph interpretation begins to refer to the area as process area 5. Stains, as well as probable storage tanks are visible in this area, comprising Buildings 4363, 4873, 4875, 4375, 4874, 4473, and 4863. A stain is clearly visible to the east of Building 4375 in May 1978. The area to the east of Building 4375 appears to be an area of increased activity. This area continues to contain more materials in subsequent photographs until 1995 when the area, according to the aerial photograph interpretation, appears to be abandoned. By 2003, all structures related to process area 5 have been removed from the location, and by 2005, the area is vegetated.[3]

Radionuclides of Concern: Available documents do not provide information to indicate that high activity radioactive materials were used or stored at Building 4875. As indicated above, Building 4875 was used to support the SNAP program, but does not appear to have been involved in nuclear work. Building 4875 was demolished in the 1970s; however, Building 4375 and surrounding area appears in aerial photographs to have remained active until approximately 1995.[4] After the building area was abandoned, barrels that may have contained radioactive material were stored in the surrounding area; however, information regarding these barrels could not be located.

Drainage Pathways: According to a 1958 engineering drawing, a drainage ditch was located to the east of the Building 4375 and Building 4875 area. The drawing depicted a 4-inch drain line that originated from a drain tank pit near the southeast corner of Building 4375 and terminated at an "existing drainage ditch."[5] Currently, surface water in the vicinity of former Building 4875 drains to the south-southeast to former L Street, then east until former L Street ends, where it then flows southeast into Area III.

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[1] Boeing, Document No. N001SRR140131, *Approved Sitewide Release Criteria for Remediation of Radiological Facility at the SSFL*, February 18, 1999.
[2] The date of the 1962/1963 aerial photographs has been determined to be approximately 1960 plus or minus a year however, the research team will continue to use the dates as they are marked on the aerial photograph figures in the attached report.
[3] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[4] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[5] Atomics International, Drawing 303-375-C1, *Drain Tank Pit and 15HP Pump Installation Bldg #375 Area*, April 4, 1958.

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4875 area is Class 2, due to the unknown nature of its operations in support of the SNAP program and its proximity to Building 4055.

Recommended Locations for Soil/Sediment Sampling: It is recommended this area be evaluated for sampling as part of Building 4375, discussed above.

2.3.9 Building 4473 Area

Note: The 2005 HSA provided very limited information regarding the Building 4473 area, and limited information was available in historical documents and environmental documents received, to date. The following information was cited as having been obtained from a 2003 personnel interview with Dan Trippeda in the 2005 HSA. To date, the research team has not received the transcript of this interview, and, as a result, is presenting information as it has been provided in the 2005 HSA. Requests for additional information regarding Building 4473 are pending. Any new information obtained as a result of these requests will be incorporated into subsequent drafts of the HSA-5D TM.

Site Description: The Building 4473 area includes Building 4473 and the surrounding area located between J and K Street north of Building 4863, discussed below. The building appears to have been under construction in 1972 based on aerial photographs, and was fully constructed by 1978.[1] The building also first appears in the 1972 Atomics International industrial planning map.[2] Figures 2.3.9a through 2.3.9b provide a current photograph and historical photographs of the facility. Plate 1 presents a summary of all identified features for this site.

Building Features: Limited information regarding Building 4473 could be located. The building was part of an extended facility that included Building 4863 and a test stand pad that measured 84 by 66 feet. The test stand pad, according to a fire preplan, comprised a hydraulic test stand, cooling towers, electrical pumps, gaseous nitrogen, electrical substation, offices, control room with computers, liquid storage vessels, and a crane. Building 4473 measured 144 square feet and was constructed of steel with a corrugated steel roof.[3] Undated photographs show an unidentified number of tanks surrounding Buildings 4473 and 4863 (see Figure 2.3.9b).

Former Use(s): Building 4473 is first identified in 1972 Atomic International industrial planning maps as a hydraulic test instrumentation building.[4] As indicated above, the 2005 HSA presented information regarding this facility based on information provided by Dan Trippeda during a September 18, 2003, personnel interview.[5] According to Mr. Trippeda, Building 4473 was part of the Hydraulic Test Facility that was used to conduct preliminary tests on piping, pumps and other loop components. The test facility used water because it has a similar flow rate to liquid sodium. According to Mr. Trippeda, the tests were designed so the researchers could

[1] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[2] Atomics International, Industrial Planning Map Nuclear Development Field Laboratories, May 1972.
[3] Author Unknown, *Fire Preplan – Building 863 Test Stand*, Undated.
[4] Atomics International, Industrial Planning Map Nuclear Development Field Laboratories, May 1972.
[5] Because the research team has not yet received the interview transcript from the 2003 interview, the information presented is paraphrased from information contained in the 2005 HSA.

examine descriptors such as fatigue rates and results such as fracturing of components. Building 4473 served as the control center for the Hydraulic Test Loop (Building 4863).[1]

Based on industrial planning maps, prior to May 1982, the building was identified as a Rockwell-owned facility. In the May 1982 planning map, the hydraulic test facility, including Buildings 4473 and 4863 are located in an area identified as a "government option boundary" and the ownership of the building is noted as being that of the Government. The facility remains to be identified as a hydraulic test instrumentation building.[2] The facility remains to be identified as a Government facility through 1992, with the 1987 map identifying the area as "inducer pump test."[3,4]

Mr. Trippeda was summarized in the 2005 HSA has having said that Building 4473 was demolished in 2003.[5] Aerial photographs also indicate the area comprising Building 4473 and the surrounding buildings were cleared from Area IV in 2003.[6]

Information from Interviewees: There have been no interviews conducted to date regarding Building 4473, with the exception of the personnel interview of Dan Trippeda on September 18, 2003. The research team is in the process of obtaining the transcript from this interview.

Radiological Incident Reports: There have been no radiological incident reports identified for Building 4473.

Current Use: As indicated above, according to Mr. Trippeda, Building 4473 was demolished in 2003.[7]

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): Radiological surveys specific to Building 4473 have not been conducted; however, according to the Area IV Radiological Characterization Survey, the area was included in the survey conducted in 1994 and 1995. Located in the central portion of survey block H13, the Building 4473 area ambient gamma survey result measured between 7.8 and 16.0 µR/hr. The survey found background to be 15.6 µR/hr, and the acceptable limit was identified by Rocketdyne as being less than 5 µR/hr above background. Accordingly, survey results in the vicinity of the Building 4473 area were found to be below the then-acceptable limits.[8,9]

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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. Citing Personnel Interview, Dan Trippeda, September 18, 2003.

[2] Energy Systems Group, Industrial Planning Map Santa Susana Field Laboratory, May 1982.

[3] ETEC, Drawing No. M000-68347-01, Santa Susana Field Laboratory ETEC Site Development Map, February 12, 1987.

[4] ETEC, Drawing No. GEN-CA-0001, SSFL Area IV Site Map, November 11, 1992.

[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. Citing Personnel Interview, Dan Trippeda, September 18, 2003.

[6] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.

[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. Citing Personnel Interview, Dan Trippeda, September 18, 2003.

[8] Rocketdyne Document A4CM-ZR-0011, Rev. A, *Area IV Radiological Characterization Survey*, August 15, 1996.

[9] Boeing, Document No. N001SRR140131, *Approved Sitewide Release Criteria for Remediation of Radiological Facility at the SSFL*, February 18, 1999.

Radiological Use Authorizations: There have been no use authorizations identified for Building 4473.

Former Radiological Burial or Disposal Locations: As indicated above, Building 4473 was located in the former location of the Building 4363 leach field. This leach field is not associated with any operations in Building 4473.

Aerial Photographs: In 1952, the area comprising the future Building 4473 is agricultural farmland. The 1957 area photographs shows a linear ground scar leading just north of the future Building 4473 area to the intersection of 22nd and L Street. This ground scar appears to correspond to a drainage channel referenced in Building 4375 construction drawings. The area remains undeveloped until 1972 aerial photographs with the appearance of construction activities to the east of the Building 4375 area in the future location of Buildings 4473 and 4863. Beginning in 1978, the aerial photograph interpretation begins to refer to the area as process area 5. Stains, as well as probable storage tanks are visible in this area, comprising Buildings 4363, 4873, 4875, 4375, 4874, 4473, and 4863. The area to the west of Building 4473 appears to be an area of increased activity. This area continues to contain more materials in subsequent photographs until 1995 when the area, according to the aerial photograph interpretation, appears to be abandoned. By 2003, all structures related to process area 5 have been removed from the location, and by 2005, the area is vegetated.[1]

Radionuclides of Concern: Based on the limited historical information available, it does not appear radionuclides were used at Building 4473.

Drainage Pathways: Aerial photographs appear to show the establishment of a drainage channel in the vicinity of the Building 4473 area in 1957. The drainage channel extended to the north of Building 4473, eastward to the intersections of L and 22nd Streets. Currently, surface water in the vicinity of former Building 4473 drains to the south-southeast into the ditch on the north side of former L Street, then east until former L Street ends, where it then flows southeast into Area III

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4473 area is Class 3 because the likeliness of radiological contamination as a result of building operations is low based on available information.

Recommended Locations for Soil/Sediment Sampling: Plate 1 and Figure 2.3 provide a convenient reference for the following recommendations.

Based on the available information, soil sampling is recommended in the Building 4473 area. Very limited information regarding the operations of Building 4473 have been located, to date. Significant information regarding the disposal and demolition of the building is lacking.

There have been no previous characterization studies for the Building 4473 area. Therefore, additional characterization is recommended for the Building 4473 area. This includes the following Building 4473 areas and appurtenances:

[1] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.

- The former Building 4473 location. Limited information is available regarding the building's operations. The area comprising the Building 4473 area included numerous above ground storage tanks.

2.3.10 Building 4863 Area

Site Description: The Building 4863 area includes Building 4863 and the surrounding area south of J Street, and northeast of the Building 4363 area. Building 4863 was part of the hydraulic test facility and appears to have been constructed in the vicinity of the former Building 4363 leach field, or slightly to the east of it.[1] Figure 2.3.10a provides a current photograph of the facility, and Figure 2.3.10b provides a series of undated photographs of the facility. Plate 1 presents a summary of all identified features for this site.

Building Features: Constructed in approximately 1971, Building 4863 was a 396-square foot facility. According to the 1987 site consolidation report, the building was an open test stand structure.[2] The frame, siding, and roof of the facility were steel and were anchored to a concrete pad. The building was elevated approximately 30 feet off the ground level and was accessed by a steel stairway on the west side. The building was part of an extended facility that included Building 4473 and a test stand pad that measured 84 by 66 feet. The test stand pad, according to a fire preplan, comprised a hydraulic test stand, cooling towers, electrical pumps, gaseous nitrogen, electrical substation, offices, control room with computers, liquid storage vessels, and a crane.[3] In addition, the hydraulic test facility included five storage tanks (Tanks T-1, T-5, T-12, T-156, and an unnumbered tank) that each contained deionized water. The tanks had a total capacity of 37,000 gallons.[4] A map showing the locations of each of these tanks was not located.

Former Use(s): Building 4863 is first identified in 1972 Atomic International industrial planning maps as a hydraulic test loop building.[5] The 2005 HSA presented information regarding this facility based on information provided by Dan Trippeda during a September 18, 2003, personnel interview.[6] According to Mr. Trippeda, Building 4863 was part of the Hydraulic Test Facility that was used to conduct preliminary tests on piping, pumps and other loop components. The test facility used water because it has a similar flow rate to liquid sodium. According to Mr. Trippeda, the tests were designed so the researchers could examine descriptors such as fatigue rates and results such as fracturing of components. Building 4863 served as the experimental test loop.[7]

Based on industrial planning maps, prior to May 1982, the building was identified as a Rockwell-owned facility. In the May 1982 planning map, the hydraulic test facility, including Buildings 4863 and 4473 are located in an area identified as a "government option boundary"

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[1] Atomics International, Drawing No. 303-GEN-C18, *Central Sewage System Plan & Topography*, August 27, 1959.
[2] Stafford, K.T., ETEC, *Site Consolidation Assessment*, April 16, 1987.
[3] Author Unknown, *Fire Preplan – Building 863 Test Stand*, Undated.
[4] Tavasoli, K., Rockwell International Internal Letter Re: SSFL Aboveground Storage Tank/Pressure Vessel Inspection, May 18, 1993.
[5] Atomics International, Industrial Planning Map Nuclear Development Field Laboratories, May 1972.
[6] Because the research team has not yet received the interview transcript from the 2003 interview, the information presented is paraphrased from information contained in the 2005 HSA.
[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. Citing Personnel Interview, Dan Trippeda, September 18, 2003.

and the ownership of the building is noted as being that of the Government. The facility remains to be identified as a hydraulic test loop.[1] The facility remains to be identified as a Government facility through 1992.[2,3]

According to a 1992 NEPA compliance activities status report included in the 1992 annual site environmental report, Building 4863 was placed on "inactive standby facility maintenance" on September 29, 1992; however, additional information regarding the maintenance operations required could not be located in the documents received.[4] Mr. Trippeda was summarized in the 2005 HSA has having said that Building 4863 was demolished in 2003.[5] Aerial photographs also indicate the area comprising Building 4863 and the surrounding buildings were cleared from Area IV in 2003.[6]

Information from Interviewees: There have been no interviews conducted to date regarding Building 4863, with the exception of the personnel interview of Dan Trippeda on September 18, 2003. The research team is in the process of obtaining the transcript from this interview.

Radiological Incident Reports: There have been no radiological incident reports identified for Building 4863.

Current Use: As indicated above, according to Mr. Trippeda, Building 4863 was demolished in 2003.[7]

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): Radiological surveys specific to Building 4863 have not been conducted; however, according to the Area IV Radiological Characterization Survey, the area was included in the survey conducted in 1994 and 1995. Located in the southwest corner of survey block H13, the Building 4863 area ambient gamma survey result measured between 6.0 and 12.2 µR/hr. The survey found background to be 15.6 µR/hr, and the acceptable limit was identified by Rocketdyne as being less than 5 µR/hr above background. Accordingly, survey results in the vicinity of the Building 4863 area were found to be below the then-acceptable limits.[8,9]

Radiological Use Authorizations: There have been no use authorizations identified for Building 4863.

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[1] Energy Systems Group, Industrial Planning Map Santa Susana Field Laboratory, May 1982.
[2] ETEC, Drawing No. M000-68347-01, Santa Susana Field Laboratory ETEC Site Development Map, February 12, 1987.
[3] ETEC, Drawing No. GEN-CA-0001, SSFL Area IV Site Map, November 11, 1992.
[4] Rockwell International, Document No. RI/RD93-125, *Rocketdyne Division Annual Site Environmental Report* 1992, December 14, 1993.
[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. Citing Personnel Interview, Dan Trippeda, September 18, 2003.
[6] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[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. Citing Personnel Interview, Dan Trippeda, September 18, 2003.
[8] Rocketdyne Document A4CM-ZR-0011, Rev. A, *Area IV Radiological Characterization Survey*, August 15, 1996.
[9] Boeing, Document No. N001SRR140131, *Approved Sitewide Release Criteria for Remediation of Radiological Facility at the SSFL*, February 18, 1999.

Former Radiological Burial or Disposal Locations: Like Building 4473, Building 4863 was located in the former location of the Building 4363 leach field. This leach field is not associated with any operations in Building 4863.

Aerial Photographs: In 1952, the area comprising the future Building 4863 is agricultural farmland. The 1957 area photographs shows a linear ground scar leading just north of the future Building 4473 and 4863 area eastward to the intersection of 22nd and L Street. This ground scar appears to correspond to a drainage channel referenced in Building 4375 construction drawings. The area remains undeveloped until 1972 aerial photographs with the appearance of construction activities to the east of the Building 4375 area in the future location of Buildings 4863 and 4473. Beginning in 1978, the aerial photograph interpretation begins to refer to the area as process area 5. Stains, as well as probable storage tanks are visible in this area, comprising Buildings 4363, 4873, 4875, 4375, 4874, 4473, and 4863. The area to the west of Building 4863 appears to be an area of increased activity. This area continues to contain more materials in subsequent photographs until 1995 when the area, according to the aerial photograph interpretation, appears to be abandoned. By 2003, all structures related to process area 5 have been removed from the location, and by 2005, the area is vegetated.[1]

Radionuclides of Concern: Based on the limited historical information available, it does not appear radionuclides were used at Building 4863.

Drainage Pathways: Aerial photographs appear to show the establishment of a drainage channel in the vicinity of the Building 4863 area in 1957. The drainage channel extended to the north of Buildings 4863 and 4473, eastward to the intersections of L and 22nd Streets. Currently, surface water in the vicinity of former Building 4863 flows to the south-southeast into the ditch on the north side of former L Street, then east until former L Street ends, where it then flows southeast into Area III.

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4863 area is Class 3 because the likeliness of radiological contamination as a result of building operations is low based on available information.

Recommended Locations for Soil/Sediment Sampling: Plate 1 and Figure 2.3 provide a convenient reference for the following recommendations.

Based on the available information, soil sampling is recommended in the Building 4863 area. Very limited information regarding the operations of Building 4863 has been located, to date. Significant information regarding the disposal and demolition of the building is lacking.

There have been no previous characterization studies for the Building 4863 area. Therefore, additional characterization is recommended for the Building 4863 area. This includes the following Building 4863 areas and appurtenances:

- The former Building 4863 location. Limited information is available regarding the building's operations. The area comprising the Building 4863 area included numerous above ground storage tanks.

[1] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.

2.3.11 Building 4873 Area

Site Description: The Building 4873 area comprises Building 4873 and the surrounding area just north of Building 4363 at the northeast corner of 24th and L Streets. This building was located outside the boundaries of the U.S. Government-optioned land at the SSFL Site. Building 4873 appears to have been constructed prior to 1958 as an "Installation of OMR Mock-Up Fuel Handling."[1,2] Figures 2.3.11a through 2.3.11c 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 is limited available information regarding the features of Building 4873. According to an undated Atomics International drawing of the bridge and index arrangement of the building, and a 1958 aerial oblique photograph of the area, the building appears to have been a tall open steel structure (see Figure 2.3.11d) located just north of Building 4363.[3,4] Additionally, aerial photographs appear to show the building to have been connected by aboveground pipelines to Building 4363.[5] The purpose of these pipelines is unknown.

Former Use(s): The 2005 HSA presented information regarding this facility based on information provided by Phil Rutherford and Del Aubuchon during September 18, 2003, personnel interviews.[6] According to the Mr. Rutherford and Mr. Aubuchon, Building 4873 served as part of the hydraulic test facility as the hydraulic test laboratory and was where the engineers established the parameters of the experiments. The building was part of the Hydraulic Test Facility that was used to conduct preliminary tests on piping, pumps and other loop components. The test facility used water because it has a similar flow rate to liquid sodium.[7]

An undated drawing identifies this facility as an "Installation of OMR Mock-Up Fuel Handling," and this facility appears to have been constructed prior to 1958.[8,9] The March 15, 1962, industrial planning map refers to "873" as a "pad at Bldg 363." In 1967, the building is labeled as a "fuel rod test tower and pad." By 1971, industrial planning maps identify the building as a hydraulic test lab and it remains identified as such through 1991, the last available ETEC site map. Unlike Buildings 4473 and 4863, discussed above, Building 4873 was owned by Rockwell during its entire operational period.[10,11,12,13]

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[1] Atomics International, Drawing No. 303-873-S5, *Installation of OMR Mock-Up Fuel Handling Bridge and Index Arrangement #875*, Date Illegible.
[2] Unknown Photographer, Aerial Oblique Photograph of SSFL dated November 11, 1958
[3] Atomics International, Drawing No. 303-873-S5, *Installation of OMR Mock-Up Fuel Handling Bridge and Index Arrangement #875*, Date Illegible.
[4] Unknown Photographer, Aerial Oblique Photograph of SSFL dated November 11, 1958
[5] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[6] Because the research team has not yet received the interview transcript from the 2003 interviews, the information presented is paraphrased from information contained in the 2005 HSA.
[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. Citing Personnel Interview, Del Aubuchon, September 18, 2003, and Personnel Interview, Phil Rutherford, September 18, 2003.
[8] Atomics International, Drawing No. 303-873-S5, *Installation of OMR Mock-Up Fuel Handling Bridge and Index Arrangement #875*, Date Illegible.
[9] Unknown Photographer, Aerial Oblique Photograph of SSFL dated November 11, 1958
[10] Atomics International, Nuclear Development Field Laboratories, Industrial Planning, March 15, 1962.
[11] Atomics International, Nuclear Development Field Laboratories, January 1, 1967.
[12] Atomics International, Nuclear Development Field Laboratories, April 1, 1971.
[13] Rockwell International, Drawing No. GEN-CA-0001, ETEC Site Map, February 19, 1991.

Information from Interviewees: There have been no interviews conducted to date regarding Building 4873, with the exception of the personnel interviews of Dan Trippeda, Phil Rutherford, and Del Aubuchon on September 18, 2003. The research team is in the process of obtaining the transcript from these interviews.

Radiological Incident Reports: There have been no radiological incident reports identified for Building 4873.

Current Use: According to Mr. Trippeda, Building 4873 was demolished in 2003; however, available documents that have been reviewed have not provided a final demolition date.[1] A November 15, 2000, addendum to the demolition contract noted that the demolition of Building 4873 included the removal of an 8-inch municipal water line located on the north side of the Building 4873 foundation. The line was to be removed to the point of intersection with a concrete pad and/or road.[2] In September 2001, the removal was further modified to include the construction of an access vault at the water shutoff valve to allow future access. It was estimated that there was 125 linear feet of underground water piping.[3]

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): Radiological surveys specific to Building 4873 have not been conducted; however, according to the Area IV Radiological Characterization Survey, the area was included in the survey conducted in 1994 and 1995. Located in the southern portion of survey block H12, the Building 4873 area ambient gamma survey result measured between 11.0 and 16.1 µR/hr. The survey found background to be 15.6 µR/hr, and the acceptable limit was identified by Rocketdyne as being less than 5 µR/hr above background. Accordingly, survey results in the vicinity of the Building 4873 area were found to be below the then-acceptable limits.[4,5]

Radiological Use Authorizations: There is no evidence to indicate the operations in Building 4873 were authorized by any use authorizations.

Former Radiological Burial or Disposal Locations: There are no radiological burial or disposal locations identified at Building 4873.

Aerial Photographs: In 1952, the area comprising the future Building 4873 area is agricultural land. By 1957, two buildings have been constructed in the Building 4873 area, including Building 4363 and what appears to be an elevated pad in the location of Building 4873. In August 1959, Building 4873 appears to be more developed with a larger structure being present. 1962/1963 photographs appear to show the presence of possible overhead pipelines connecting Building 4873 with Building 4363. Beginning in 1978, the aerial photograph interpretation begins to refer to the area as process area 5. Stains, as well as probable storage tanks are visible in this area, comprising Buildings 4363, 4873, 4875, 4375, 4874, 4473, and 4863. This area

[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. Citing Personnel Interview, Dan Trippeda, September 18, 2003.
[2] Boeing, *Building(s) 4363, 4375, and 4873 Addendum to Demolition Contract*, November 15, 2000.
[3] Boeing, *Building(s) 4353, 4363, 4375 and 4873 Addendum to Demolition Contract*, September 4, 2001.
[4] Rocketdyne Document A4CM-ZR-0011, Rev. A, *Area IV Radiological Characterization Survey*, August 15, 1996.
[5] Boeing, Document No. N001SRR140131, *Approved Sitewide Release Criteria for Remediation of Radiological Facility at the SSFL*, February 18, 1999.

remained active through the early 1990s. In 1995 the area appears to no longer be active, and the Building 4873 structure no longer appears to be present. By 2003 all structures related to this processing area have been removed. By 2005 the former Building 4873 area is vegetated.[1]

Radionuclides of Concern: Based on the limited historical information available, it does not appear radionuclides were used at Building 4873.

Drainage Pathways: 1957 site drawings and plot plans show a drainage ditch beginning at the southwest corner of the building, then flowing north along the west end of the building, then flowing east along the northern boundary of the building to an area east of the building where the drawing indicates that the ditch should be run "so drainage will discharge to south of building."[2] (See Figure 2.3.11e.) Currently, surface water within the vicinity of former Building 4873 drains to the southeast into the ditch on the north side of former L Street. Surface water then runs east along former L Street till it dead ends, where it then flows southeast into Area III.

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4873 is Class 2 based on limited available historical information and the proximity of the building to Building 4363.

Recommended Locations for Soil/Sediment Sampling: Plate 1 and Figure 2.3 provide a convenient reference for the following recommendations.

Based on the available information, soil sampling is recommended in the Building 4873 area. Very limited information regarding the operations of Building 4873 has been located, to date. Significant information regarding the disposal and demolition of the building is lacking.

There have been no previous characterization studies for the Building 4873 area. Therefore, additional characterization is recommended for the Building 4873 area. This includes the following Building 4873 areas and appurtenances:

- The former Building 4873 location. Limited information is available regarding the building's operations. Based on aerial photographs, the building was an open steel structure and included possible above ground pipelines that were connected to Building 4363. The purpose of the pipelines could not be determined from available documents.

2.4 GROUP 4

The Group 4 index map is presented in Figure 2.4. Group 4 includes is located in HSA-5D South and includes two water storage tanks (Tank 4701 and 4702) and the borrow area. Limited information is available regarding these areas.

Tank 4701 and Tank 4702

Tanks 4701 and 4702 are located on the ridgeline along the southern edge of Area IV. The tanks have been used to store water for use at the SSFL. Facility drawings show that waterlines to

[1] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[2] Atomics International, Drawing No. 303-363-C13, *Grading and Plot Plan, Building 363 Remodel*, 1957.

buildings originate from the pipeline leading from the two tanks. According to the 2005 HSA, Dan Trippeda indicated that water only flowed out from the tanks. Documents could not be located to indicate how the tanks were refilled or the capacities of each tank. There have been no radiological surveys specific to Tanks 4701 or 4702 conducted, and available documents did not identify any use authorizations or incident reports relating to the tanks. Both tanks remain standing at the site.[1]

Aerial photographs show the presence of a single vertical tank on the ridgeline as early as 1957. An aboveground pipeline leads from the tank to the base of the ridge, where it appears to go underground. Ground scarring is visible from the tank to 24th Street. Beginning in 1965, a second tank is visible to the west of the first tank. This new tank is no longer visible in 1967; however a larger tank has been placed adjacent to the west side of the 1957-era tank. The site remains relatively unchanged through 2005, where the tanks remain visible.[2]

Process water used at the SSFL was obtained from wells and stored in 50,000 gallon tanks.[3]

As a result of the limited information available regarding these tanks, and their remoteness from radiologically controlled facilities, the preliminary MARSSIM Classification for Tanks 4701 and 4702 is Class 3. There are no recommended sampling locations for either of these tanks.

[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. Citing Personnel Interview, Dan Trippeda, September 18, 2003.
[2] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[3] Incomplete Document regarding "North American Aviation Inc., Atomics International Involvement in Atomic Energy Research and Development since 1946," Date unknown.

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 U-235 for use in fission counter tubes. License No. SNM-21 was renewed, extended, and/or 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 Commission (NRC) and License No. SNM-21 became an NRC license. License No. SNM-21 applied to contractor owned facilities, only, located outside the former ETEC boundary. Buildings 4020 and 4055, within Subarea HSA-5D, operated under License No. SNM-21.

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), which is adjacent to the HSA-5D subarea. 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 micro curies total
Hydrogen-3	Titanium tritide foil (U.S. Nuclear Corporation)	500 mill curies
Hydrogen-3	Titanium tritide foil (U.S. Radium Corporation)	1 curie
Strontium-90	Sealed source (U.S. Nuclear Corporation Model 312)	5 micro curies
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 micro curies
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 mill curies each
Americium-241	Any	2 mill curies
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 Building 4020, the Hot Laboratory, and Building 4055, the Nuclear Materials Development Lab, as well as up to four other facilities in Subarea HSA-5D that may have been involved in the use

of radioactive materials. 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 micro curies
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 micro curies 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.

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.

Table 3.3
Summary of Subarea HSA-5D Sites
Radionuclides of Concern

Site No.	Use(s)	Current Status	Potential Radionuclides 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

Table 3.3 (continued)
Summary of Subarea HSA-5D Sites
Radionuclides of Concern

Site No.	Use(s)	Current Status	Potential Radionuclides of Concern	MARSSIM Class
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
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

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4.0 REACTOR/CRITICALITY FACILITIES/SIGNIFICANT SITES WORKS CITED

4.1 BUILDING 4020

Facility Name	Building No.	Period of Operation	Notes
Hot Laboratory	4020	1959–1996	

Building 4020 Cited Documents

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4.2 BUILDING 4055

Facility Name	Building No.	Period of Operation	Notes
Nuclear Materials Development Facility	4055	1967-1977	

Building 4055 Cited Documents

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4.3 BUILDING 4373

Facility Name	Building No.	Period of Operation	Notes
SNAP Critical Facility	4373	1956 -	Critical Test Assembly

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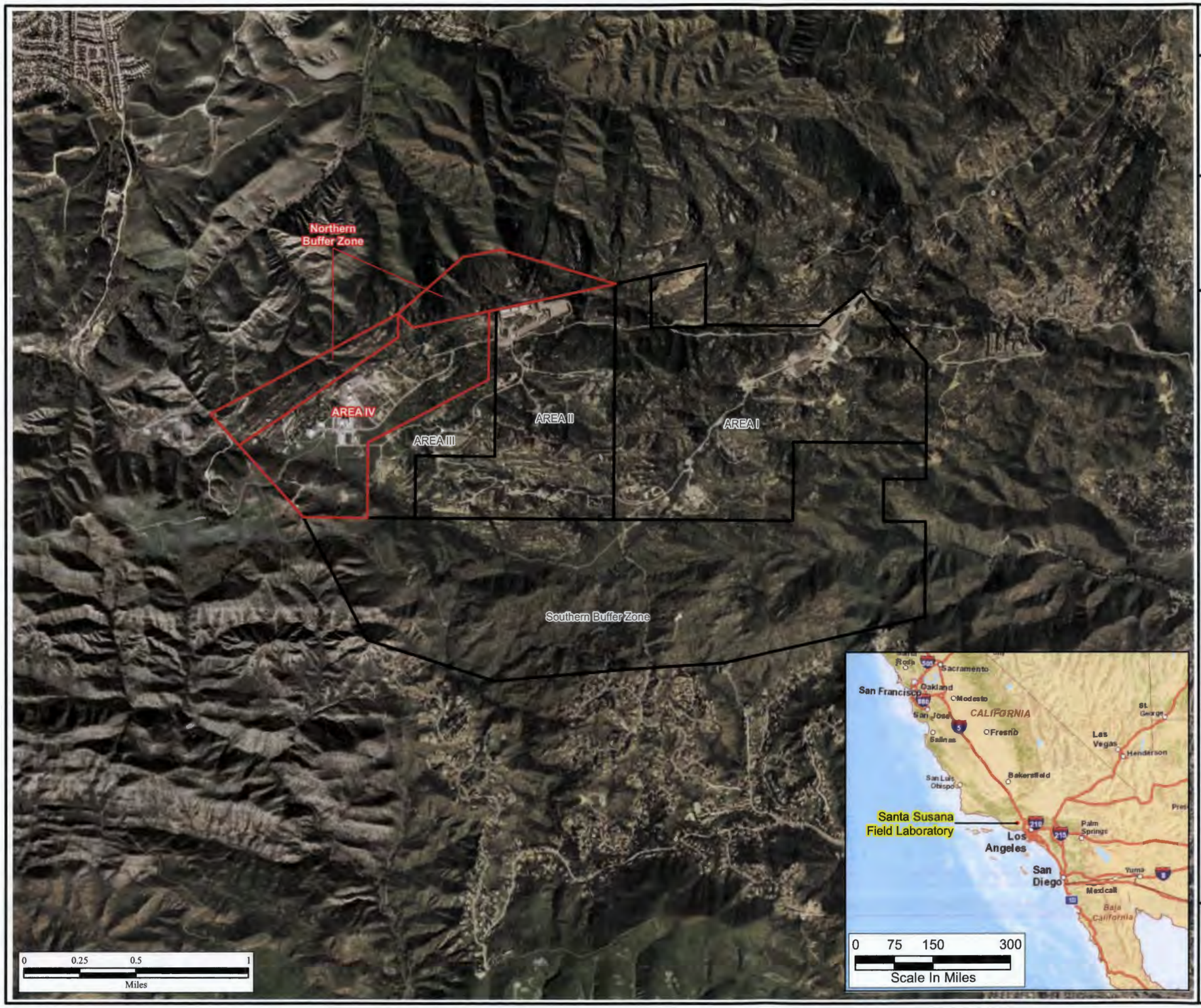
FIGURES

PARTIALLY SCANNED
OVERSIZE ITEM(S)

See document # 2266488
for partially scanned image(s).
PLATE 1
SUBAREA HSA - 5D
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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HGL HydroGeoLogic Inc

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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

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(1-02)site_layout.mxd
11/22/2011 tjansen
Project: EP9038
Sorce: Boeing Company, 2008
CIRGIS, 2007

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Figure 1.3
Subarea HSA-5D
Santa Susana Field Laboratory

U.S. EPA Region 9

Legend

Buildings

- Existing
- Removed
- Lined Channel
- Intermittent Stream*
- Pipe (Unknown Type)
- Surface Water Flow
- Drainage Divide

*Intermittent streams also represent unlined channels.

N

0 100 200 400

Scale In Feet

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Project: EP9038
Source:Boeing Company, 2008
CIRGIS, 2007

HGL HydroGeoLogic, Inc.

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Figure 2.1
Area IV Subarea 5D-1
Santa Susana Field Laboratory

U.S. EPA Region 9

Legend

- Subarea 5D-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
- Proposed Sampling Locations
- 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

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Sorce: Boeing Company, 2008
CIRGIS, 2007

HGL HydroGeoLogic, Inc

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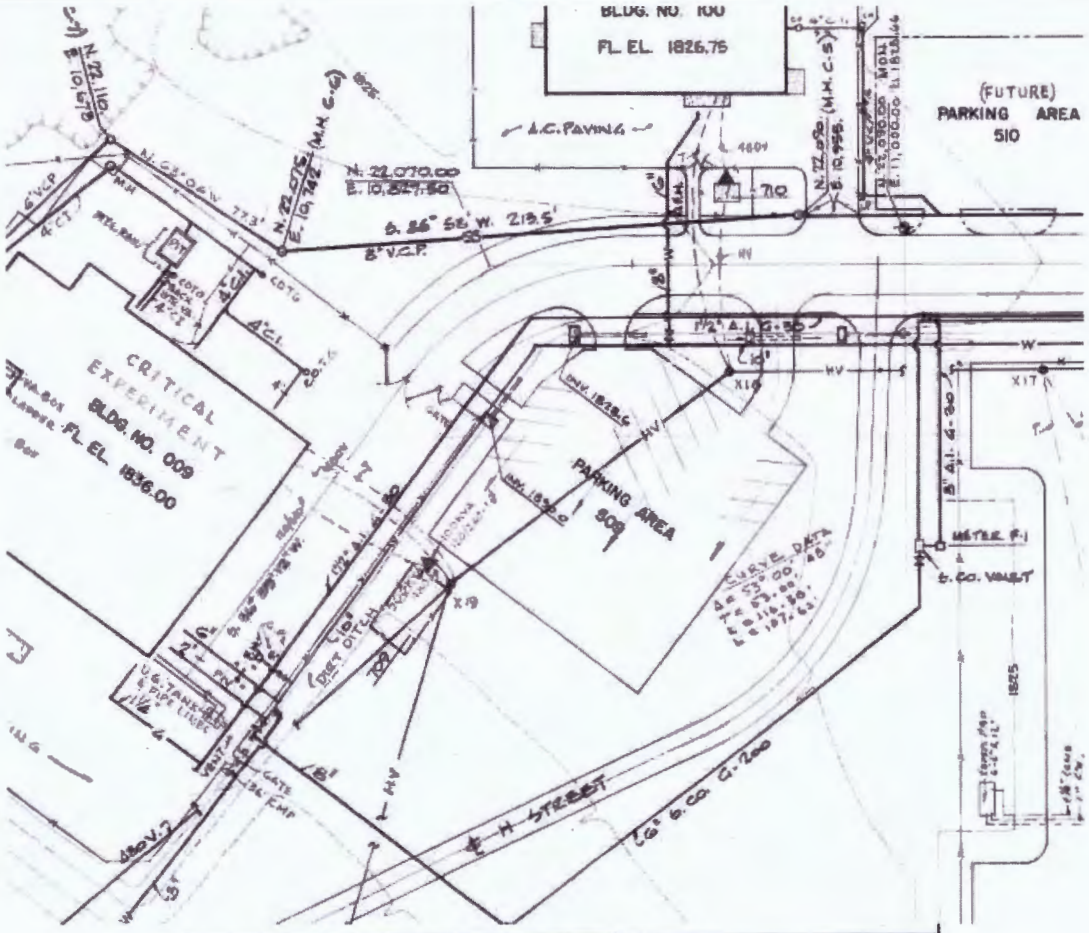
Project:EP9038
Revised: 03/23/2011 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.1a
Parking Lot 4509
Site Photograph



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SANTA SUSANA FACILITY
PLOT PLAN

DRAWN	HAMMAN	DWG. SIZE E	303-GEN.-C 45
CHECKED			
ENGINEER	R.P.HAMMAN	SCALE 1"=40'	SHEET NO. 11 OF 14
APPROVED			

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Revised: 03/21/2011 TJ
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Figure 2.1.1b
Parking Lot 4509
Plot Plan

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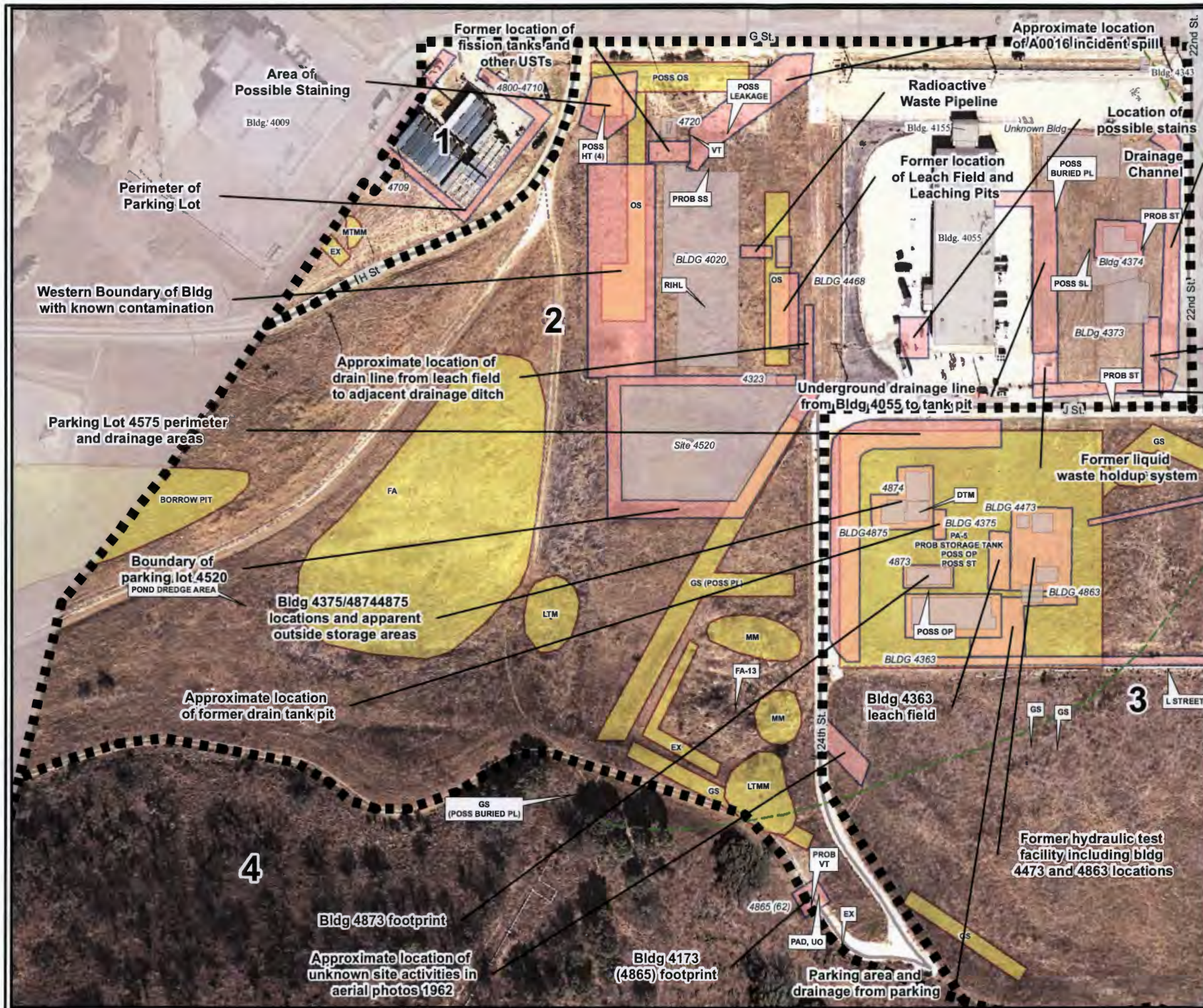
Figure 2.1.1c
Parking Lot 4509
Undated Aerial Oblique



Historical Site Assessment
Final Technical Memorandum - HSA-5D

Figure 2.2
Area IV Subarea 5D-2
Santa Susana Field Laboratory

U.S. EPA Region 9

Legend

- Subarea 5D-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
- Proposed Sampling Locations
- 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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U.S. EPA Region 9

Figure 2.2.1a
Building 4020
Site Photograph

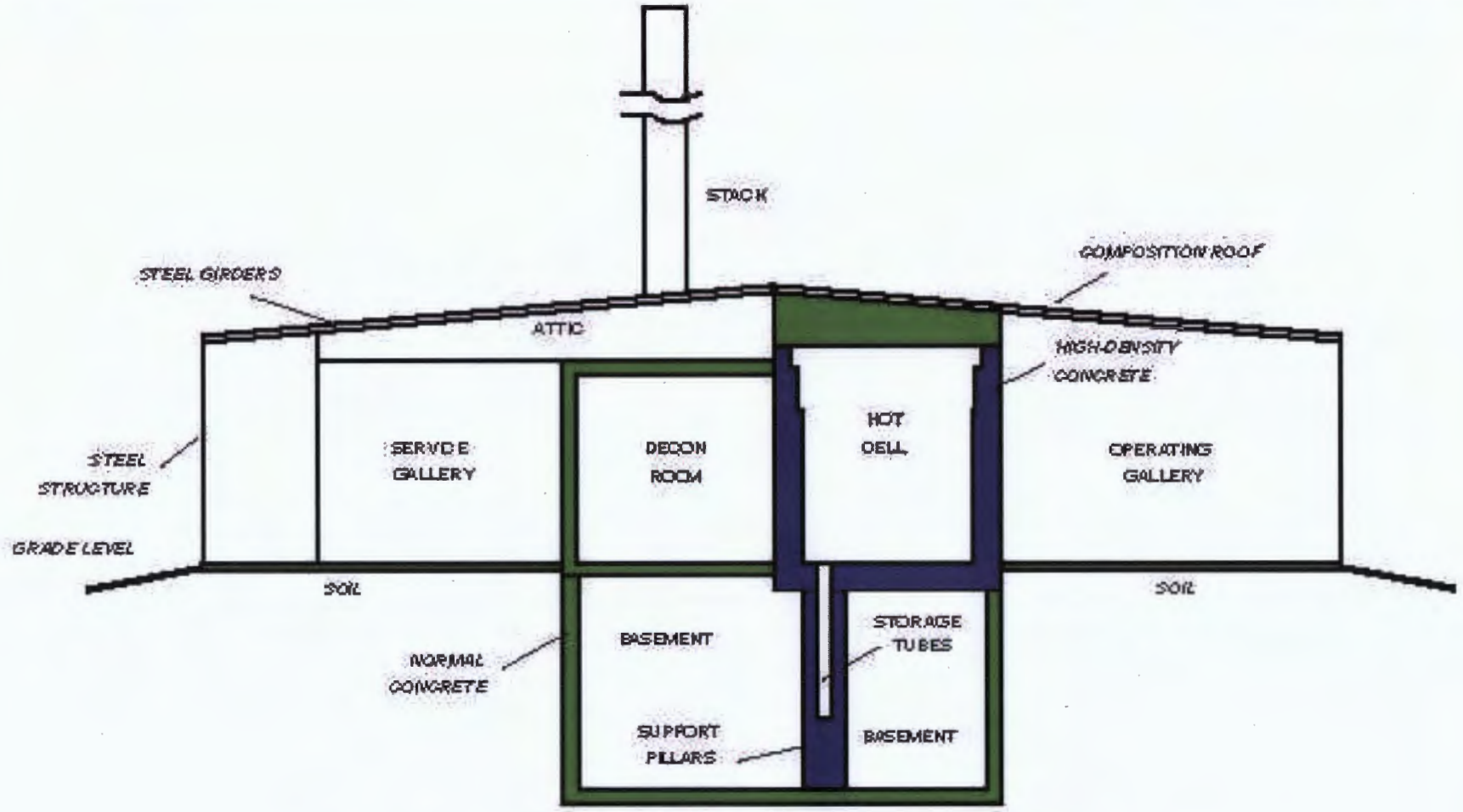

Figure 2-2. Elevation View of Building 4020, Showing the Geometry of the Hot Cells, Decon Rooms, and Basement.

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Project:EP9038
Revised: 03/24/2011 TJ
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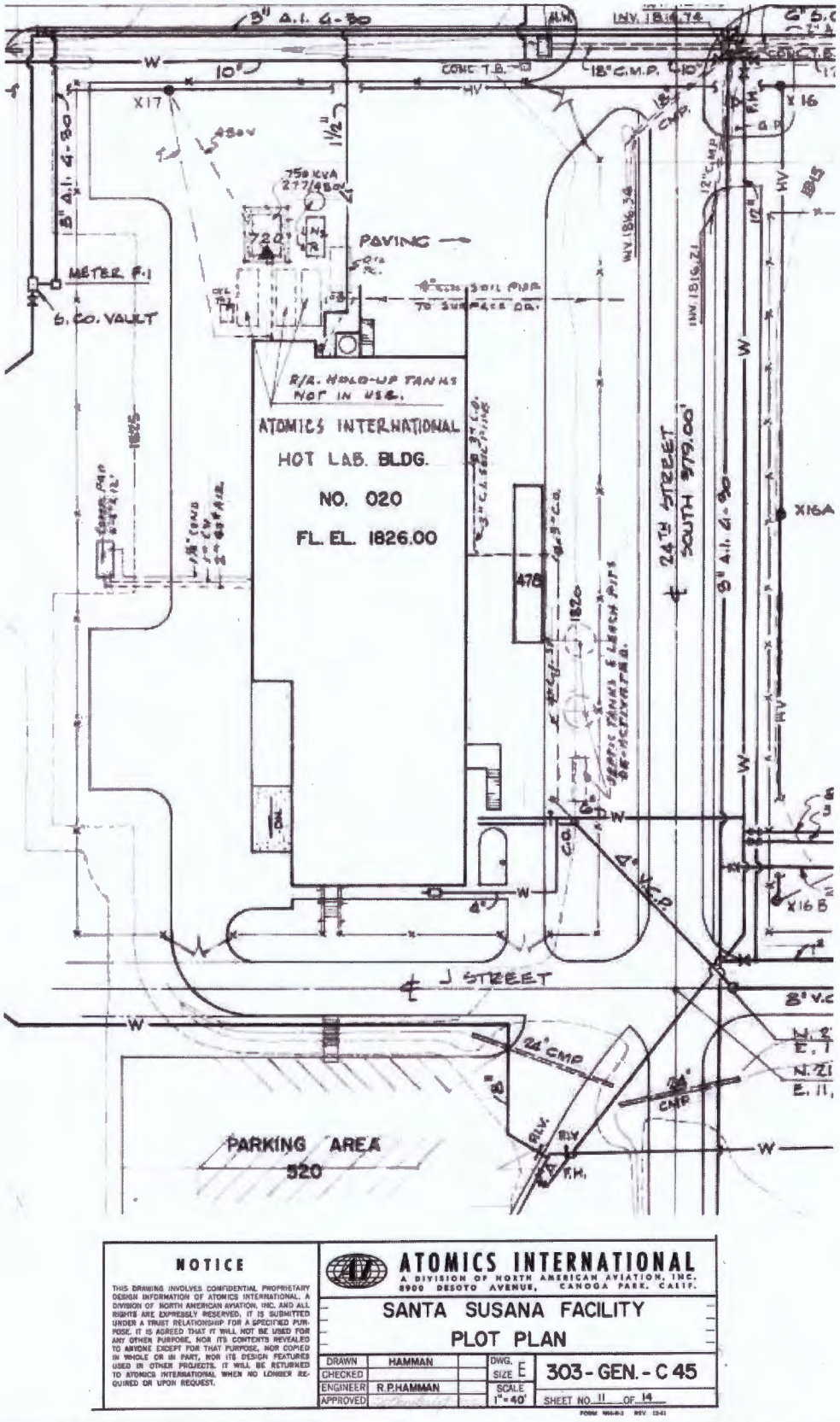
U.S. EPA Region 9

Figure 2.2.1b
Building 4020
Elevation View



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Revised: 03/21/2011 TJ
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Figure 2.2.1c
Building 4020
Plot Plan

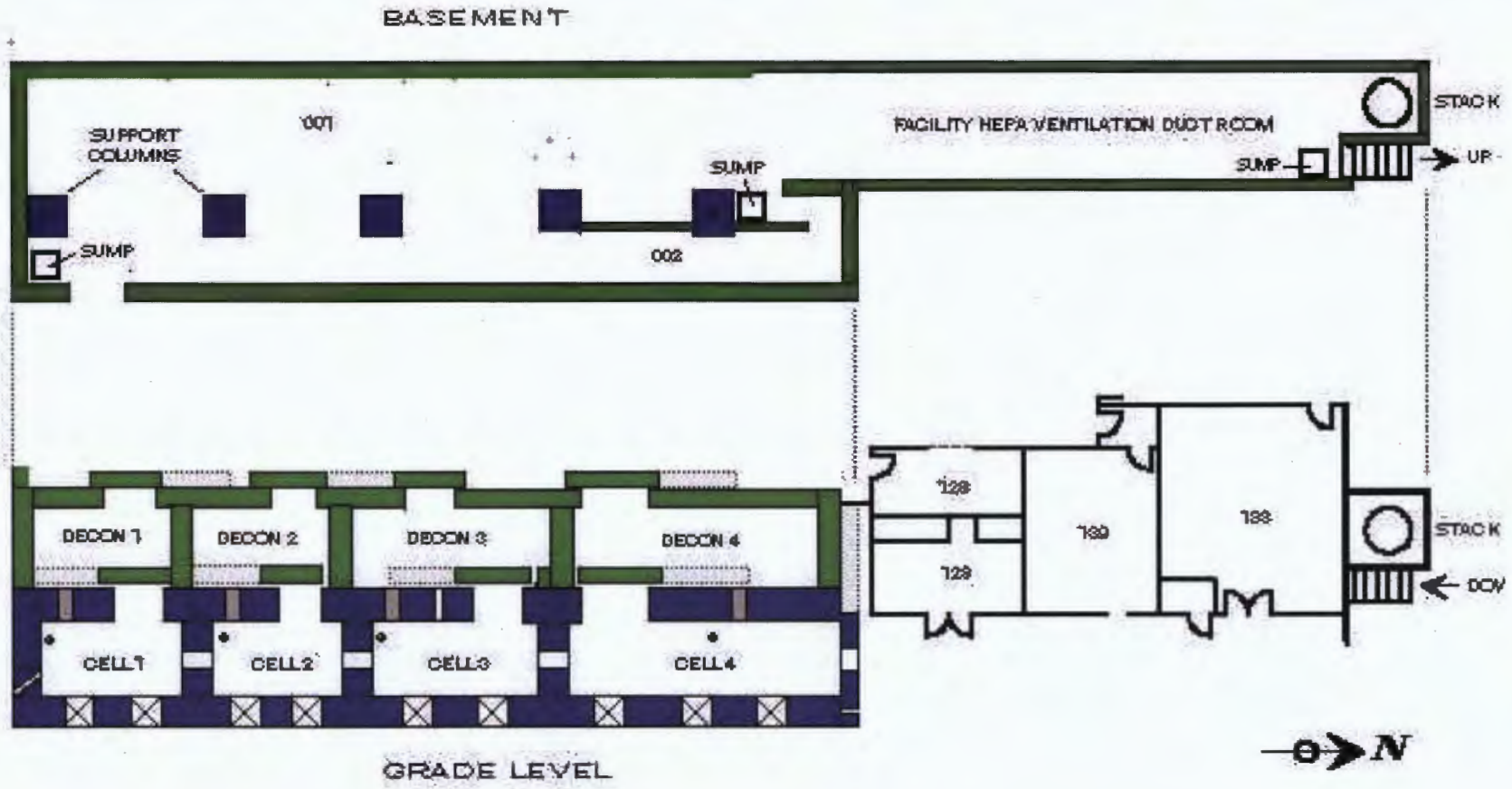
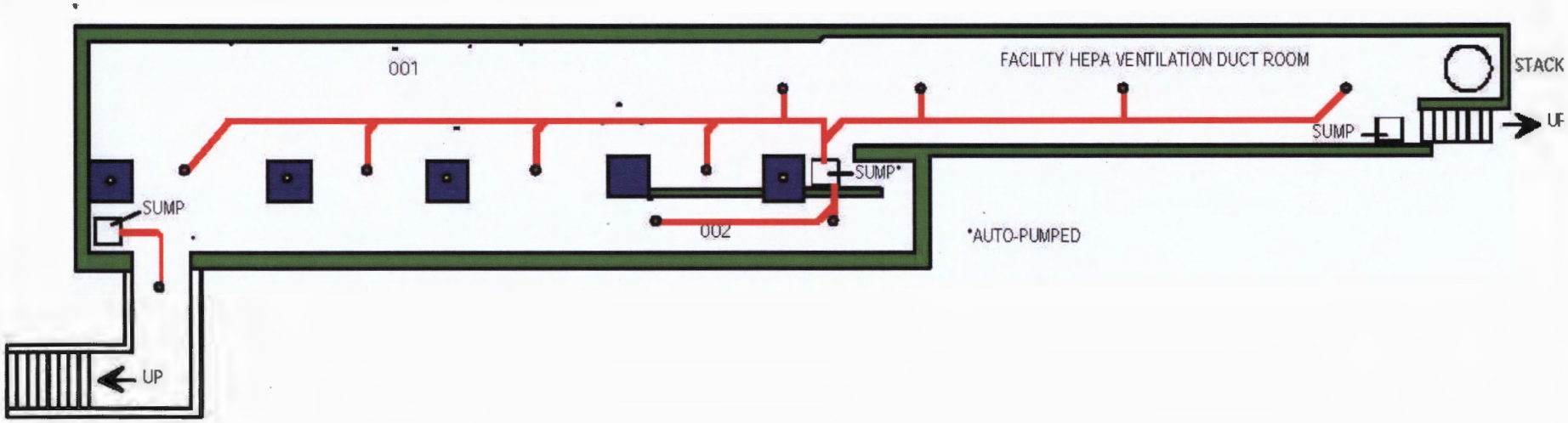


Figure 2-4. Plan View of the Building 4020 Basement, Shown Relative to the Hot Cells and Decon Room.

Y:/Santa_Susana/EP9038/TM/HSA_5D (2-2-1d)Bldg4020BP.cdr *Project:EP9038* *Revised: 03/24/2011 TJ* *Source: Boeing Company, 2008* **U.S. EPA Region 9**		**Figure 2.2.1d** **Building 4020** **Basement Plan**



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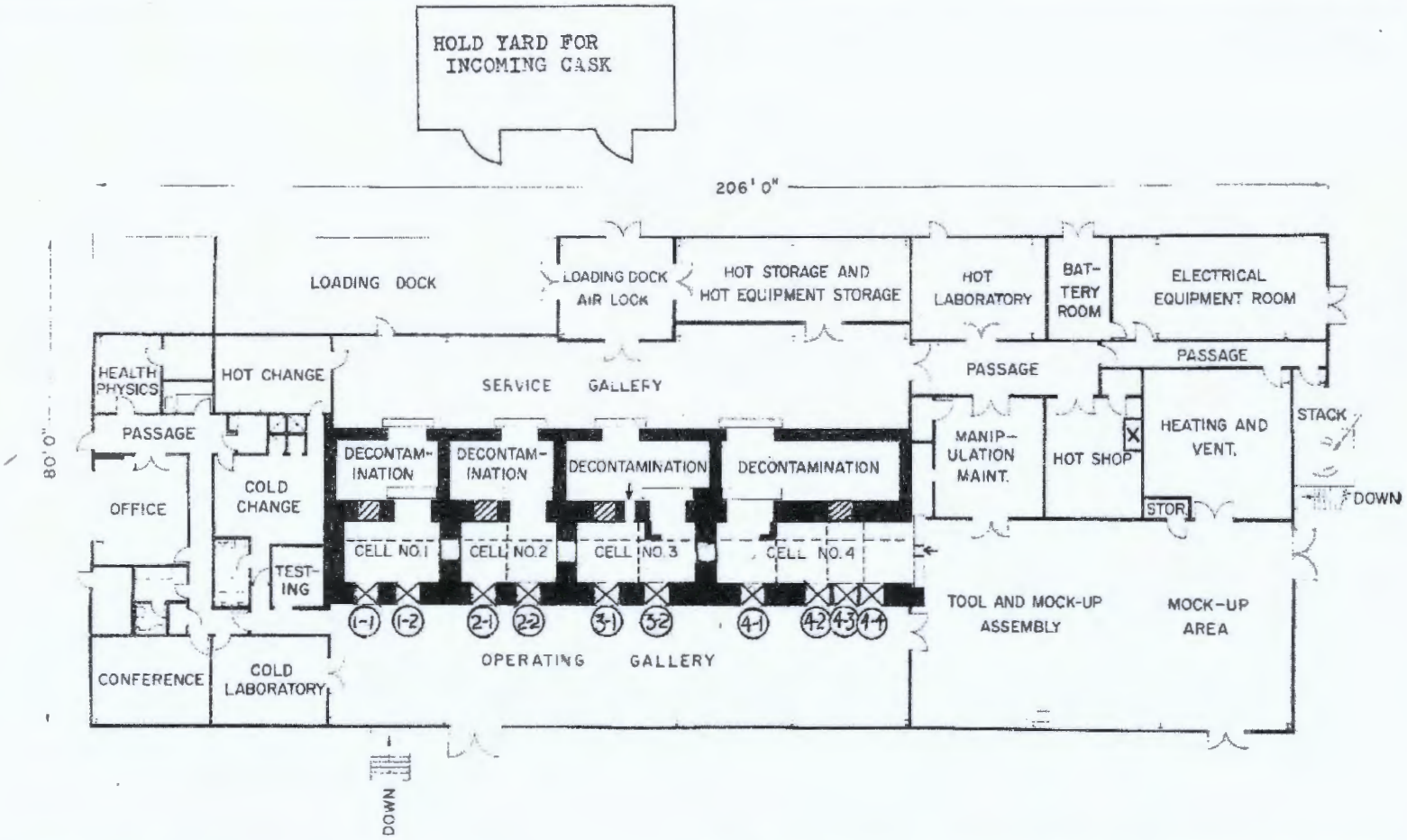
Project:EP9038
Revised: 03/24/2011 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.2.1e
Building 4020
Basement Sums and Drainage



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Project:EP9038
Revised: 03/24/2011 TJ
Source: Boeing Company, 2008

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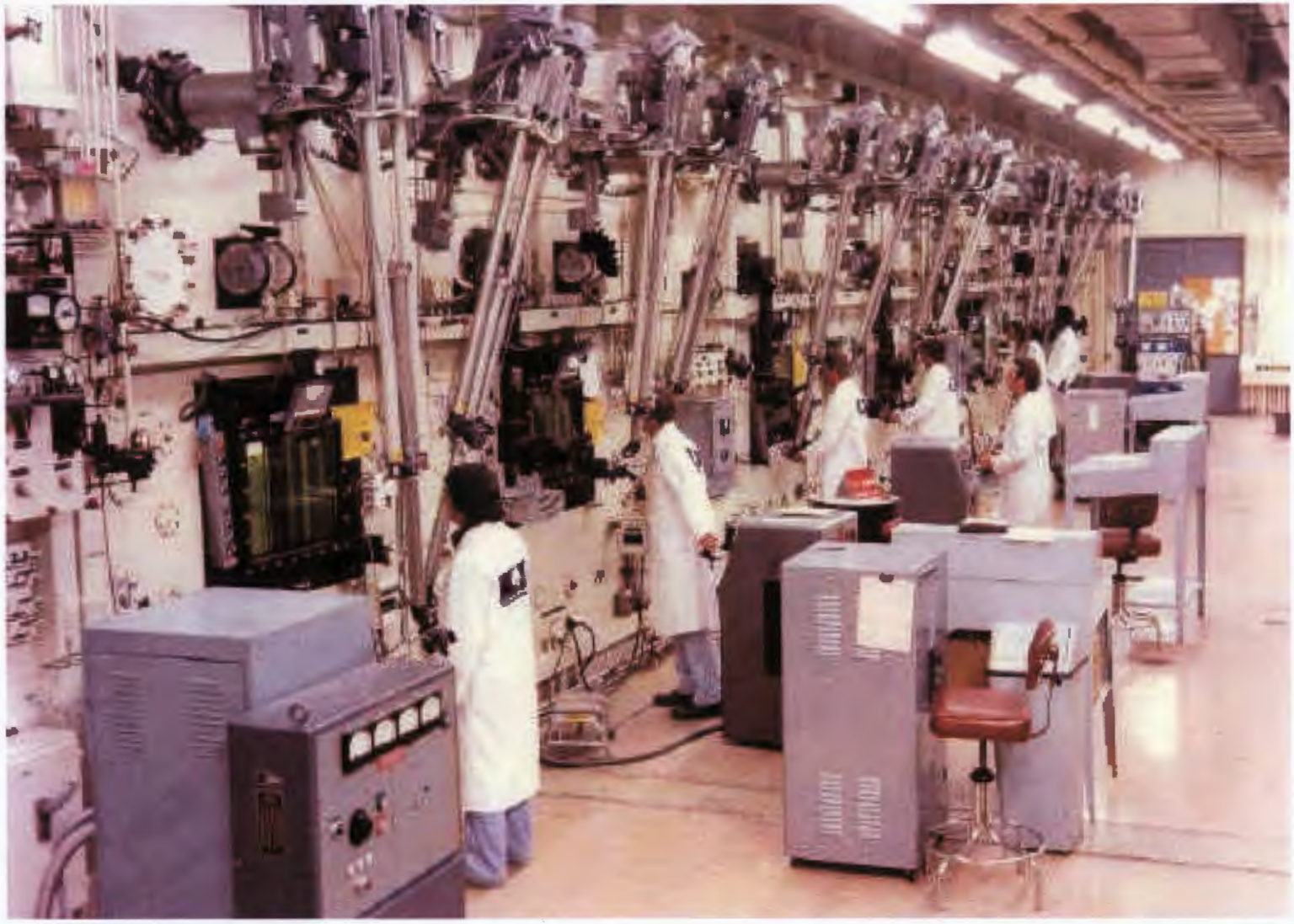
Figure 2.2.1f
Building 4020
Floor Plan



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Revised: 03/24/2011 TJ
Source: Boeing Company, 2008

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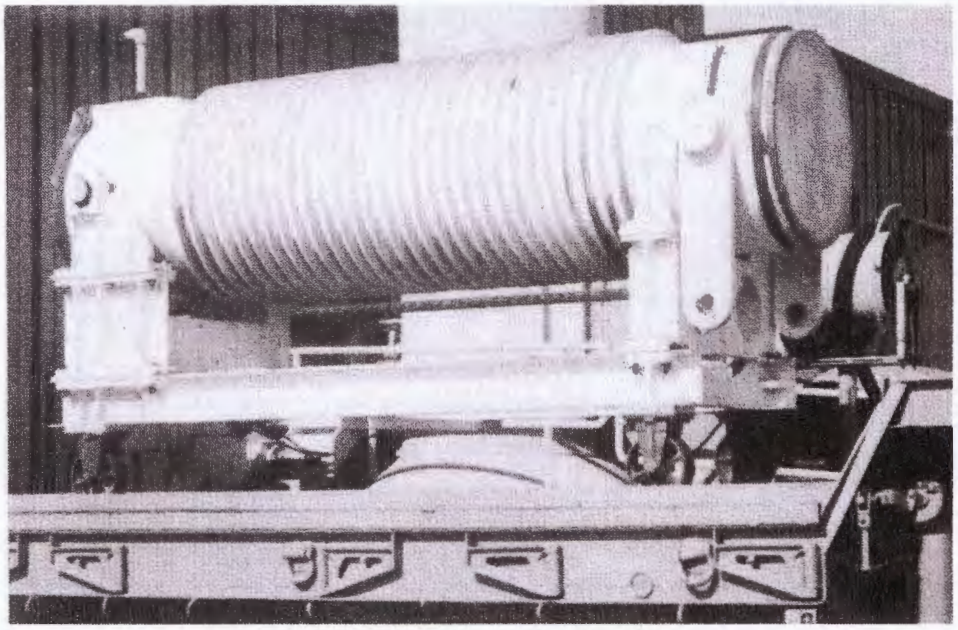
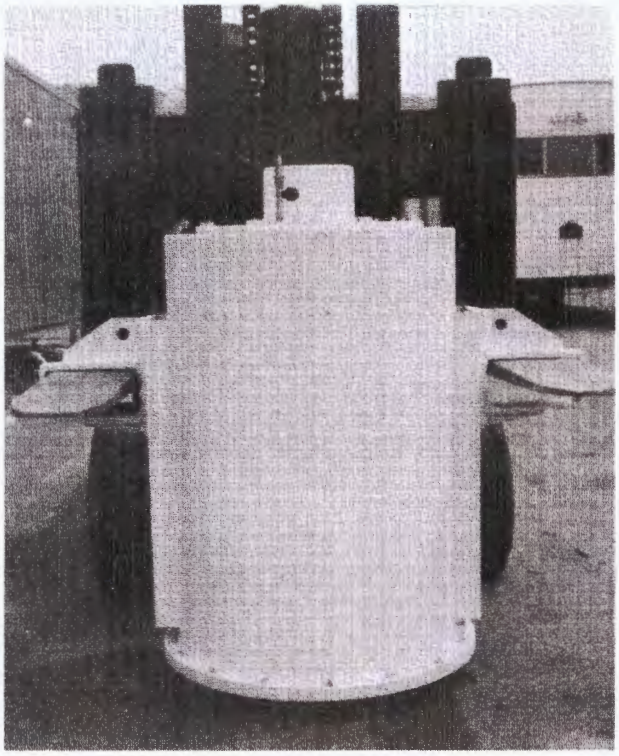
Figure2.2.1g
Building 4020
Operating Gallery
Photograph





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Source: Boeing Company, 2008

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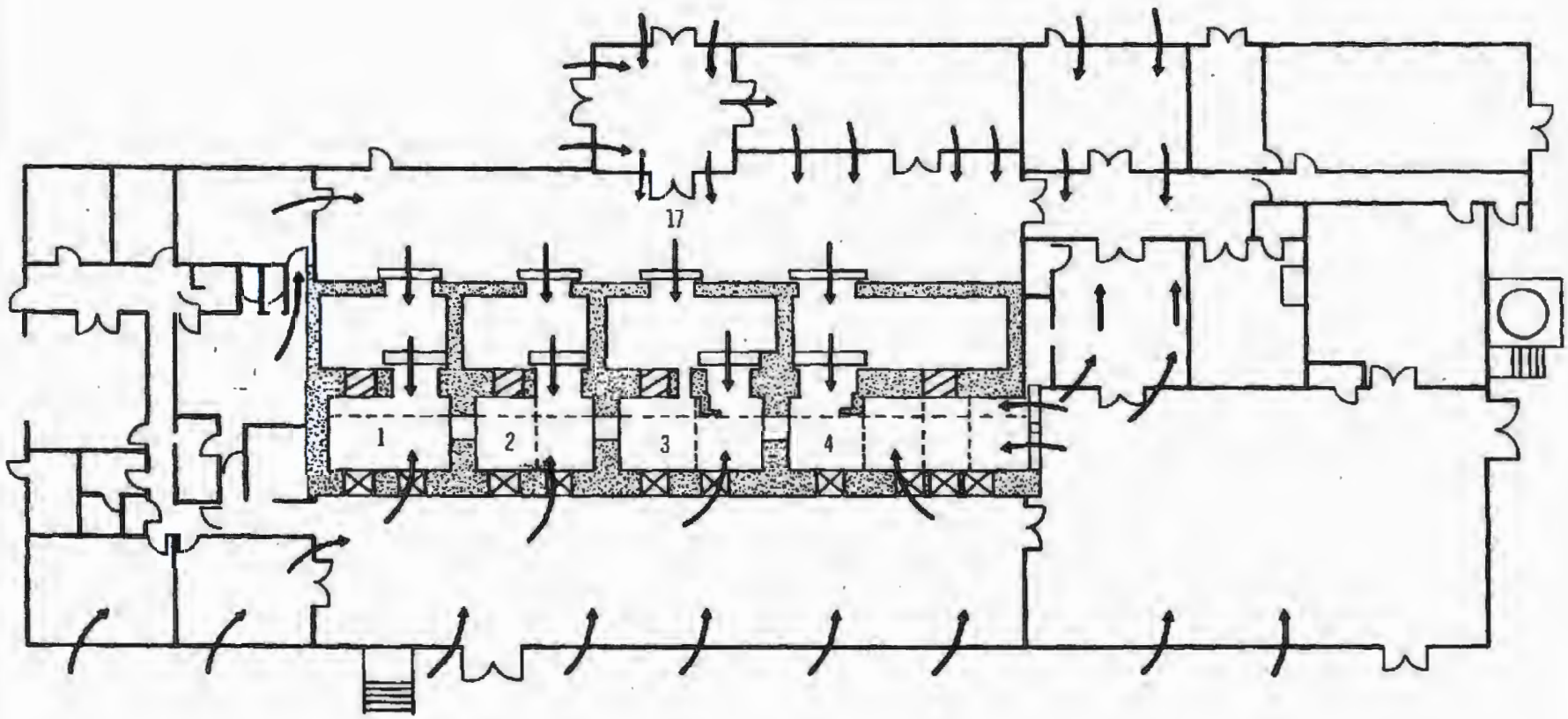
Figure 2.2.1h
Building 4020
Piqua and
S8ER Casks



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Revised: 03/24/2011 TJ
Source: Boeing Company, 2008

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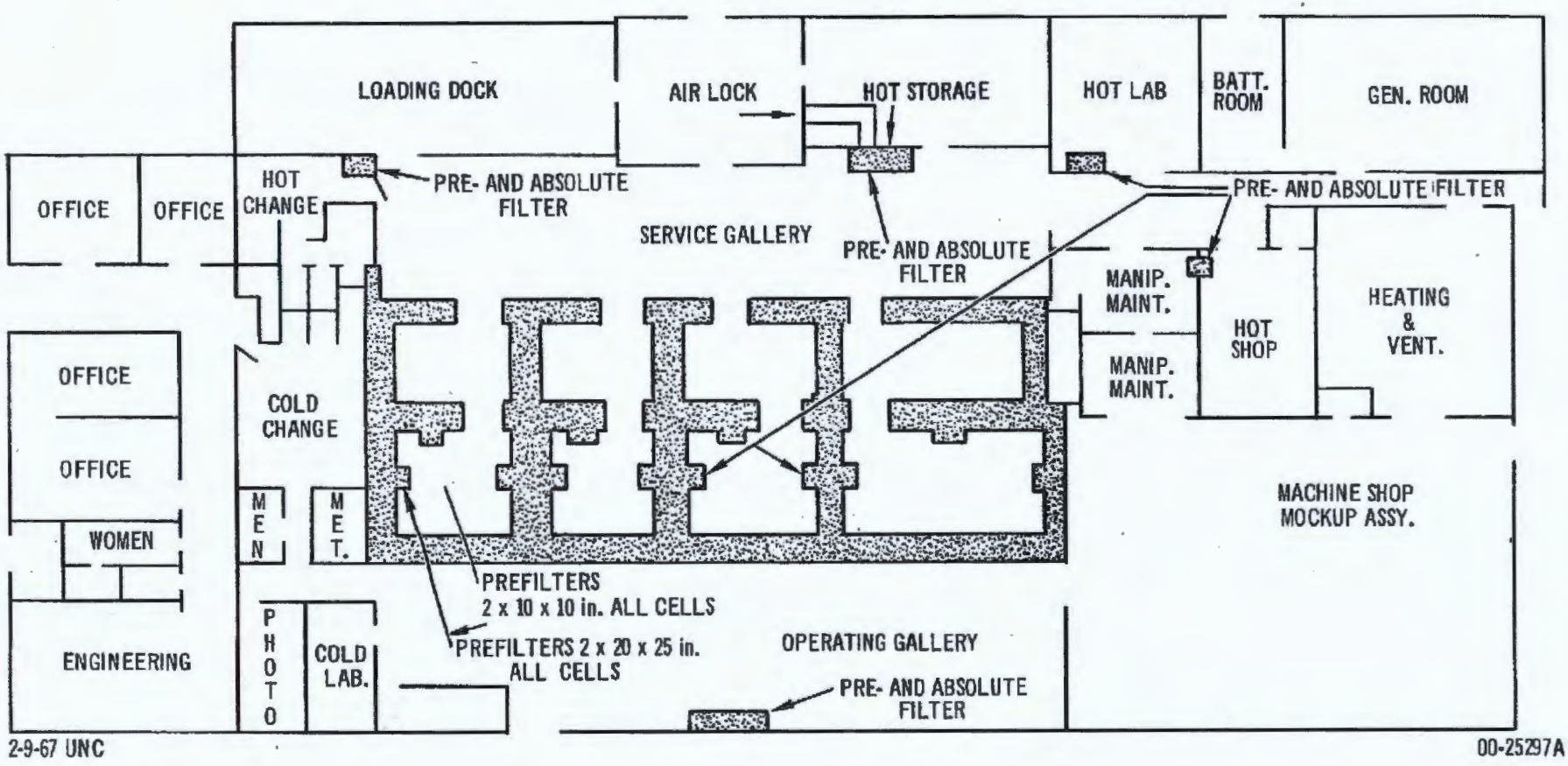
Figure 2.2.1i
Building 4020
Ventilation Flow Diagram



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Revised: 03/24/2011 TJ
Source: Boeing Company, 2008

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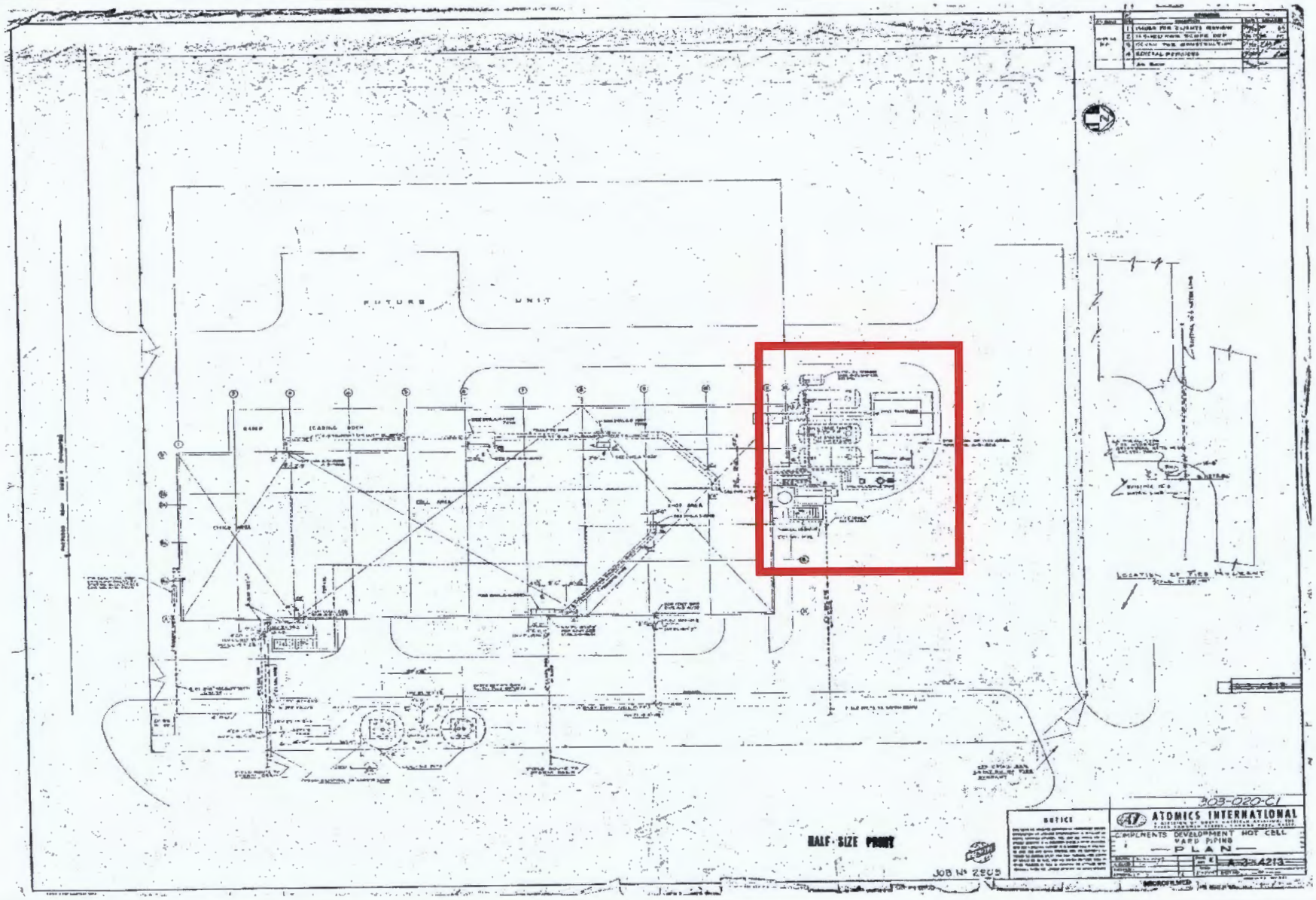
Figure 2.2.1j
Building 4020
Vent Filter
Locations



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Revised: 03/24/2011 TJ
Source: Boeing Company, 2008

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Figure 2.2.1k
Building 4020
Underground Fission Gas Tank Locations

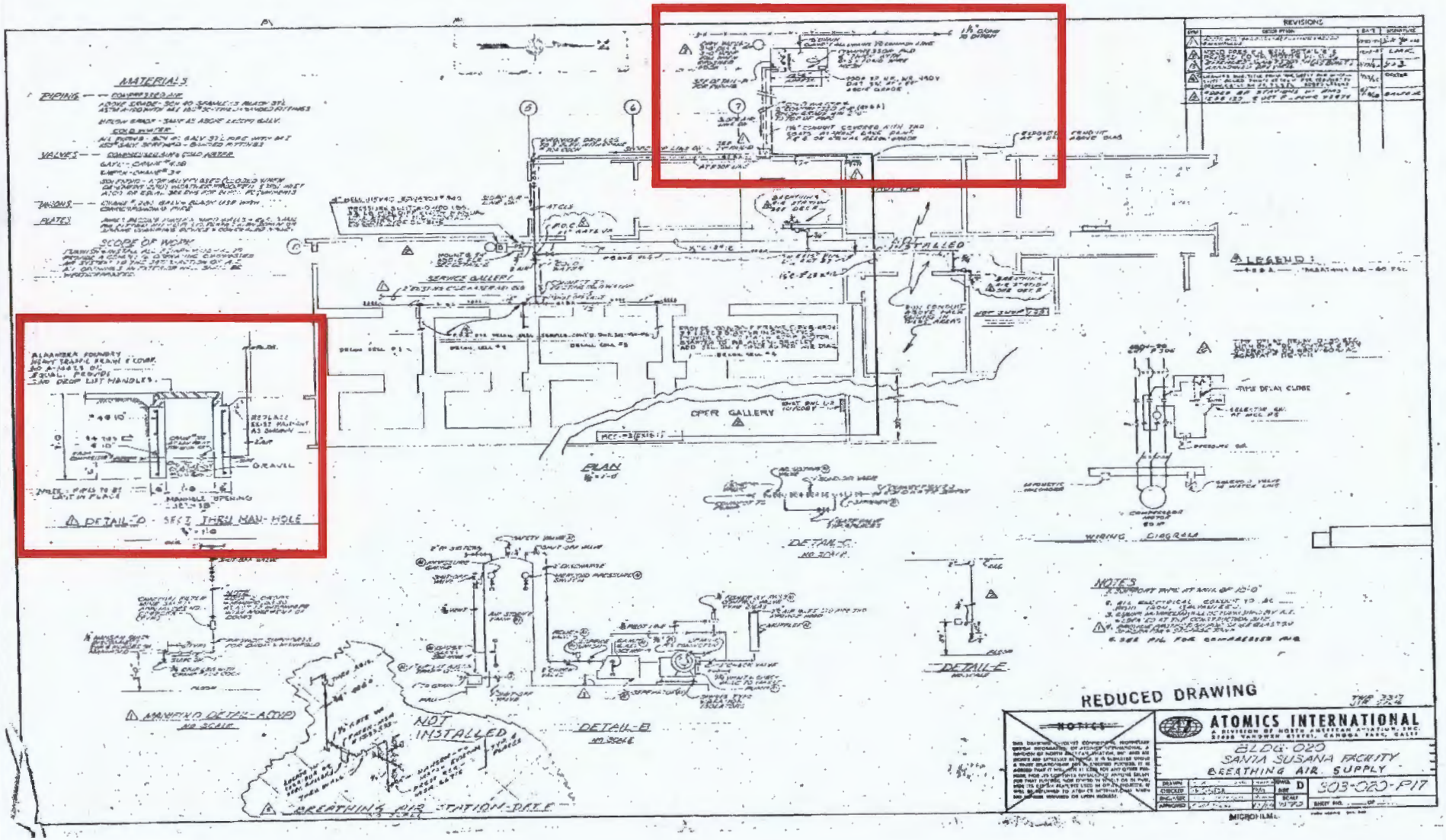

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Figure 2.2.1l
Building 4020
Leach Field and
Manhole Detail

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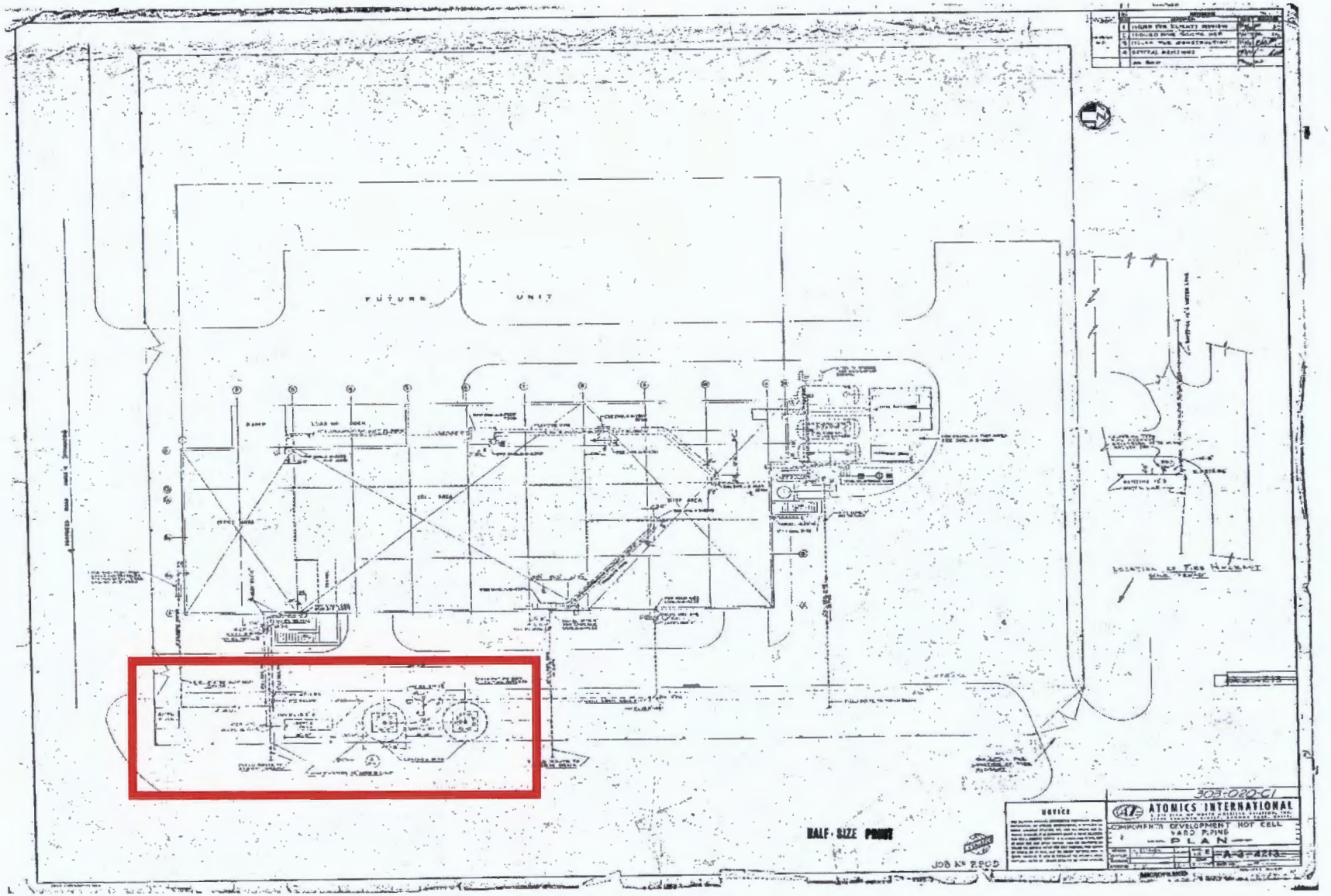

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Source: Boeing Company, 2008

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Figure 2.2.1m
Building 4020
Leach Field and
Leaching Pits Piping

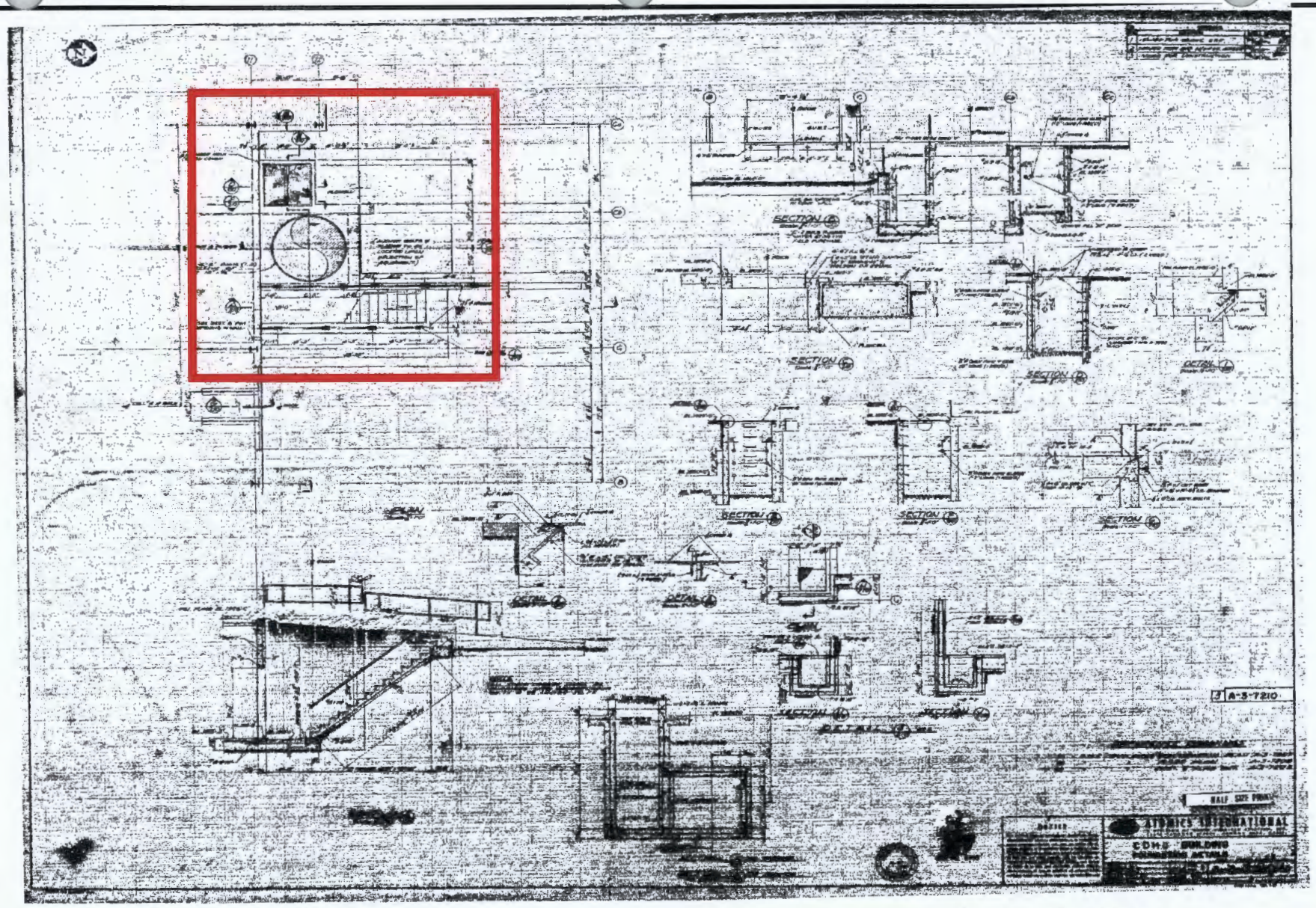

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Figure 2.2.1n
Building 4020
Stack and
Manhole Detail

Area	Removable (dpm/100 cm^2)		Fixed (mrad/hr)	
	General Surfaces	Inaccessible Surfaces	General Surfaces	Inaccessible Surfaces
Hot cells 1,2,3,4	>1,000,000	>1,000,000	400	5000
Decon rooms 1,2,3,4	50,000	500,000	10	30
Hot slave shop	200,000		10	
Service gallery	500	2000	5	15
Hot laboratory, material testing laboratory, air lock, and change rooms	200	100,000* (glove box)	15	2
Operating gallery	200 (Cell face)	20,000	30 (Cell face)	5
Boiler room, battery room, generator room cold slave shop, and equipment room	<50	--	2	--
Metallograph room, chemical laboratory, and offices	<50	--	--	--
Tool and mock-up area	<50	200	5	--
Basement	5000	>1,000,000 (R/A exhaust)	10	5000
Attic	1000	--	--	--
West loading dock and pad, north loading dock and pad, and hot storage yard	100	--	10	--
Radioactive liquid tank and building	500	5000	50	0.2

*Alpha contamination contained inside glove box

D638-0020

Y:/Santa_Susana/EP9038/TM/HSA_5D (2-2-1o)Bldg4020PR.cdr
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Figure 2.2.1o
Building 4020
Projected Radioactive Contamination

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Project:EP9038
Revised: 03/24/2011 TJ
Source: Boeing Company, 2008

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Figure 2.2.1p
Building 4020
Stockpiled Soil
During Basement
Demolition

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Project:EP9038
Revised: 03/24/2011 TJ
Source: Boeing Company, 2008

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Figure 2.2.1q
Building 4020
Completed Building Excavation

Backfilling and Compaction of the Basement Excavation. [ETEC-10/24/97-395401]

Site After Backfilling the Basement Excavation. [ETEC-11/4/97-395422]

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Revised: 03/24/2011 TJ
Source: Boeing Company, 2008

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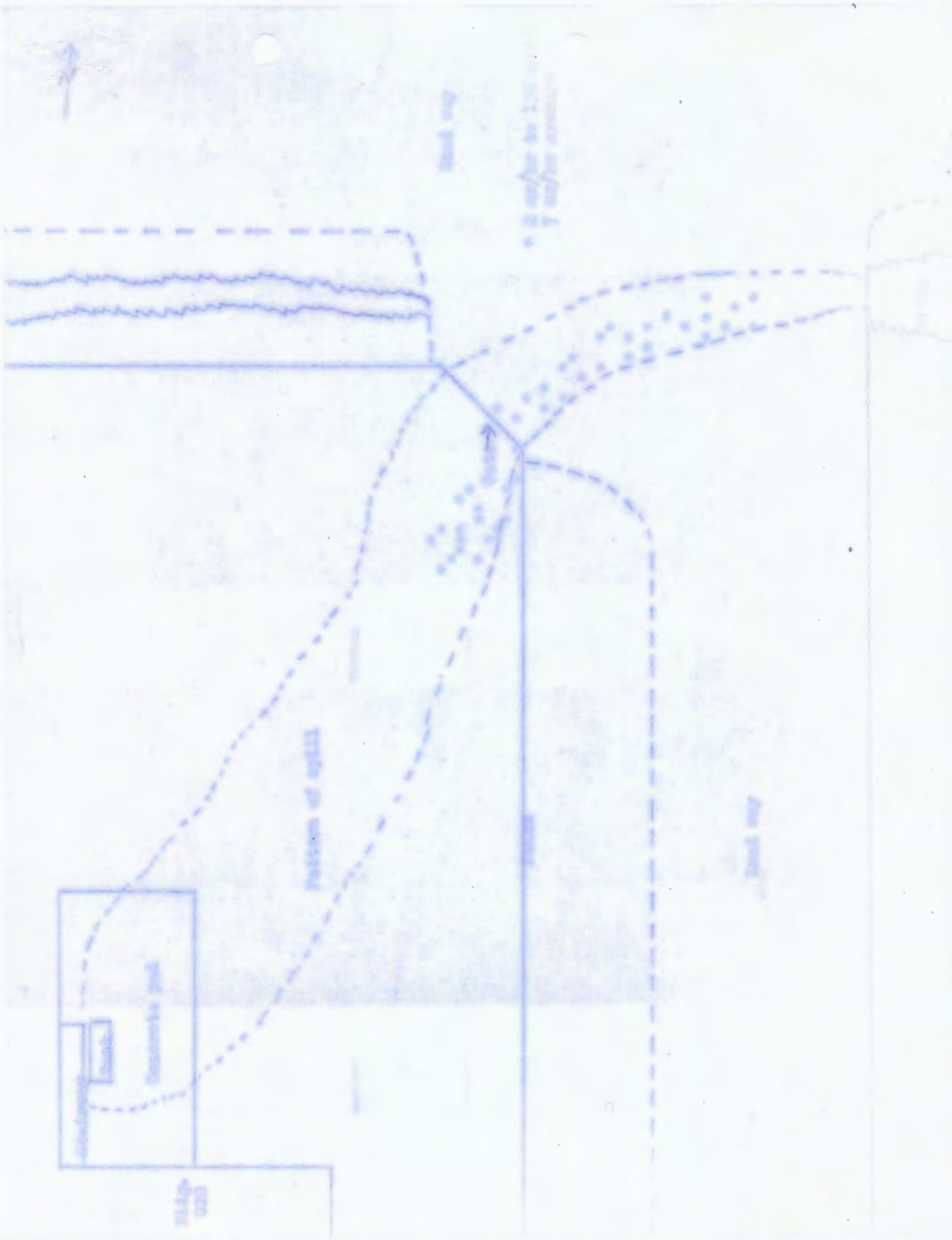
Figure 2.2.1r
Building 4020
Backfilling Operations and Completion



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Source: Boeing Company, 2008

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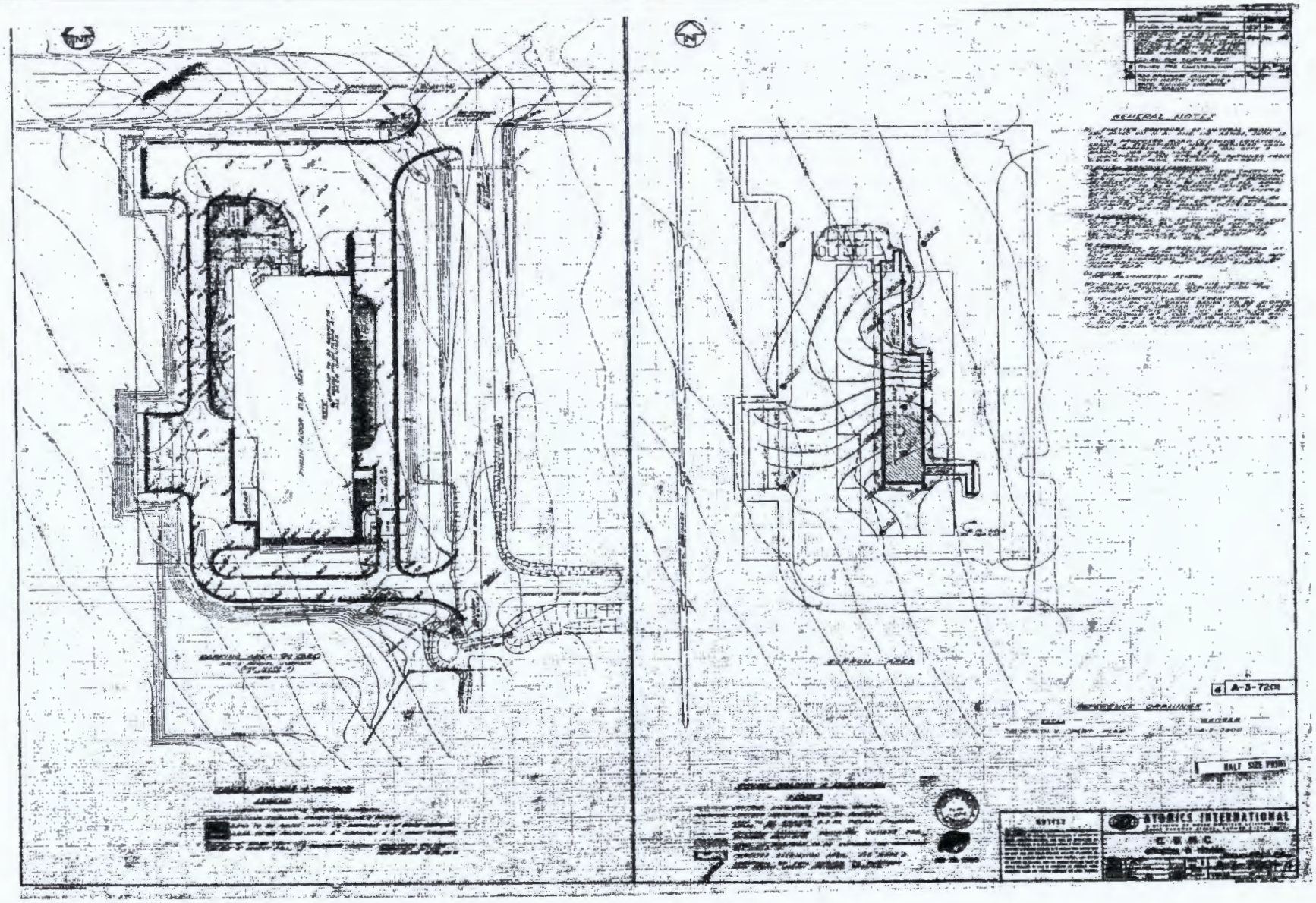
Figure 2.2.1s
Building 4020
A0016 Incident Report Spill



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Revised: 03/24/2011 TJ
Source: Boeing Company, 2008

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Figure 2.2.1t
Building 4020
Grading and
Paving

Y:/Santa_Susana/EP9038/TM/HSA_5D
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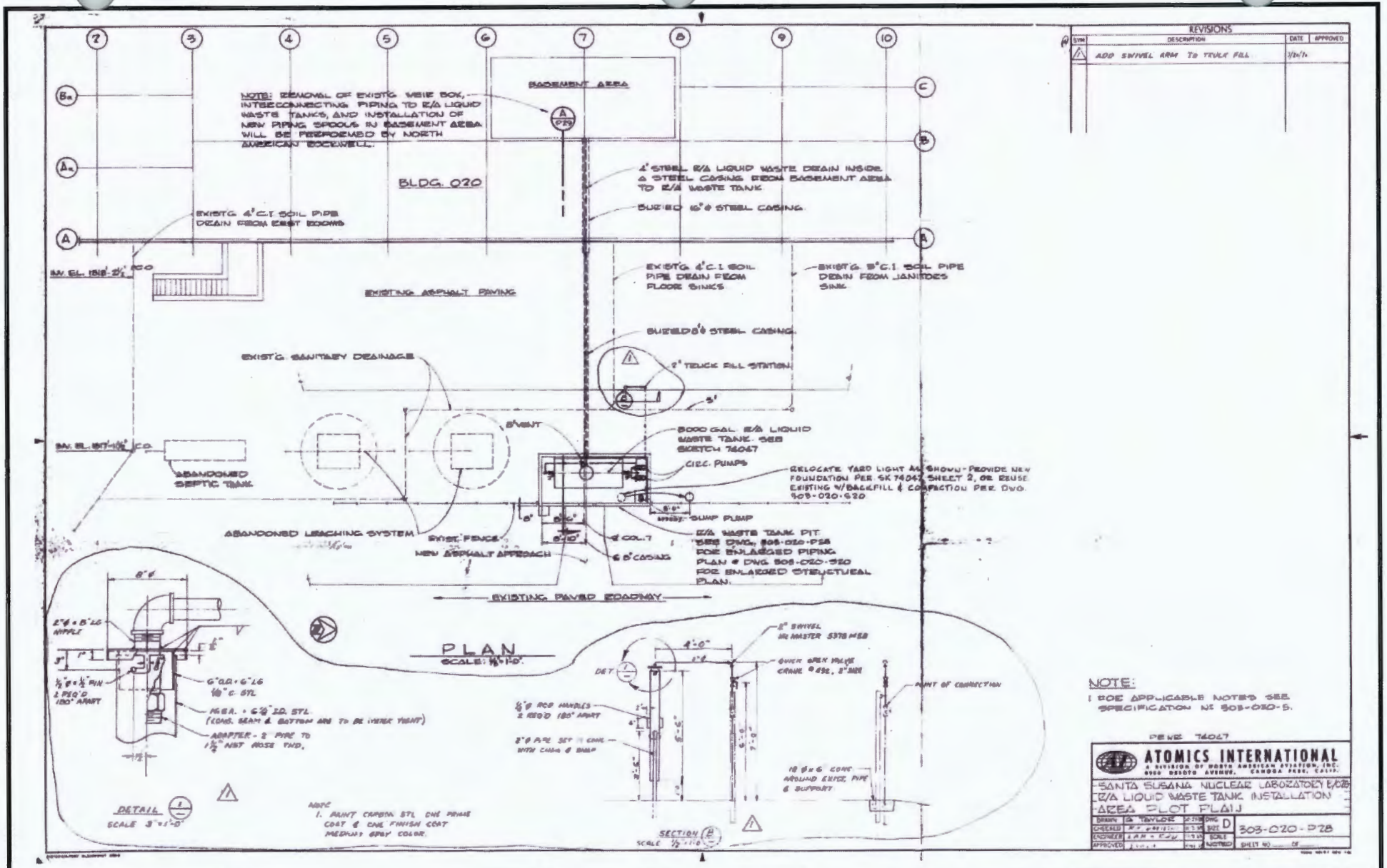
Project:EP9038
Revised: 03/23/2011 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.2.2a
Building 4468
Site Photograph



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Source: Boeing Company, 2008

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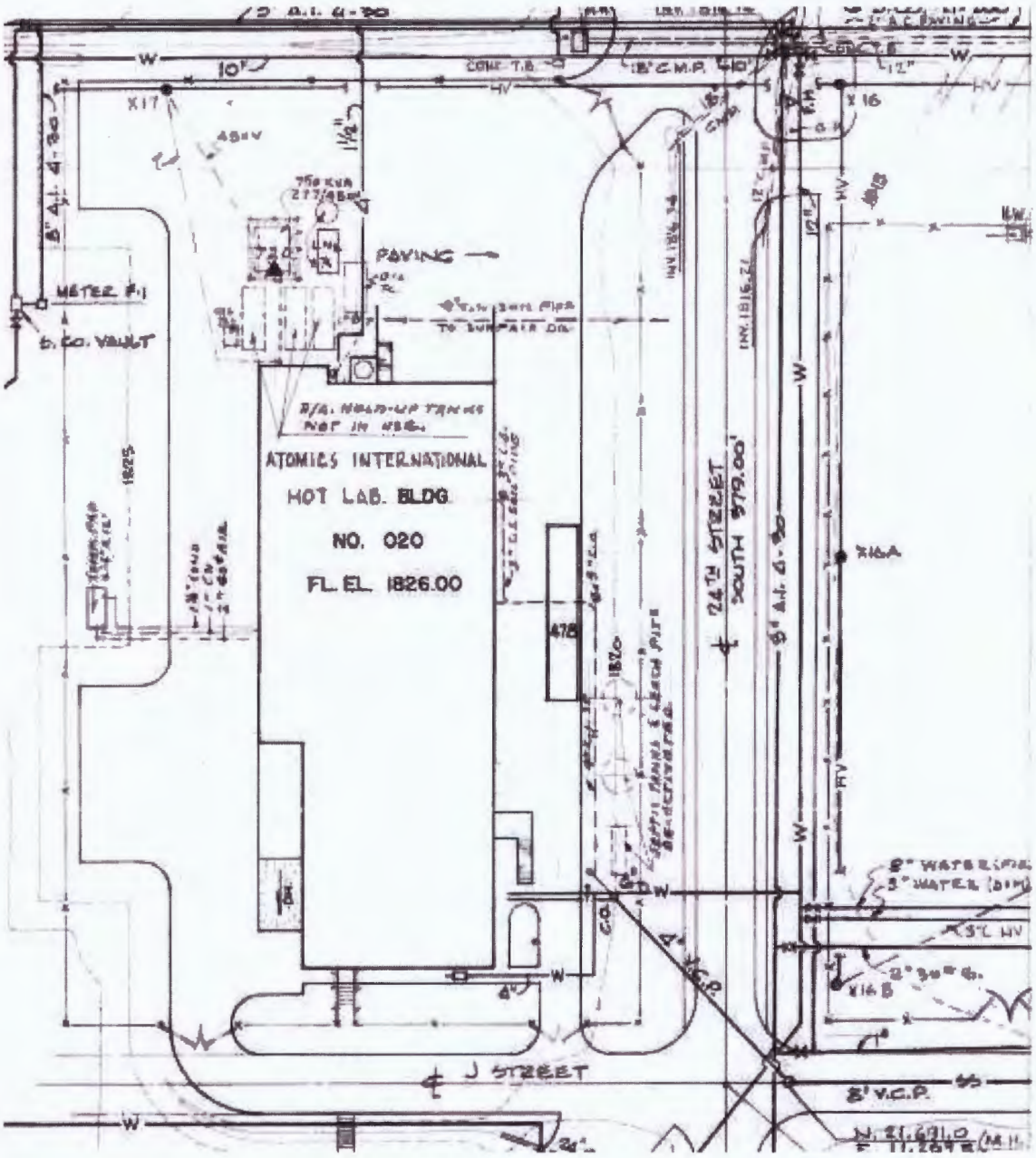
Figure 2.2.2b
Building 4468/4020
Piping Plan



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8900 DESOTO AVENUE, CANOGA PARK, CALIF.

SANTA SUSANA FACILITY
PLOT PLAN

DRAWN	HAMMAN	DWG. SIZE	E	303-GEN.-C 45
CHECKED				
ENGINEER	R.P.HAMMAN	SCALE	1"=40'	
APPROVED				SHEET NO. 11 OF 14

Y:/Santa_Susana/EP9038/TM/HSA_5D (2-2-2c)Bldg4468PP.cdr
Project:EP9038
Revised: 03/21/2011 TJ
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Figure 2.2.2c
Building 4468
Plot Plan

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Project:EP9038
Revised: 03/21/2011 TJ
Source: Boeing Company, 2008

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Figure 2.2.2d
Building 4468
Demolition Photograph

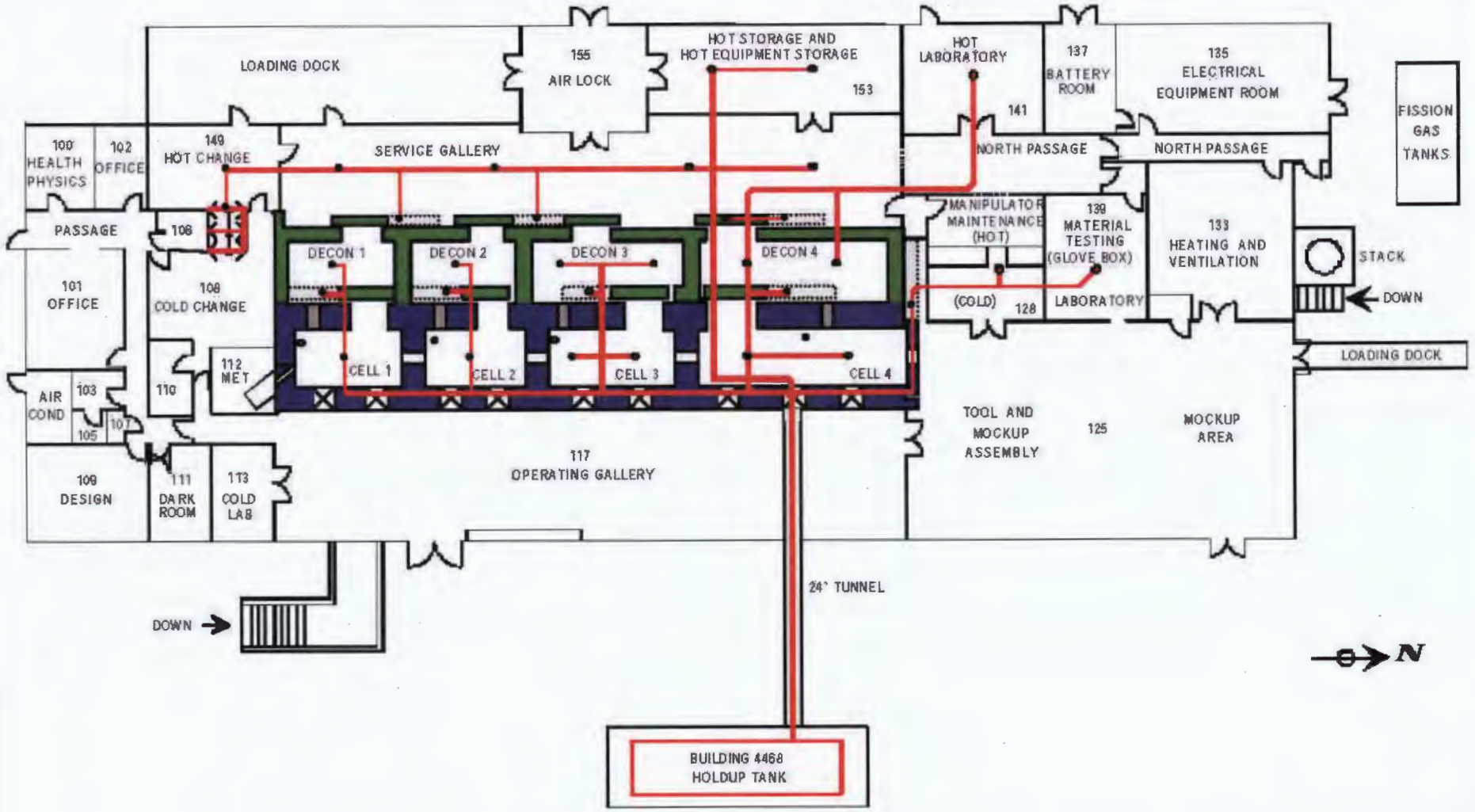

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Figure 2.2.2e
Building 4468/4020
Drain Lines

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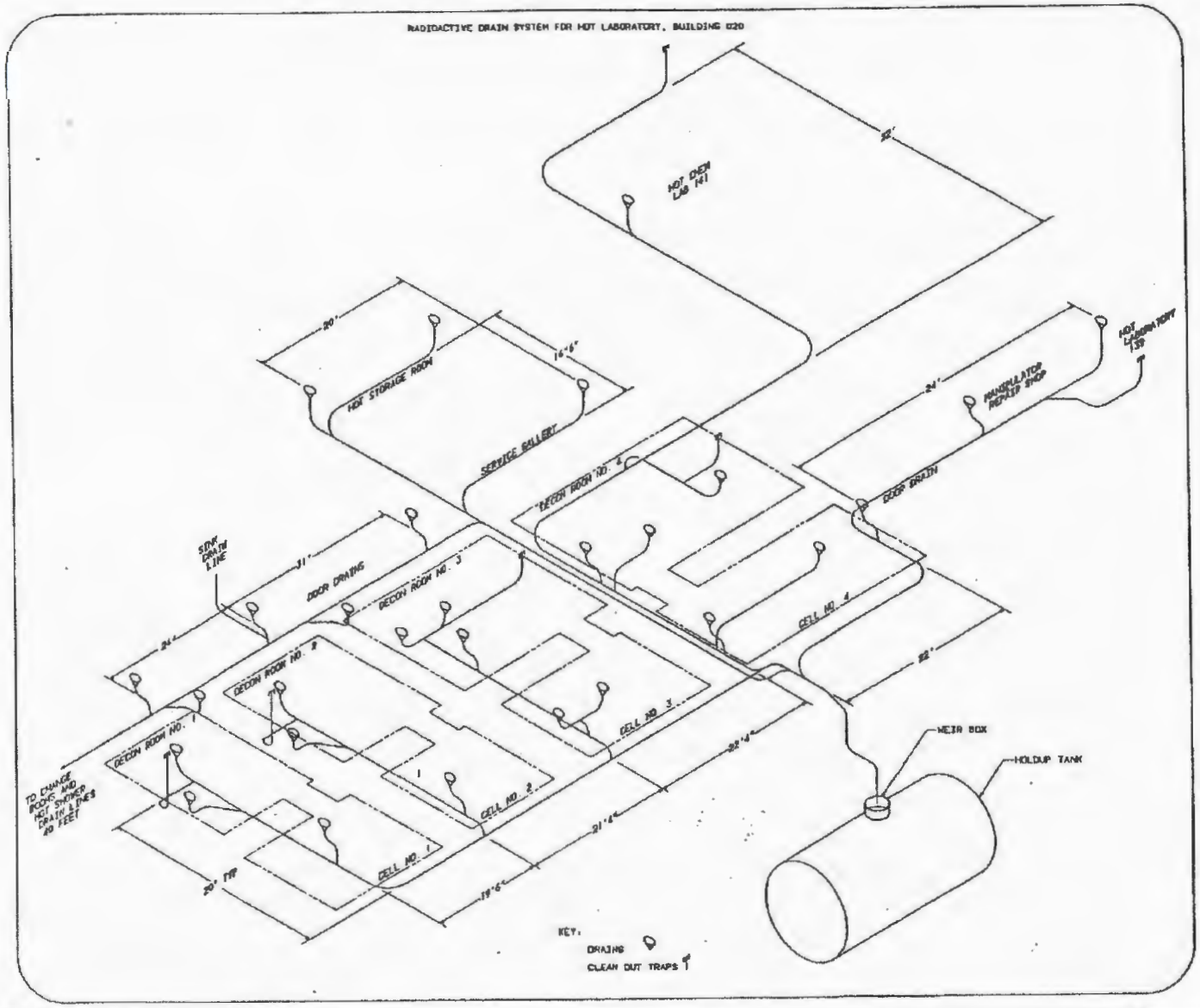

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Revised: 03/24/2011 TJ
Source: Boeing Company, 2008

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Figure 2.2.2f
Building 4468
Radioactive
Drain System

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Project:EP9038
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Source: Boeing Company, 2008

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Figure 2.2.2g
Building 4468
Liquid Waste
Facility Building
1997

Y:/Santa_Susana/EP9038/TM/HSA_5D (2-2-3a)Bldg4520SP.cdr
Project:EP9038
Revised: 03/23/2011 TJ
Source: Boeing Company, 2008

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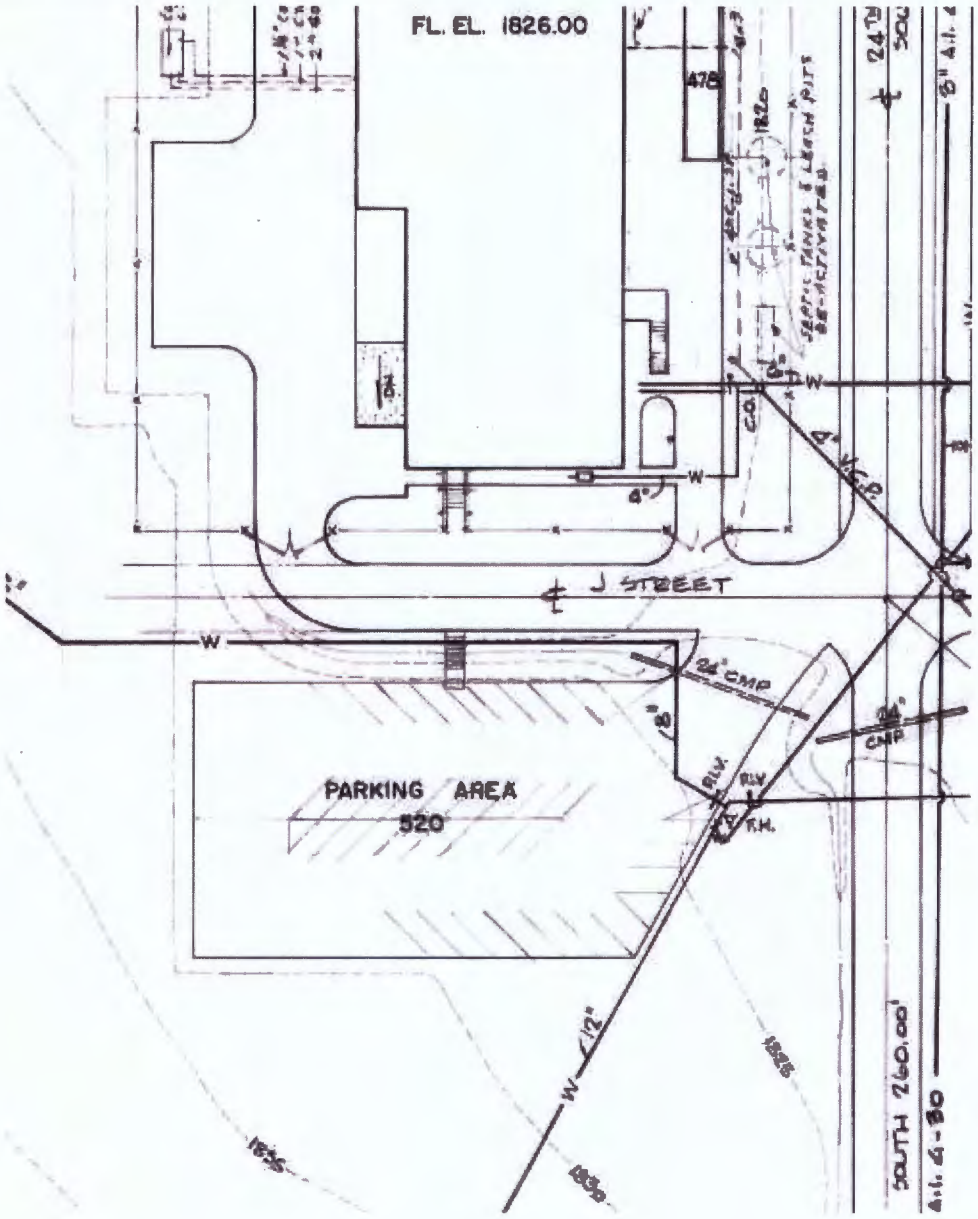
Figure 2.2.3a
Parking Lot 4520
Site Photograph



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SANTA SUSANA FACILITY
PLOT PLAN

DRAWN	HAMMAN	DWG. SIZE E	303 - GEN. - C 45
CHECKED			
ENGINEER	R.P.HAMMAN	SCALE 1"=40'	SHEET NO. 11 OF 14
APPROVED			

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Project:EP9038
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Figure 2.2.3b
Building 4520
Plot Plan

Building 4055 Looking North

Building 4055 Former Liquid Waste Tank Location

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Project:EP9038
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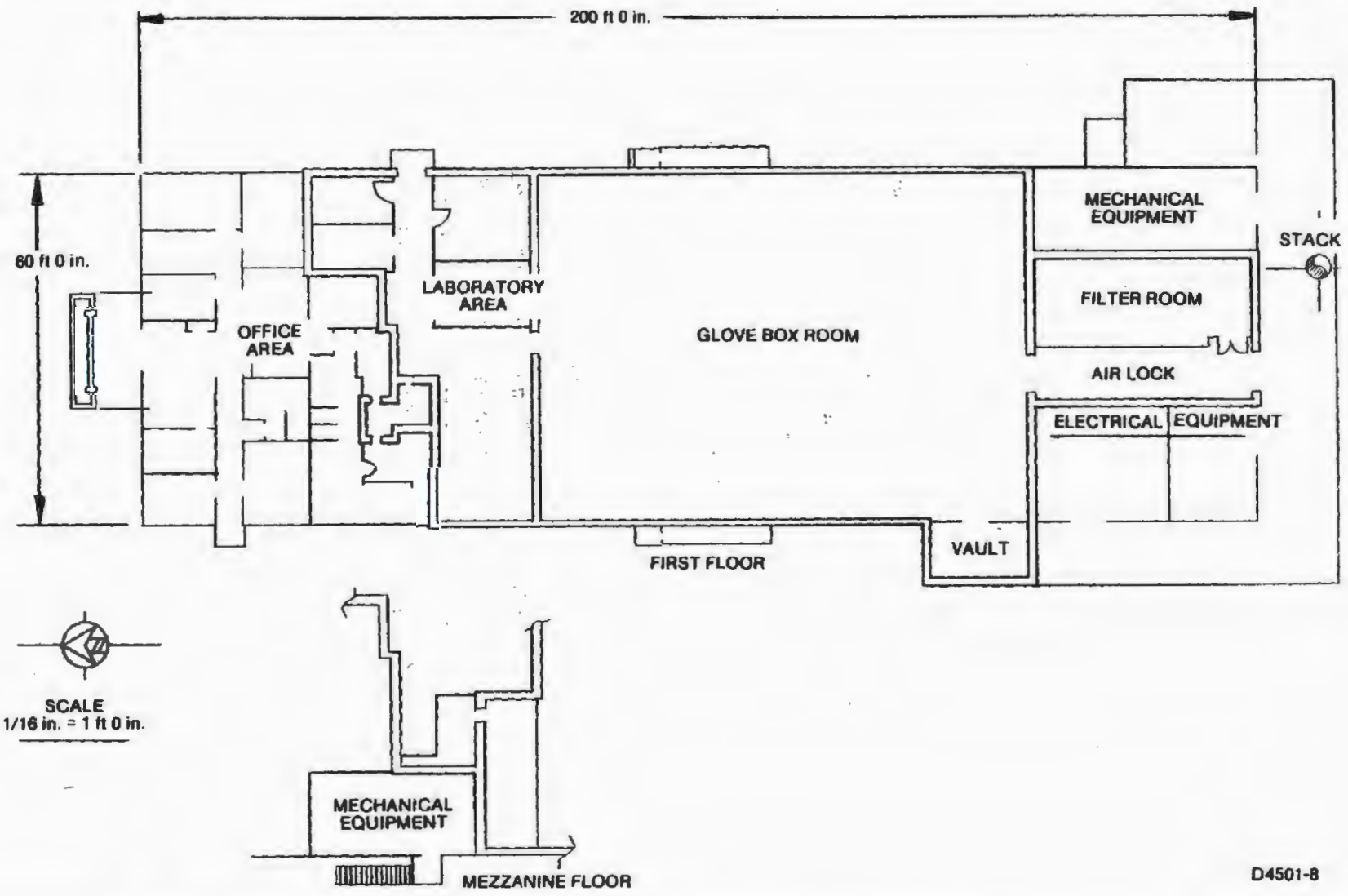
Figure 2.2.4a
Building 4055
Site Photograph



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Source: Boeing Company, 2008

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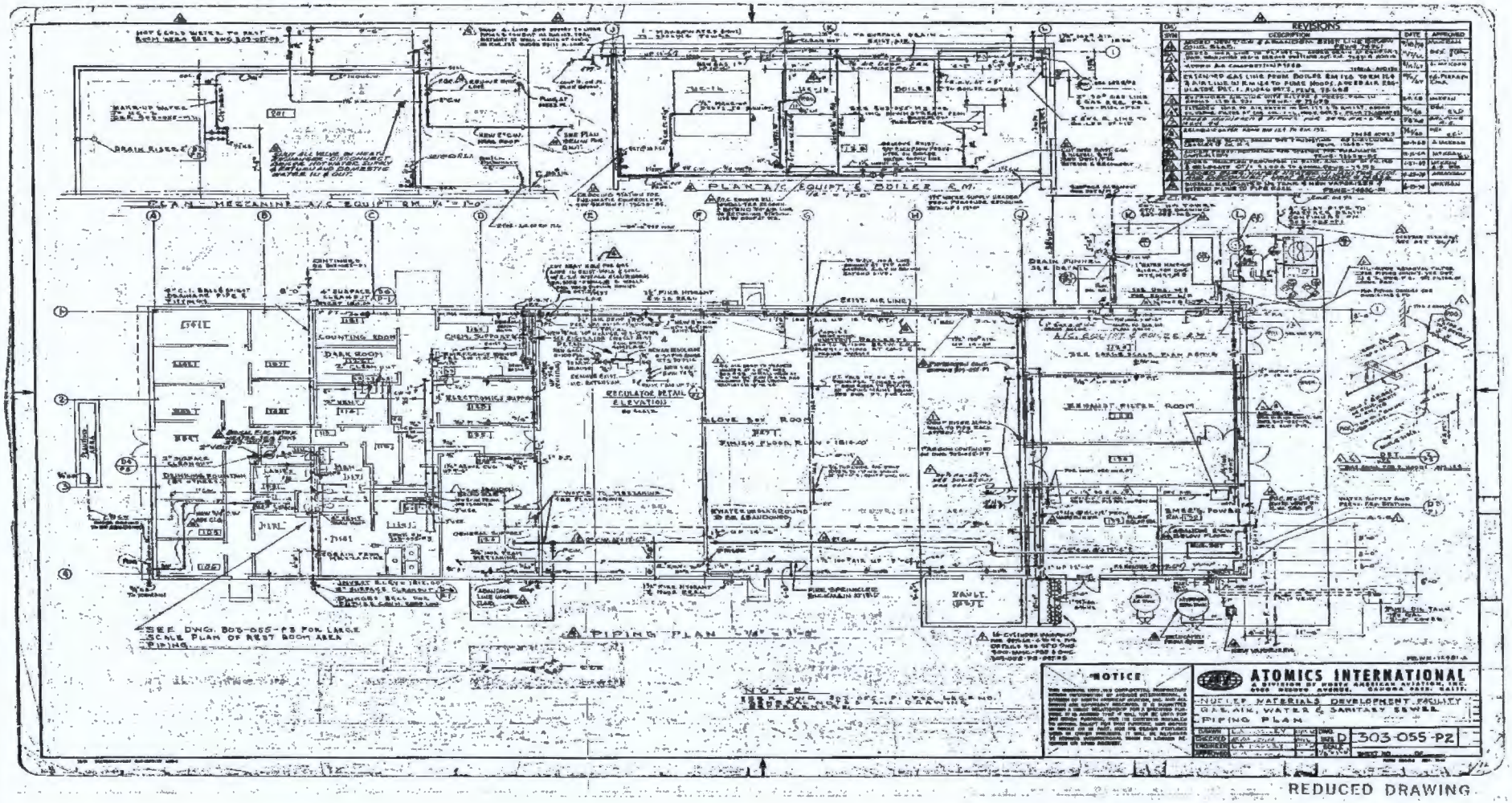
Figure 2.2.4b
Building 4055
Floor Plan



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Source: Boeing Company, 2008

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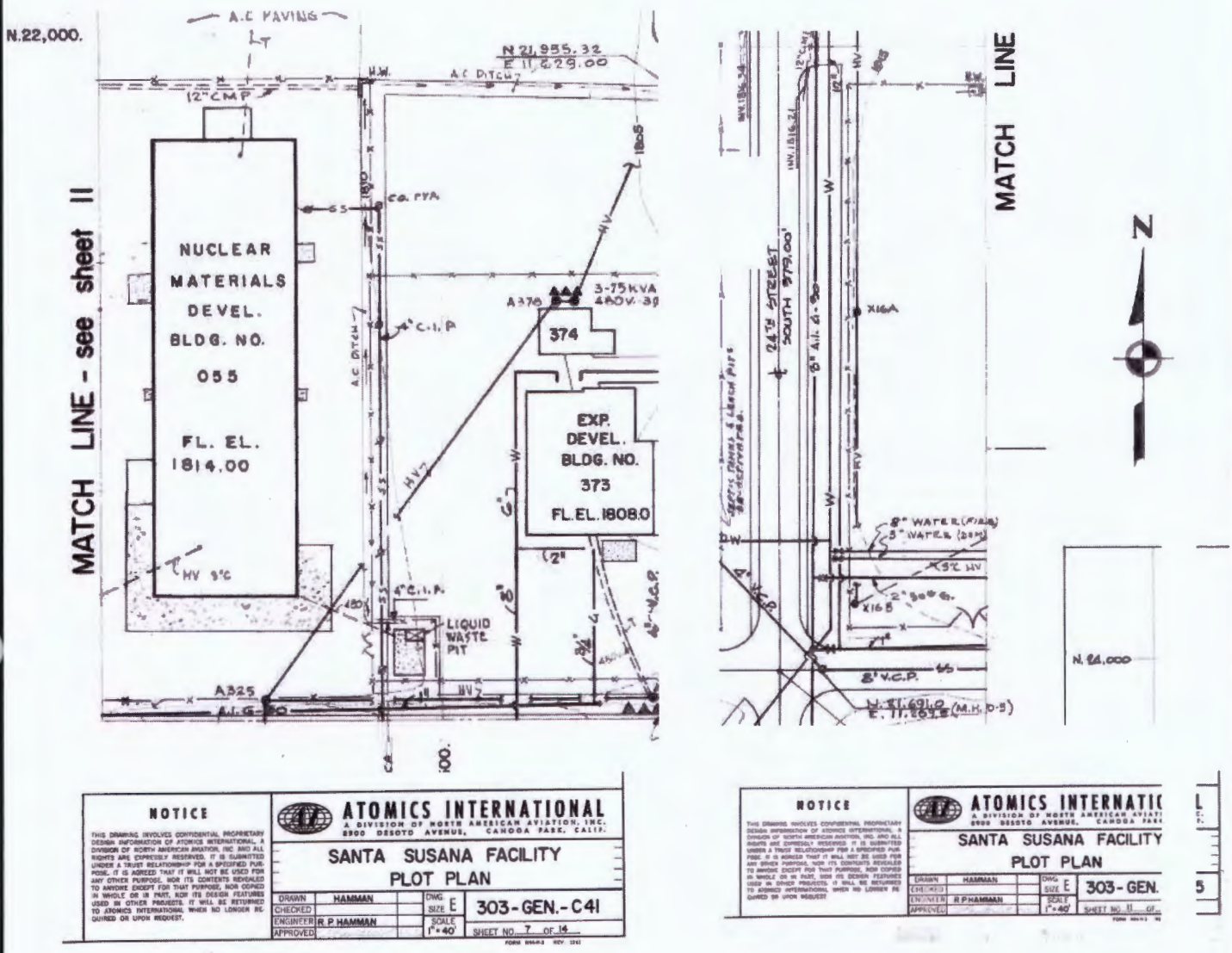
Figure 2.2.4c
Building 4055 Layout, Gas, Water and Sanitary Sewer Piping Plan



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Source: Boeing Company, 2008

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Figure 2.2.4d
Building 4055
Plot Plan

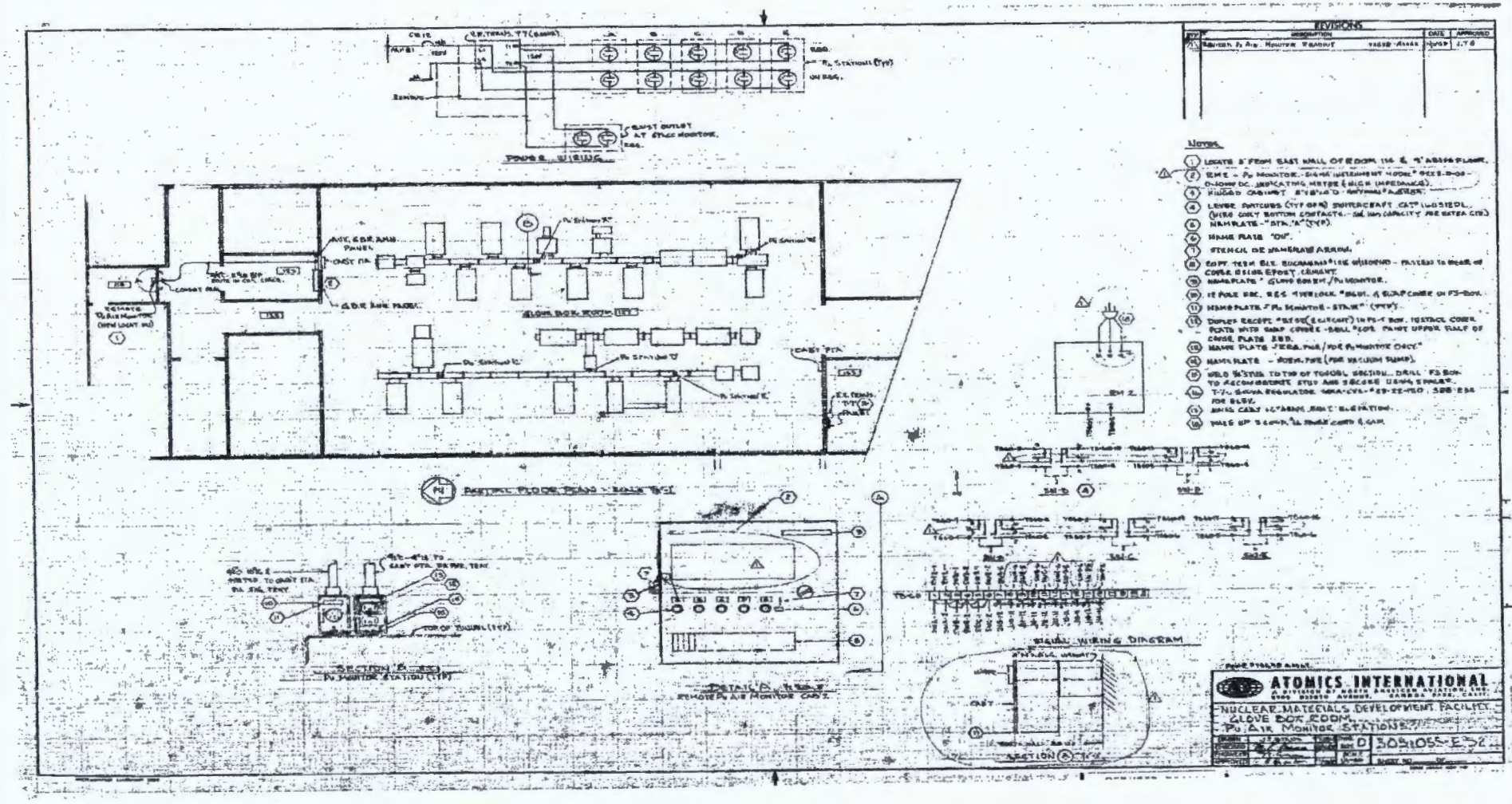

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Figure 2.2.4e
Building 4055
Glove Box
Room Layout

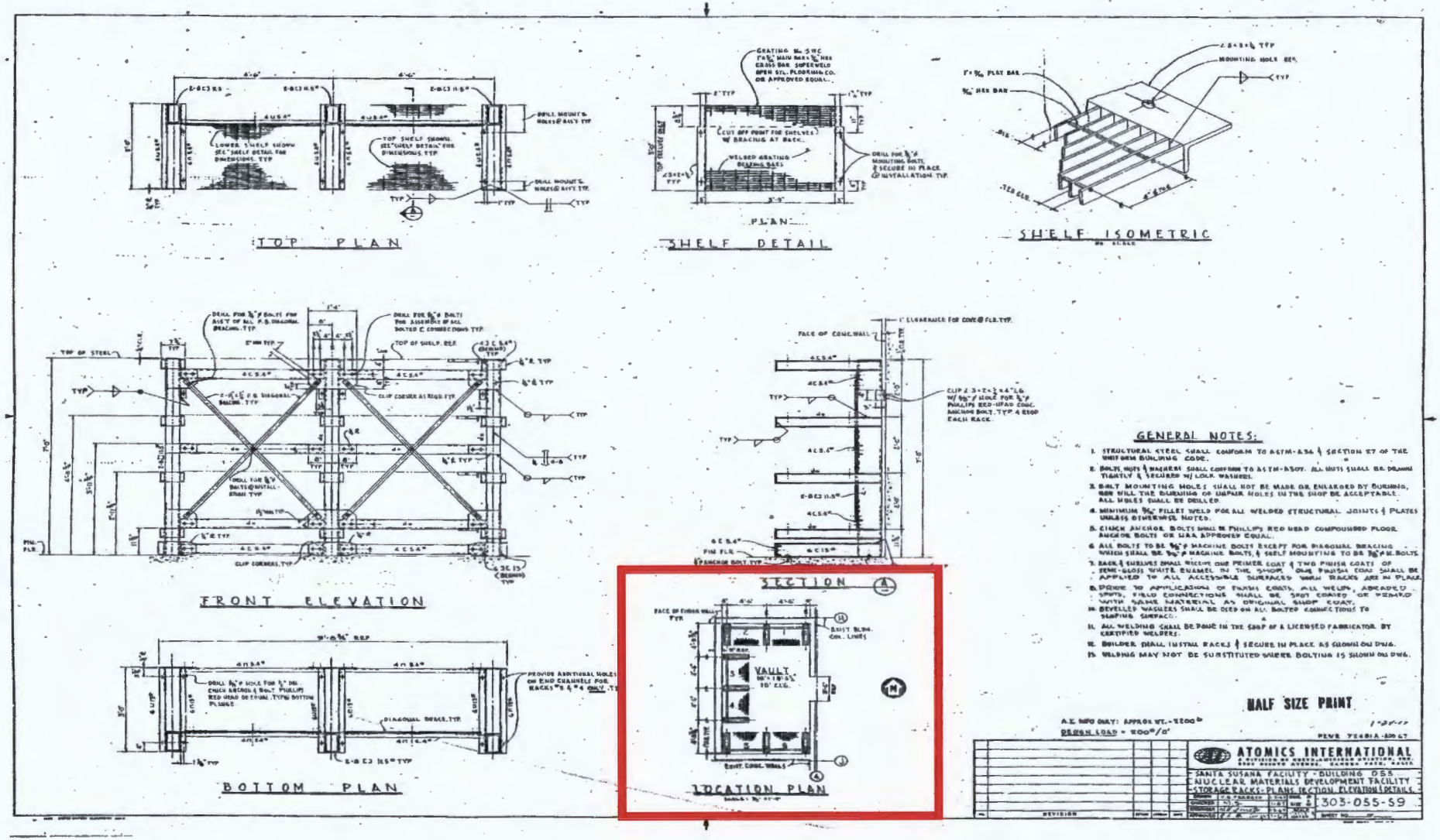

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Figure 2.2.4f
Building 4055
Storage Vault

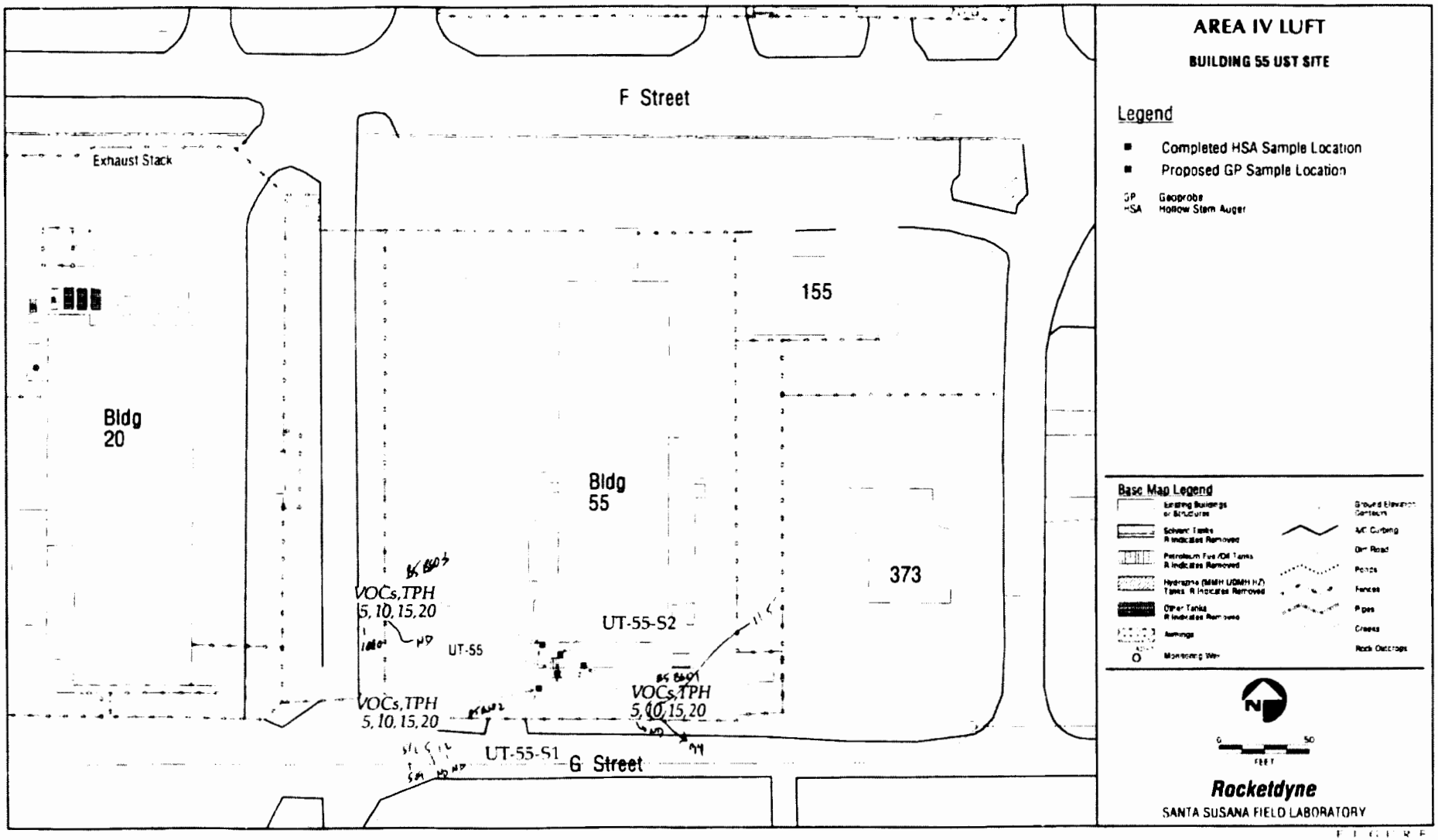

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Figure 2.2.4g
Building 4055
UT-55 Diesel Storage Tank Location

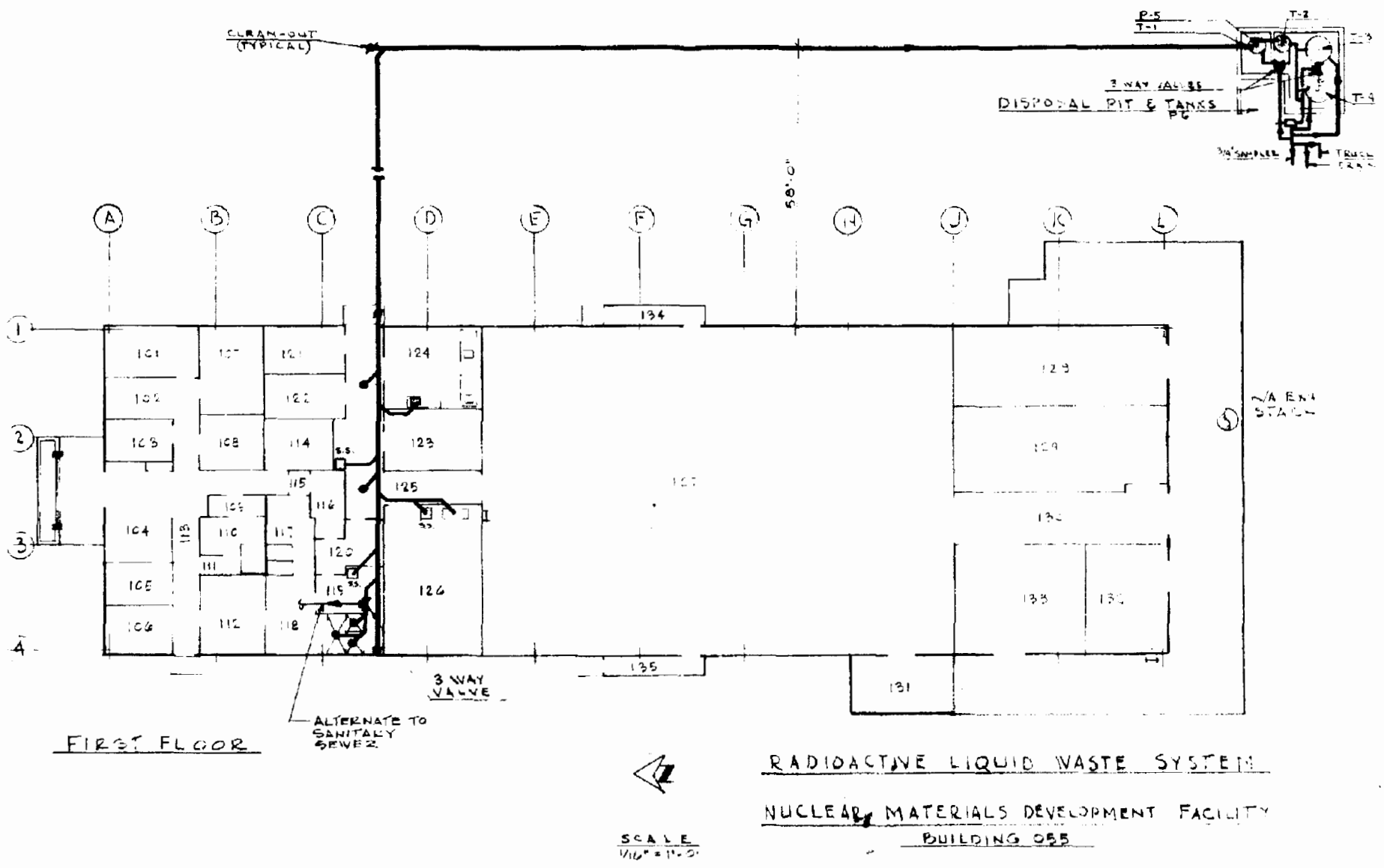

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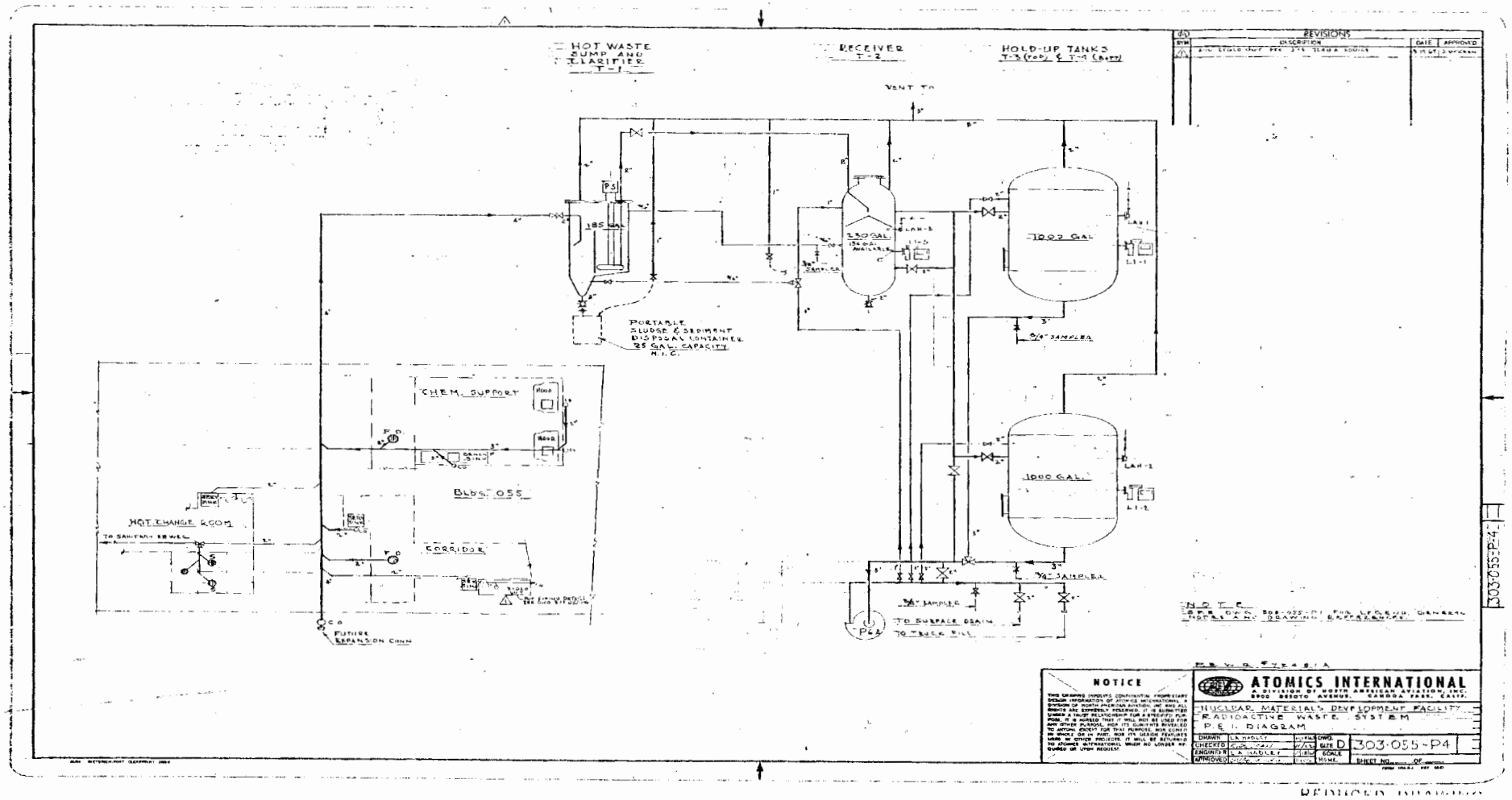
Figure 2.2.4h
Building 4055
Liquid Waste
Holdup System



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Source: Boeing Company, 2008

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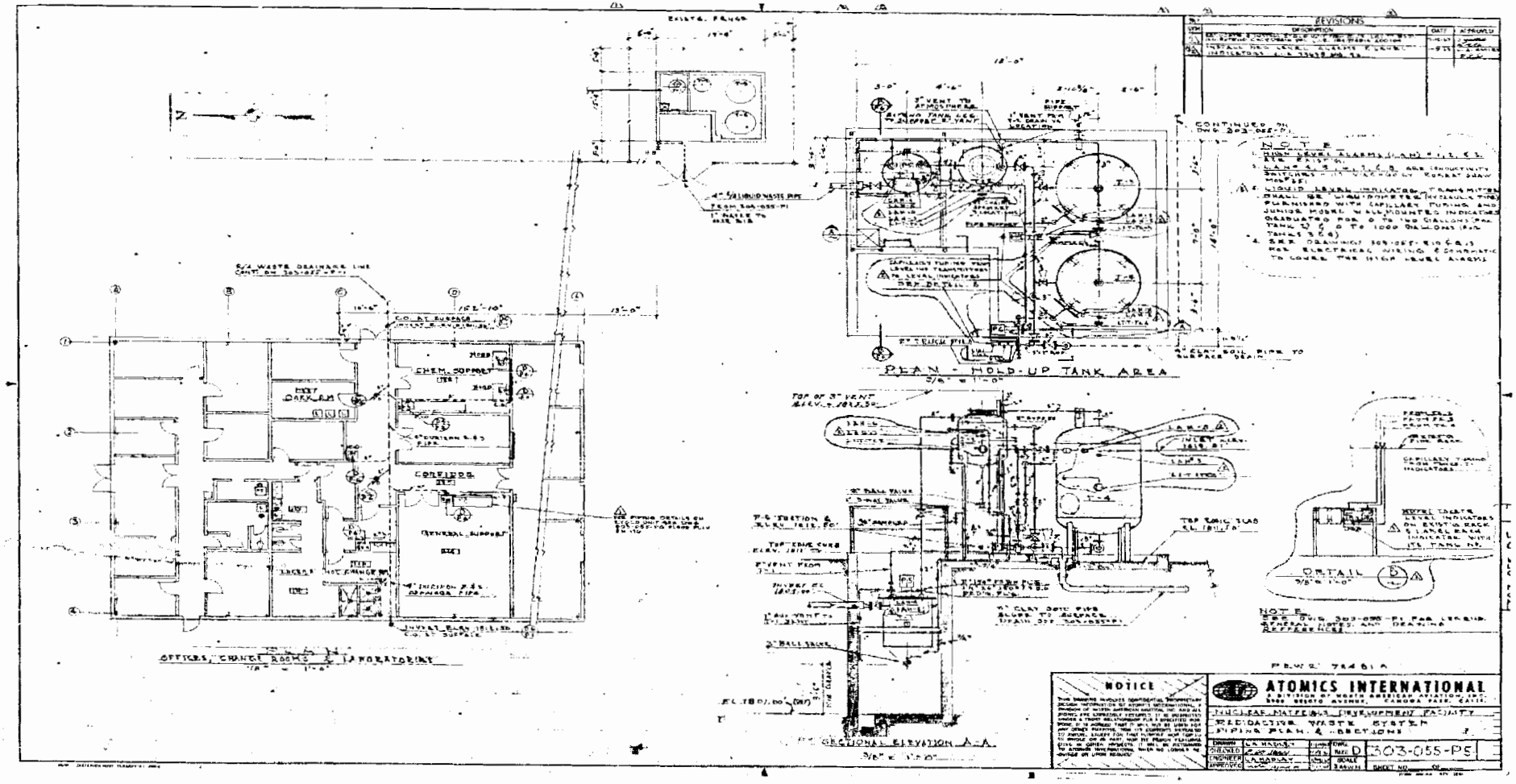
Figure 2.2.4i
Building 4055
Radioactive Waste
System P&I Diagram



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Source: Boeing Company, 2008

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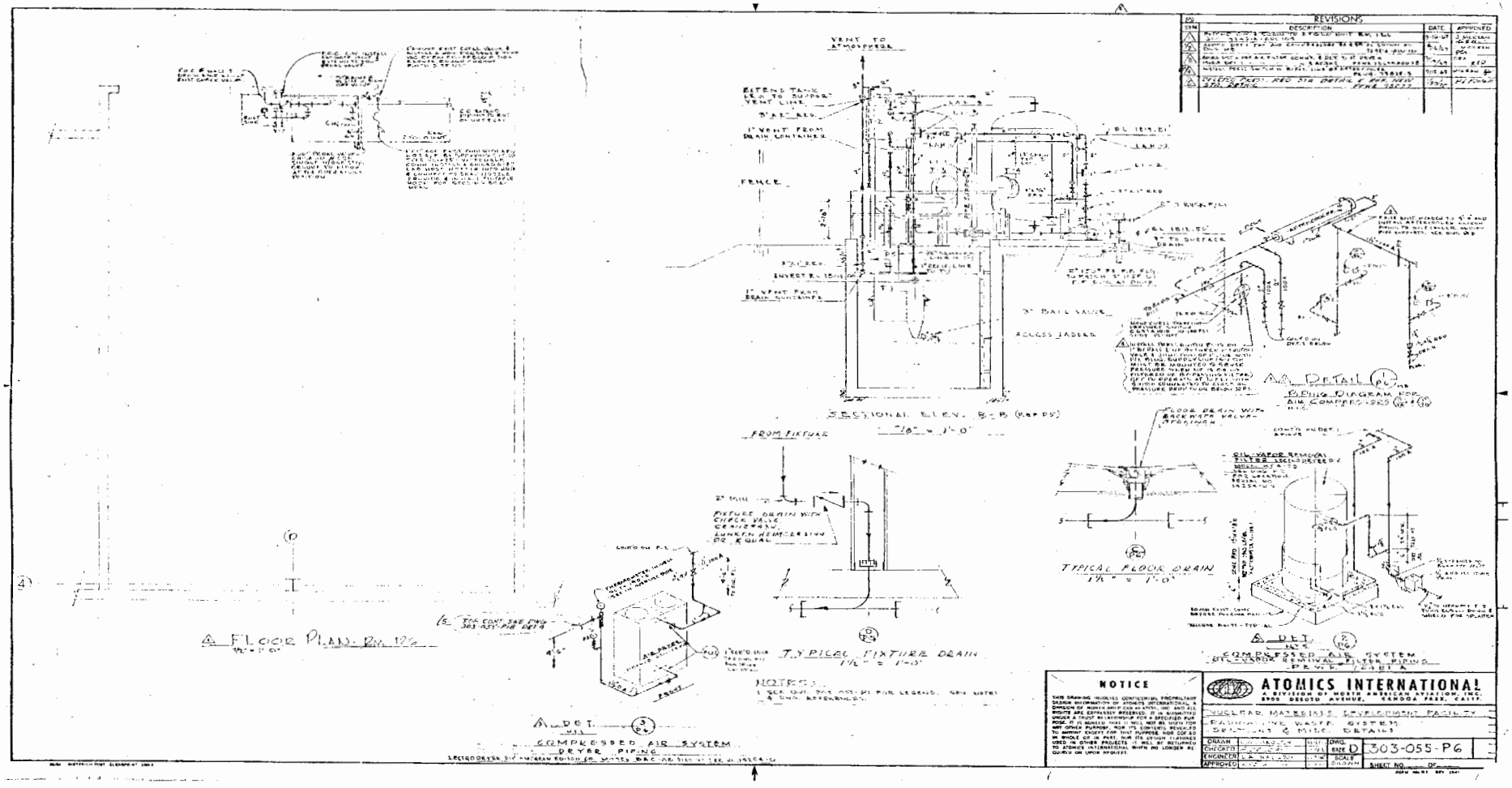
Figure 2.2.4j
Building 4055
Radioactive Waste System Piping Plan and Sections



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Source: Boeing Company, 2008

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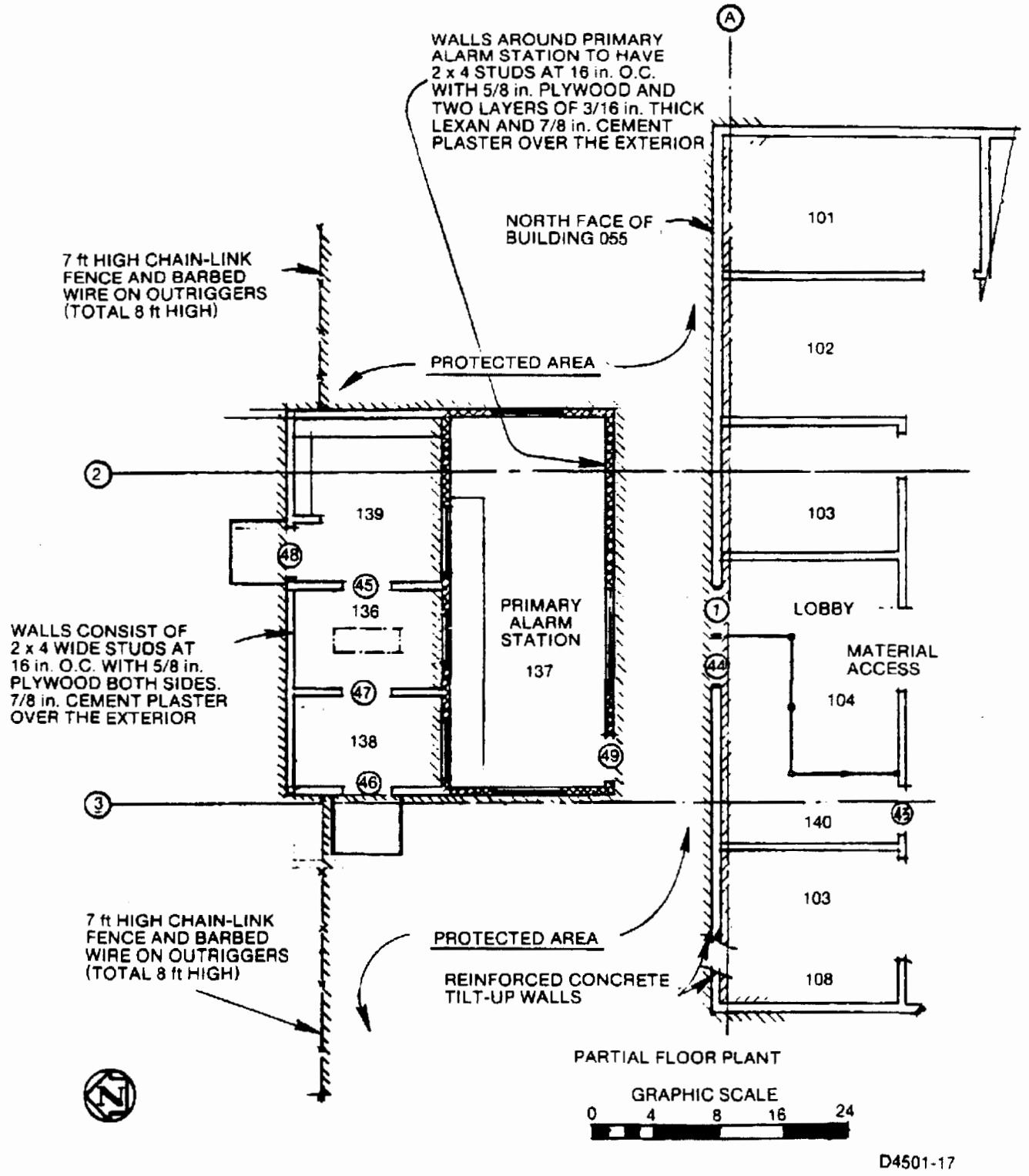
Figure 2.2.4k
Building 4055
Radioactive Waste
System Sections &
Miscellaneous Detail



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Source: Boeing Company, 2008

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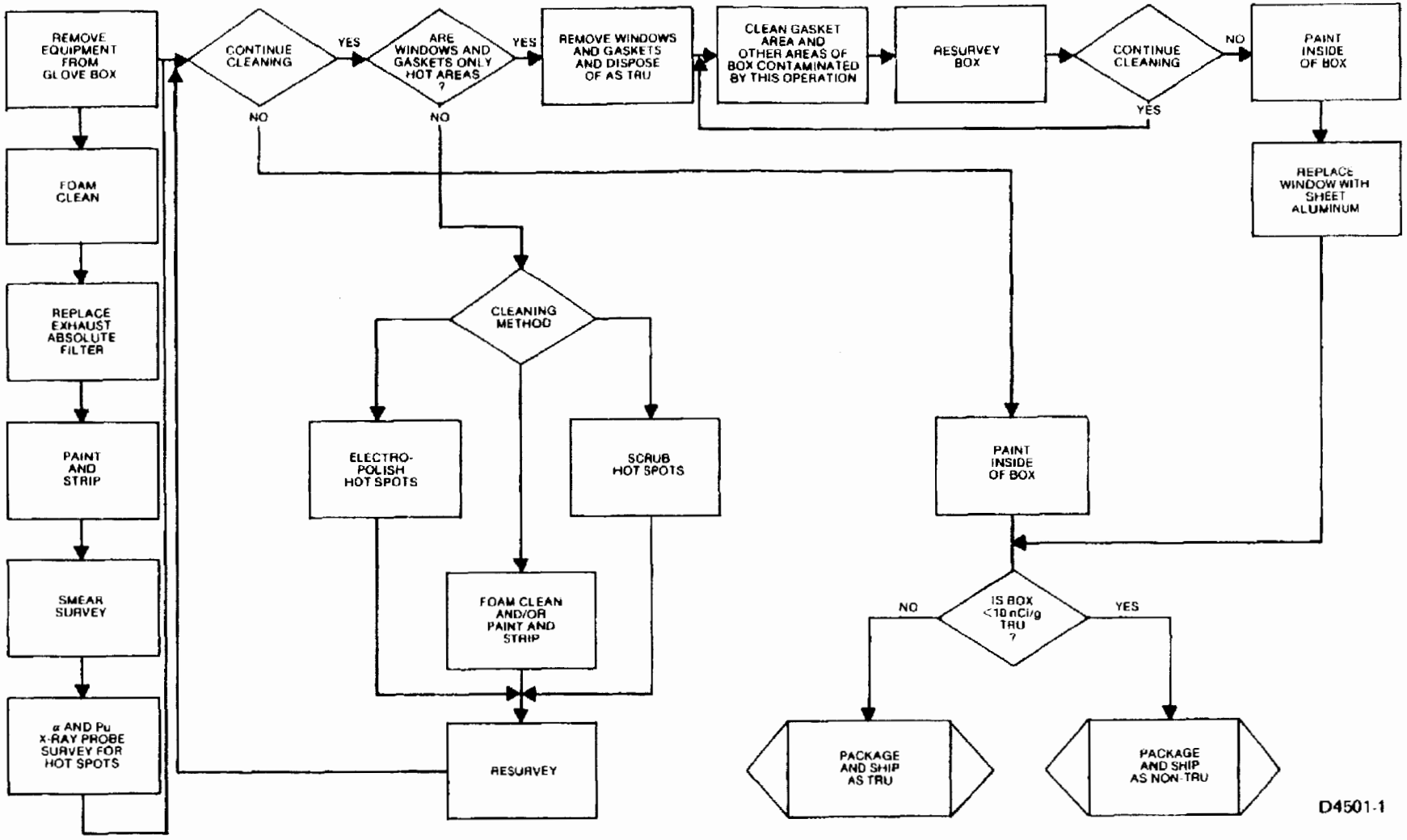
Figure 2.2.4l
Building 4055 Security Post Layout



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Project EP9038
Revised: 03/22/2011 TJ
Source: Boeing Company, 2008

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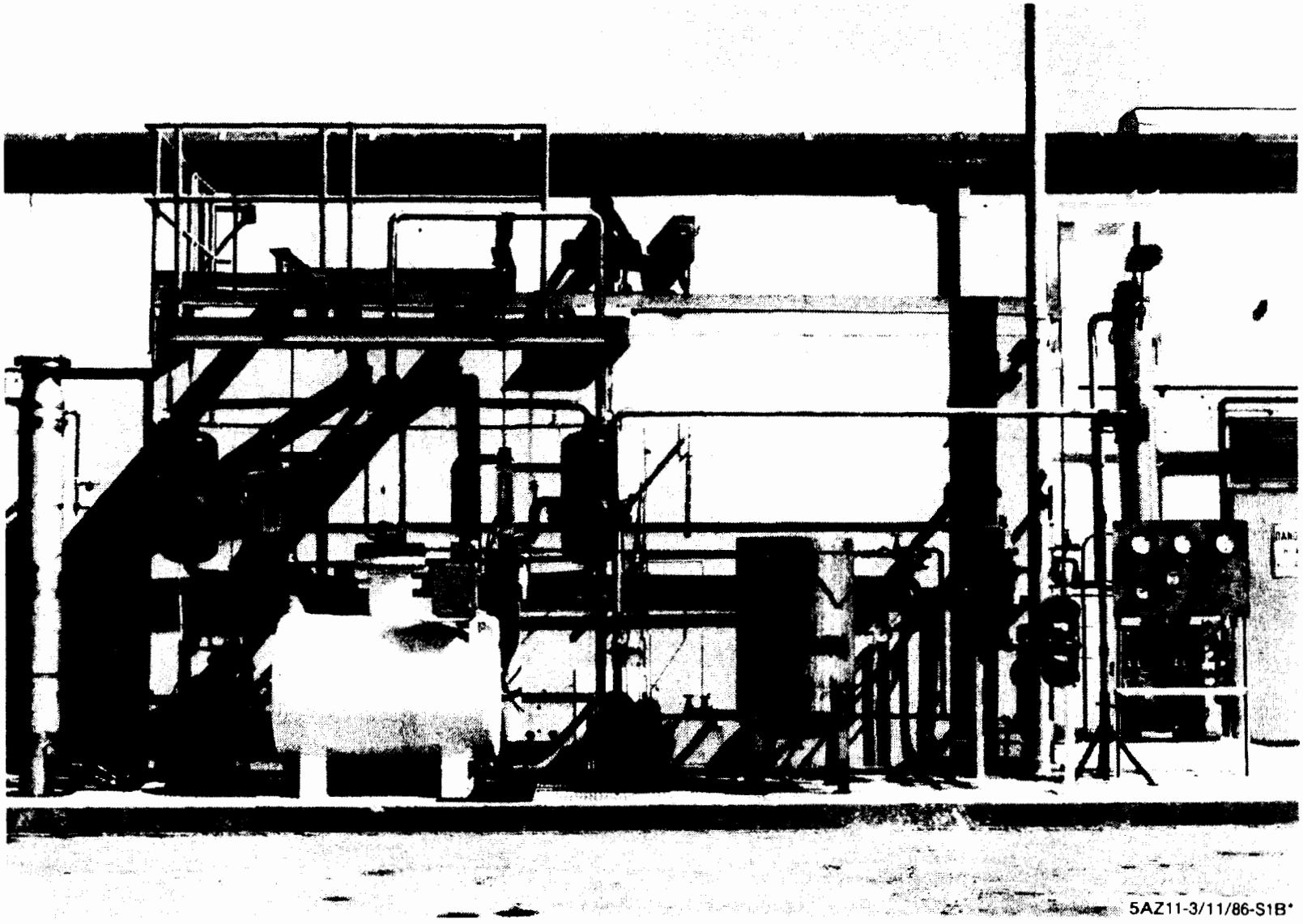
Figure 2.2.4m
Building 4055
Glove Box Cleaning
Flow Diagram



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Project:EP9038
Revised: 03/22/2011 TJ
Source: Boeing Company, 2008

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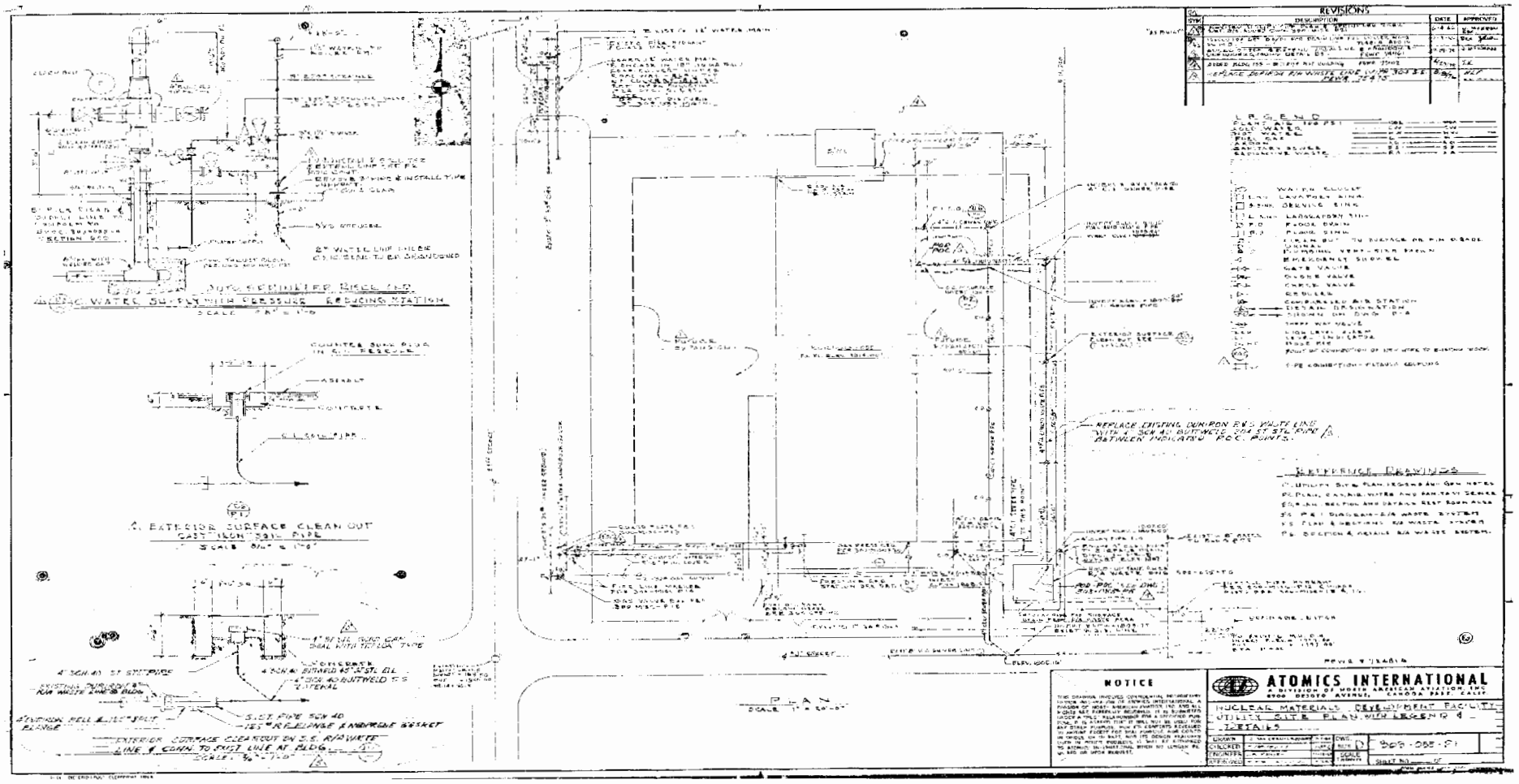
Figure 2.2.4n
Building 4055
NaK bubbler
Cleaning Facility
Photograph



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Project:EP9038
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Figure 2.2.4o
Building 4055
Radioactive Waste
System Utility
Site Plan

REDACTED

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Project:EP9038
Revised: 03/22/2011 TJ
Source: Boeing Company, 2008

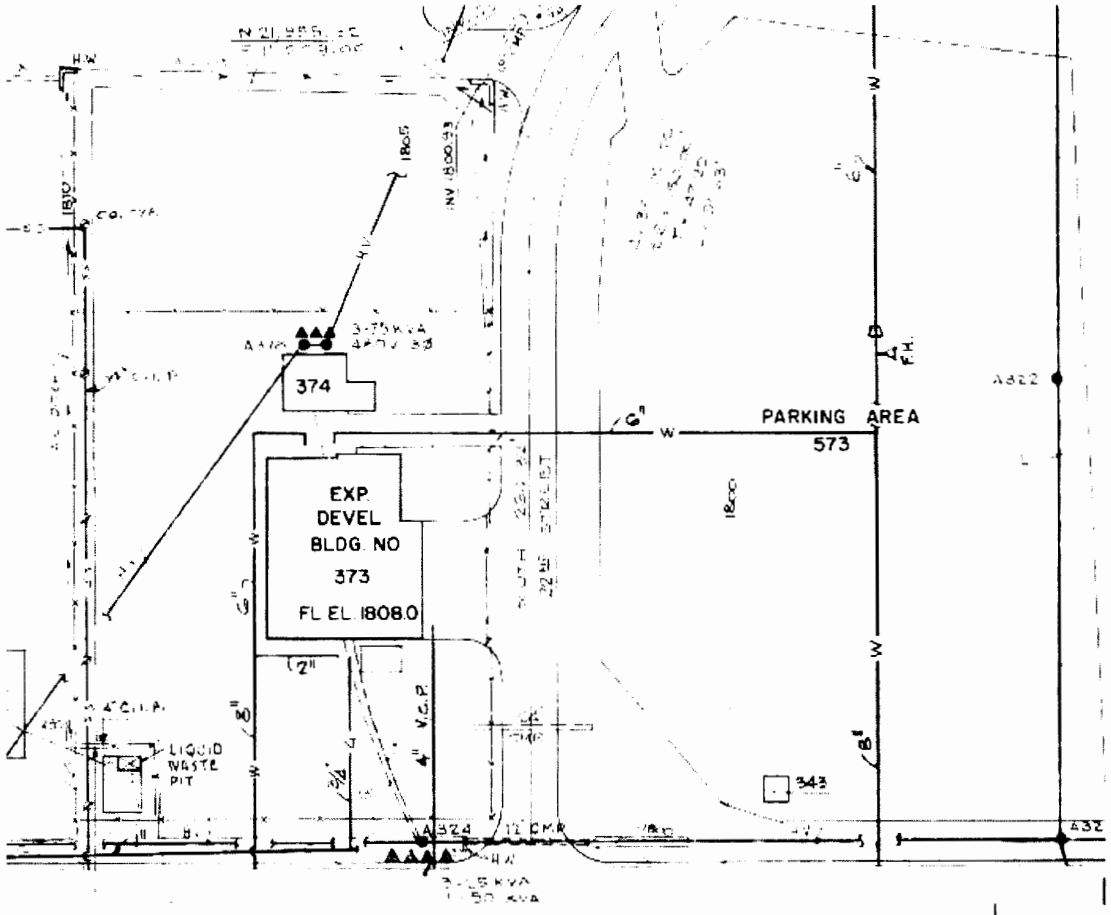
U.S. EPA Region 9

Figure 2.2.4p
Building 4055
Glove Box B8
Radwaste Combustion Installation

Y:/Santa_Susana/EP9038/TM/HSA_5D (2-2-5a)Bldg4373SP.cdr
Project:EP9038
Revised: 03/23/2011 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.2.5a
Building 4373
Site Photograph



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SANTA SUSANA FACILITY
PLOT PLAN

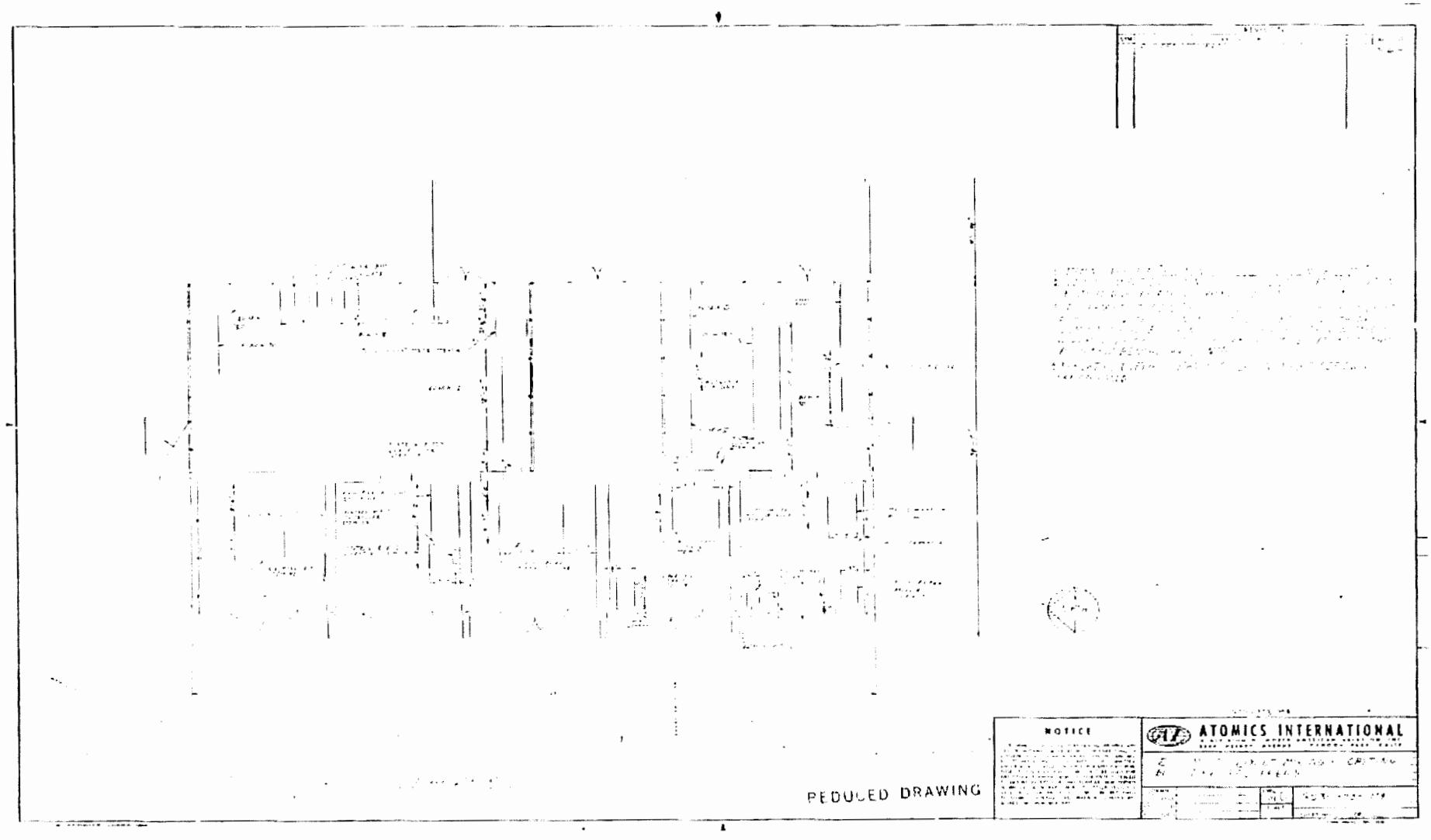
DRAWN	HAMMAN		DWG SIZE E	303-GEN.-C41
CHECKED				
ENGINEER	R.P. HAMMAN		SCALE 1"=40'	SHEET NO. 7 OF 14
APPROVED				

FORM NRI-P-3 REV. 12-61

Y:/Santa_Susana/EP9038/TM/HSA_5D (2-2-5b)Bldg4373PP.cdr
Project:EP9038
Revised: 03/22/2011 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.2.5b
Building 4373
Plot Plan



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Revised: 03/22/2011 TJ
Source: Boeing Company, 2008

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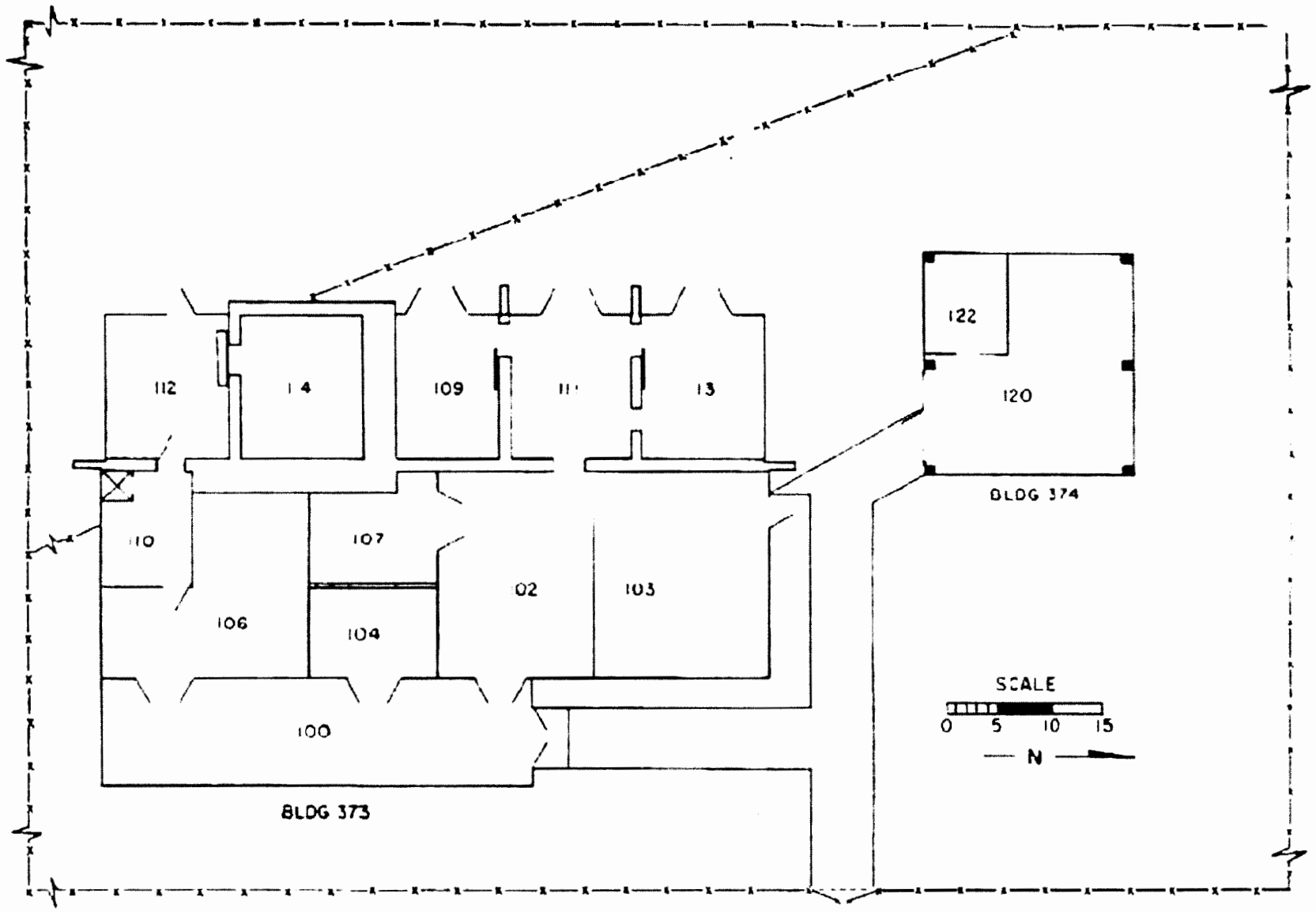
Figure 2.2.5c
Building 4373
Equipment Layout
Mixing and Casting
Building



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Source: Boeing Company, 2008

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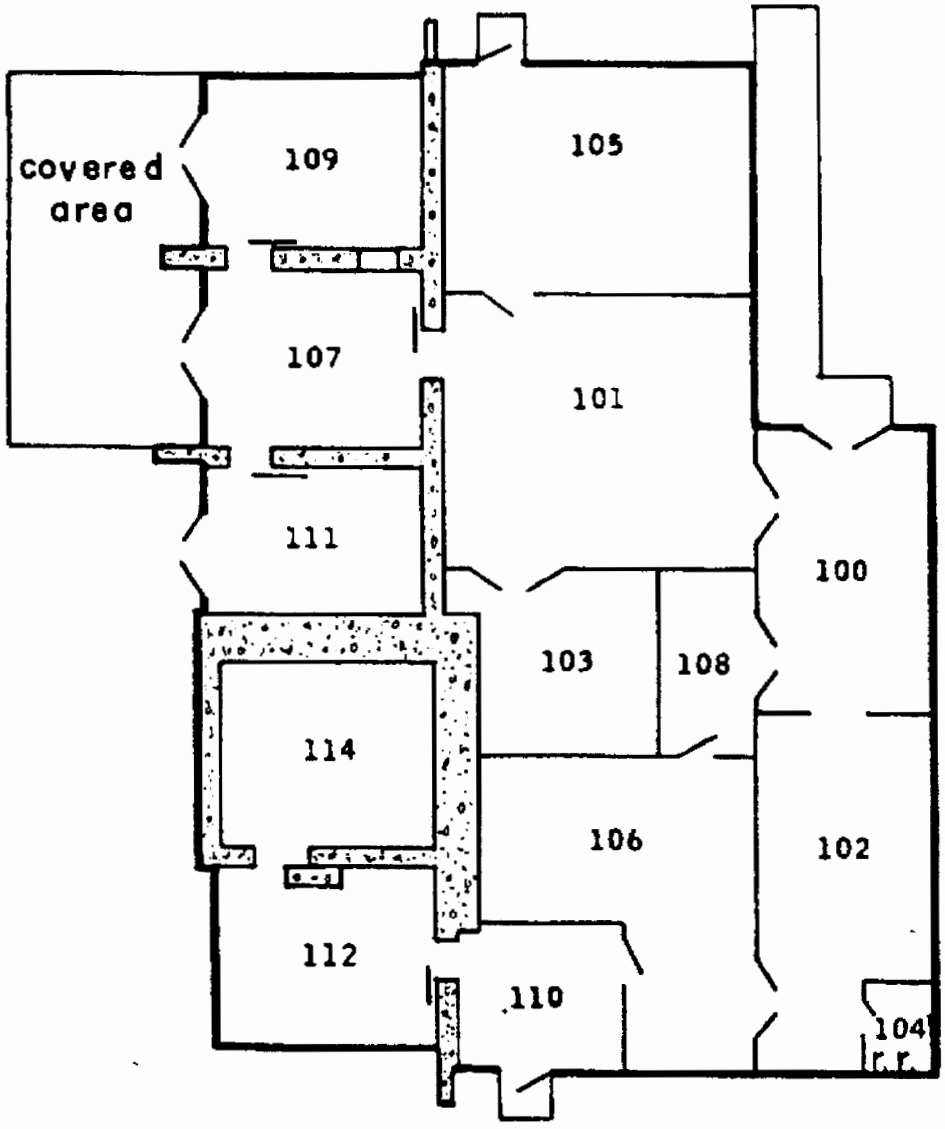
Figure 2.2.5d
Building 4373
SNAP Critical
Facility Layout
1962



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Revised: 03/22/2011 TJ
Source: Boeing Company, 2008

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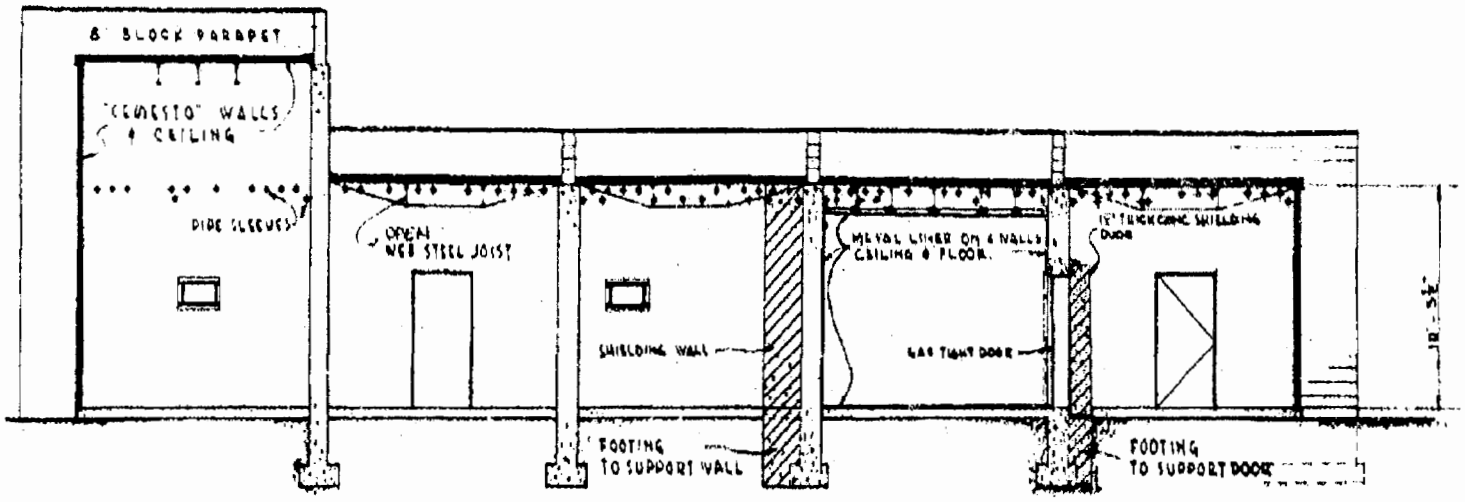
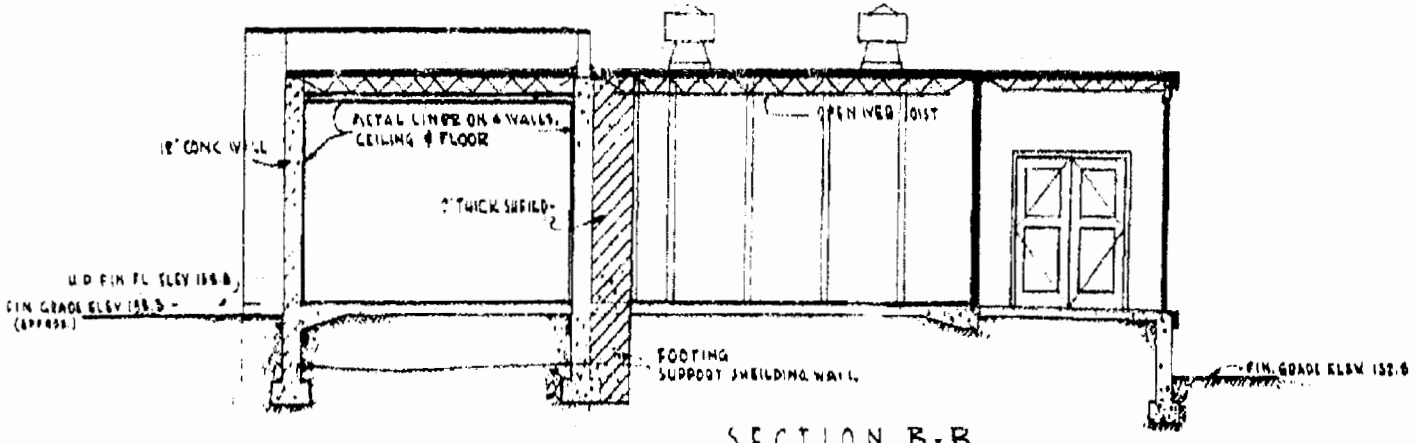
Figure 2.2.5e
Building 4373
SNAP Critical
Facility Layout
1969



SECTION A-A



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Revised: 03/22/2011 TJ
Source: Boeing Company, 2008

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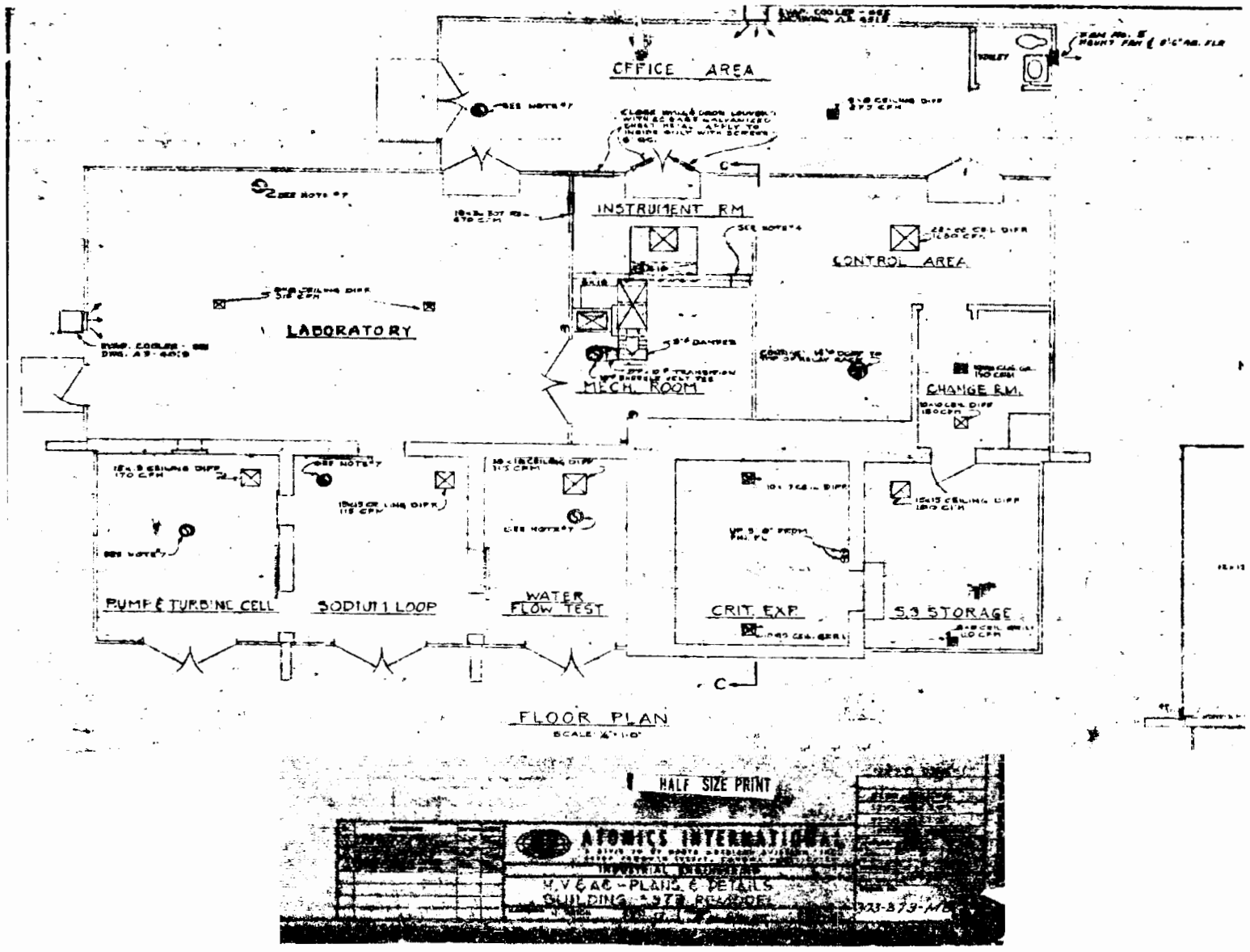
Figure 2.2.5f
Building 4373
Sectional View



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Revised: 03/22/2011 TJ
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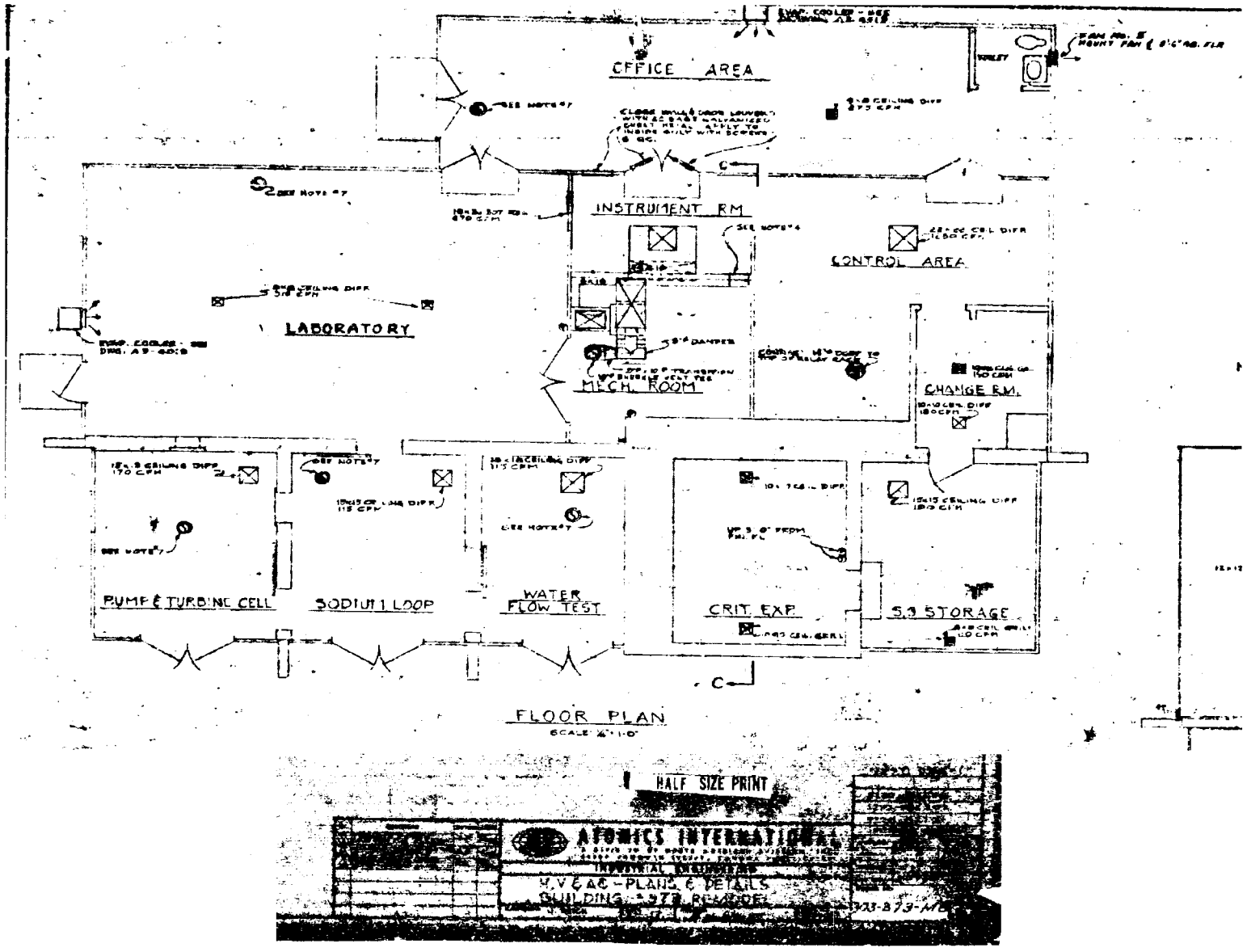
Figure 2.2.5g
Building 4373
HV&AC Plans and Details



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Revised: 03/22/2011 TJ
Source: Boeing Company, 2008

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Figure 2.2.5h
Building 4373
Mercury Test
Loop Installation

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Project:EP9038
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Source: Boeing Company, 2008

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Figure 2.2.5i
Building 4373
1999 Aerial Oblique

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Project:EP9038
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Source: Boeing Company, 2008

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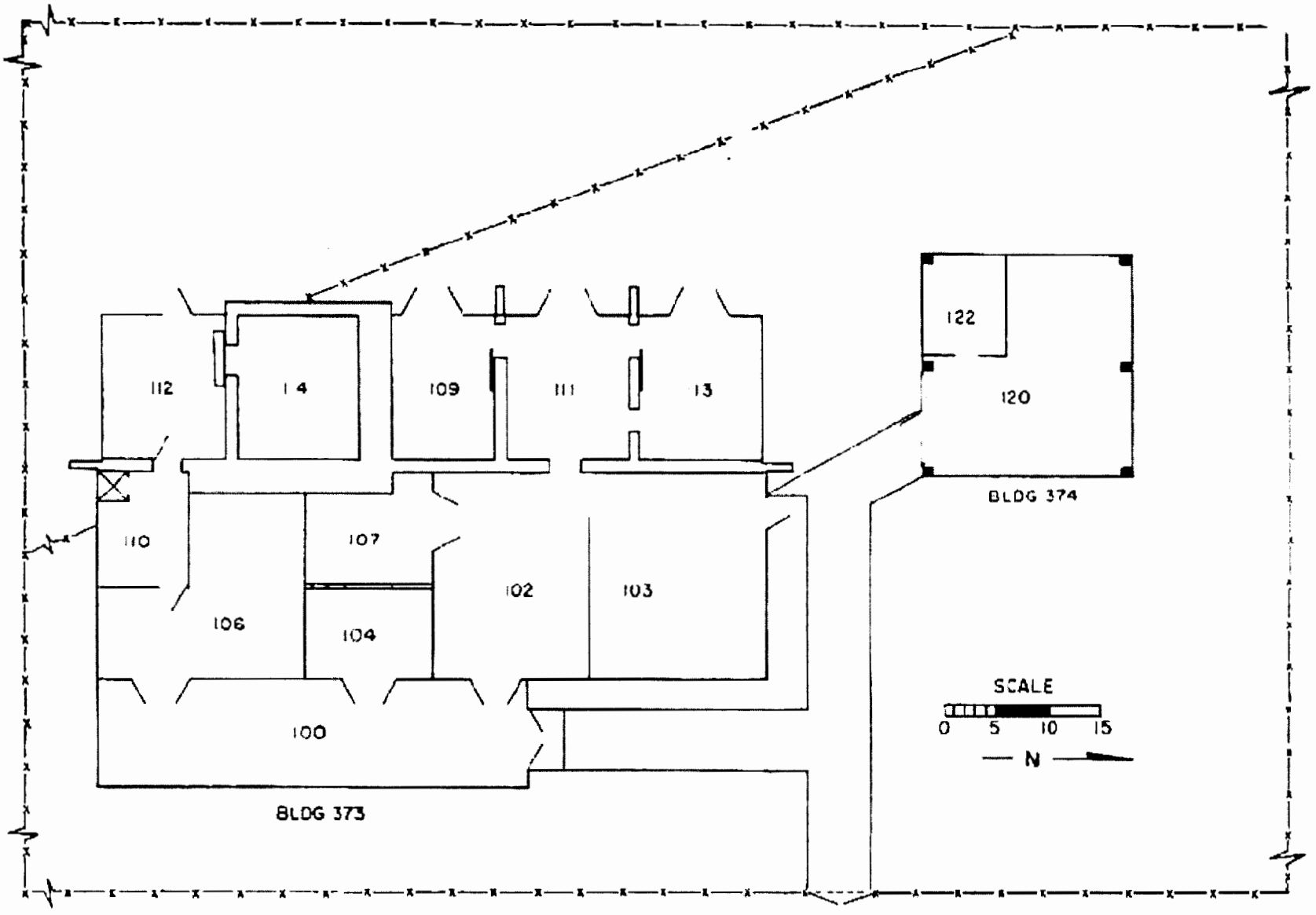
Figure 2.2.6a
Building 4374
Site Photograph



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Project:EP9038
Revised: 03/22/2011 TJ
Source: Boeing Company, 2008

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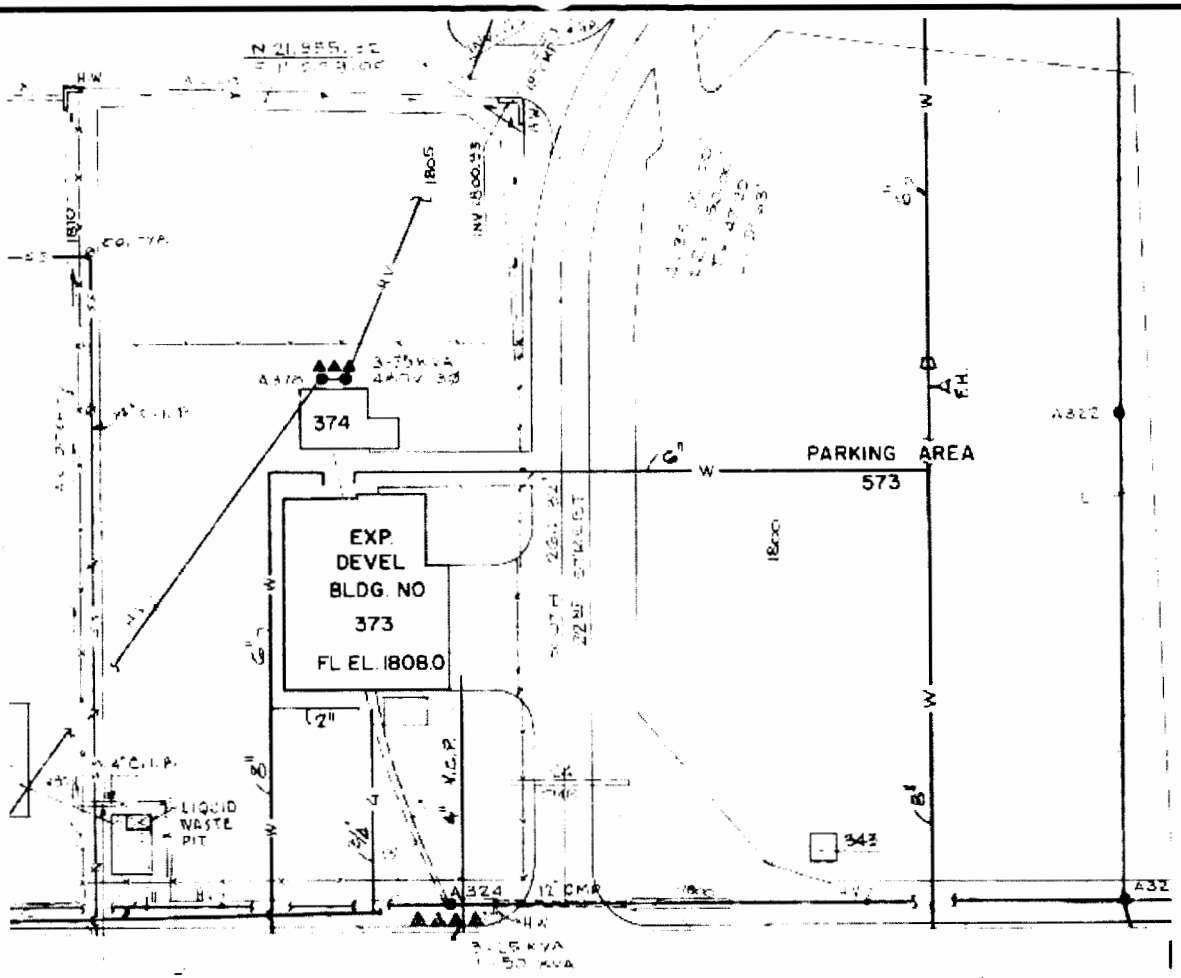
Figure 2.2.6b
Building 4374
Floor Plan



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PLOT PLAN

DRAWN	HAMMAN		DWG SIZE E	303-GEN.-C41
CHECKED				
ENGINEER	R P HAMMAN		SCALE 1"=40'	SHEET NO. 7 OF 14
APPROVED				

Y:/Santa_Susana/EP9038/TM/HSA_5D (2-2-6c)Bldg4374PP.cdr
Project:EP9038
Revised: 03/22/2011 TJ
Source: Boeing Company, 2008

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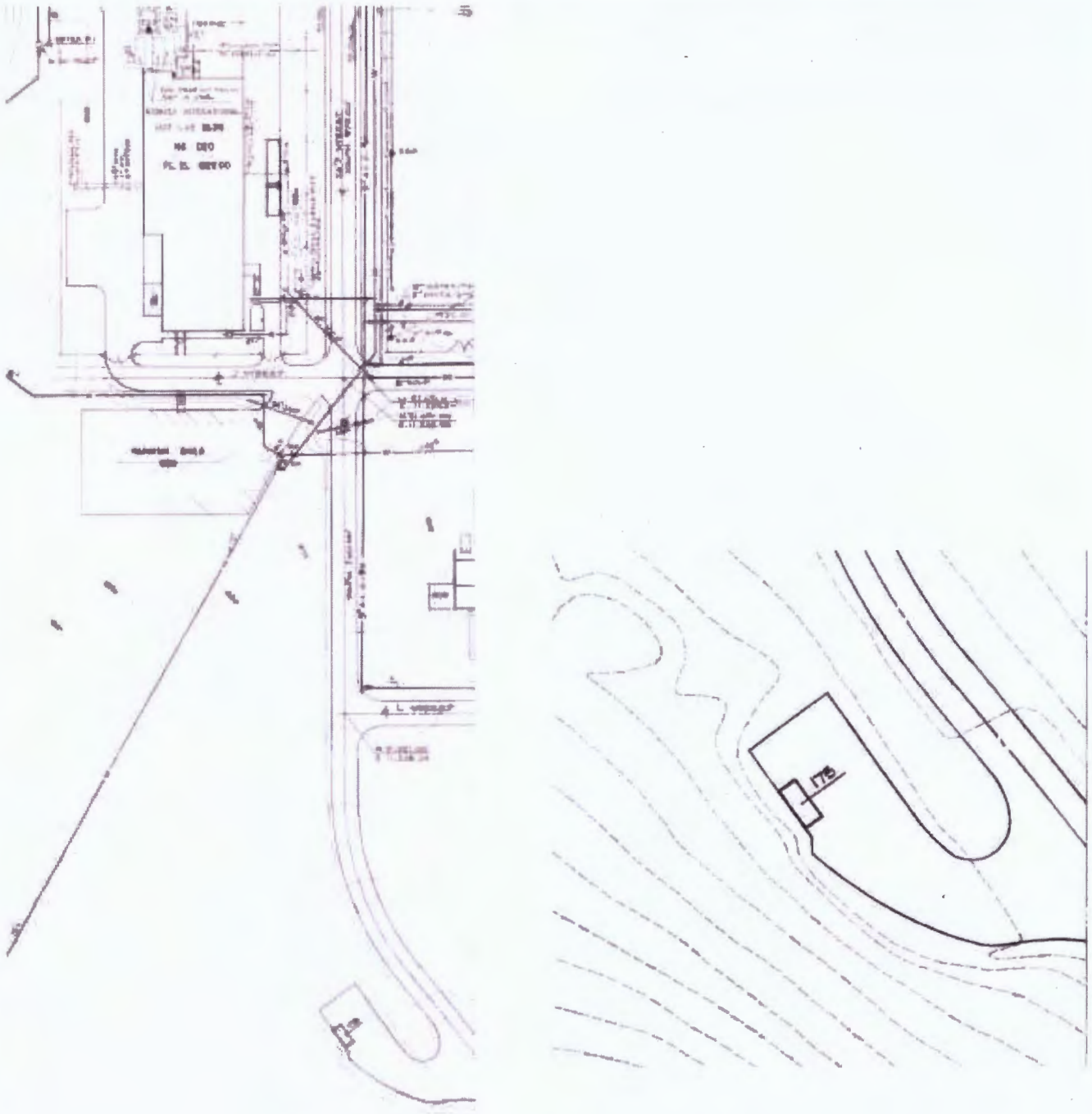
Figure 2.2.6c
Building 4374
Plot Plan



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Project:EP9038
Revised: 03/21/2011 TJ
Source: Boeing Company, 2008

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Figure 2.2.7b
Building 4173(4865)
Plot Plan

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Project:EP9038
Revised: 03/23/2011 TJ
Source: Boeing Company, 2008

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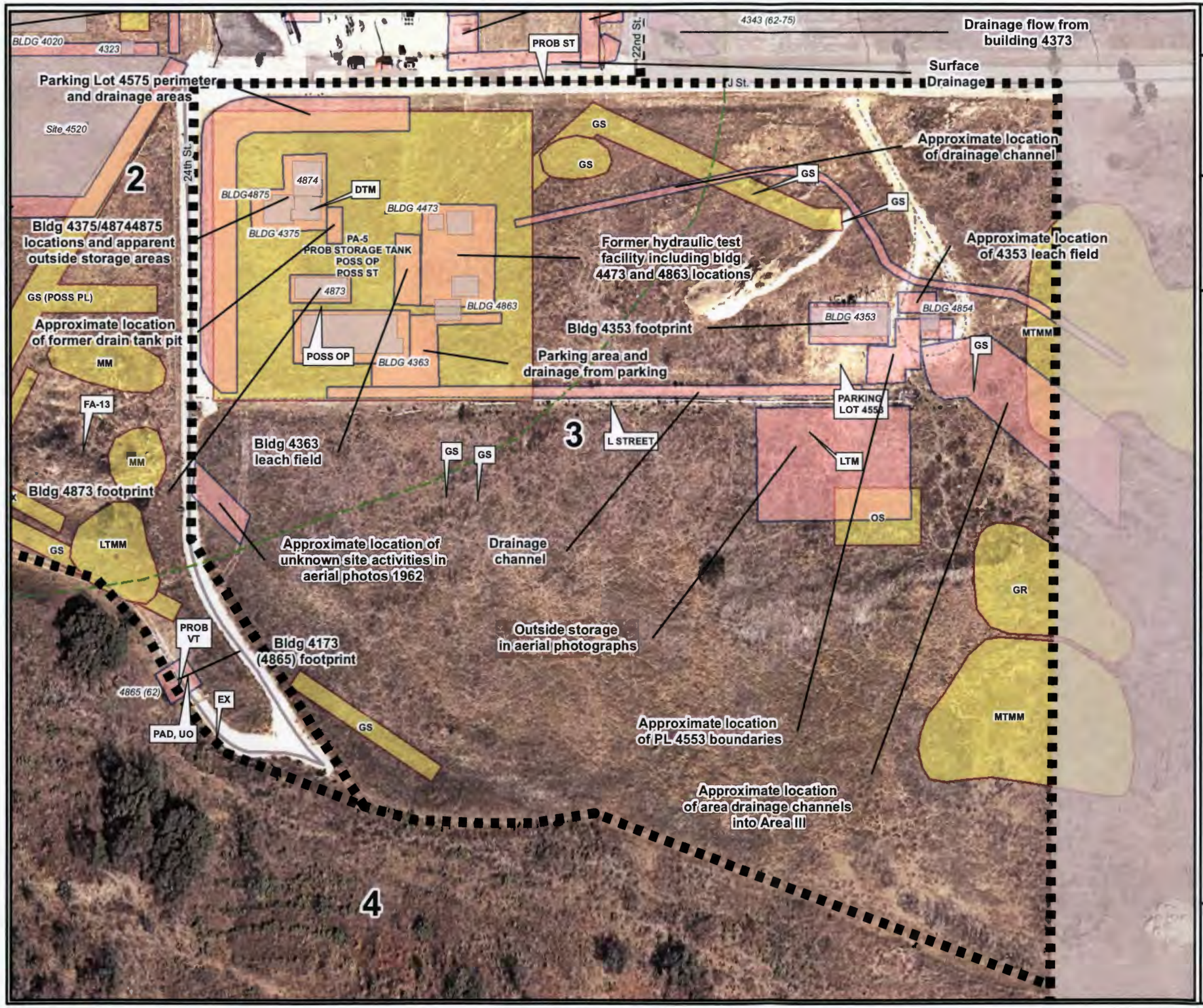
Figure 2.2.7a
Building 4173(4865)
Site Photograph

Figure 2.3
Area IV Subarea 5D-3
Santa Susana Field Laboratory

U.S. EPA Region 9



Legend

Subarea 5D-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	
Proposed Sampling Locations	
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 25 50 100
Scale In Feet

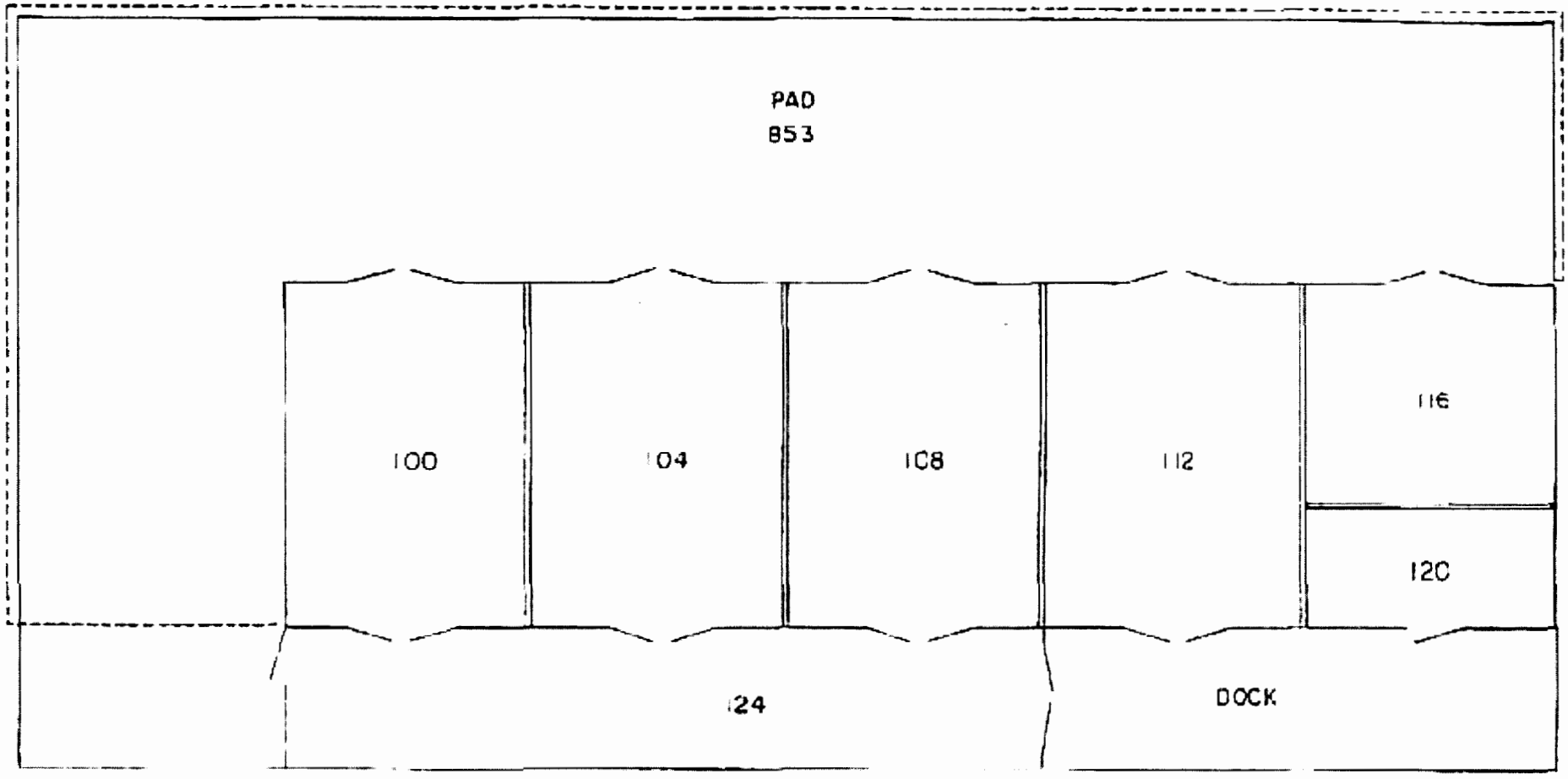
Y:\Santa_Susana\EP9038\TM\HSA_5D
(2-3)5D-3.mxd
12/1/2011 tjansen
Sorce: Boeing Company, 2008
CIRGIS, 2007

HGL HydroGeoLogic, Inc.

Y:/Santa_Susana/EP9038/TM/HSA_5D (2-3-1a)Bldg4353SP.cdr
Project:EP9038
Revised: 03/23/2011 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.3.1a
Building 4353
Site Photograph



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Project:EP9038
Revised: 03/22/2011 TJ
Source: Boeing Company, 2008

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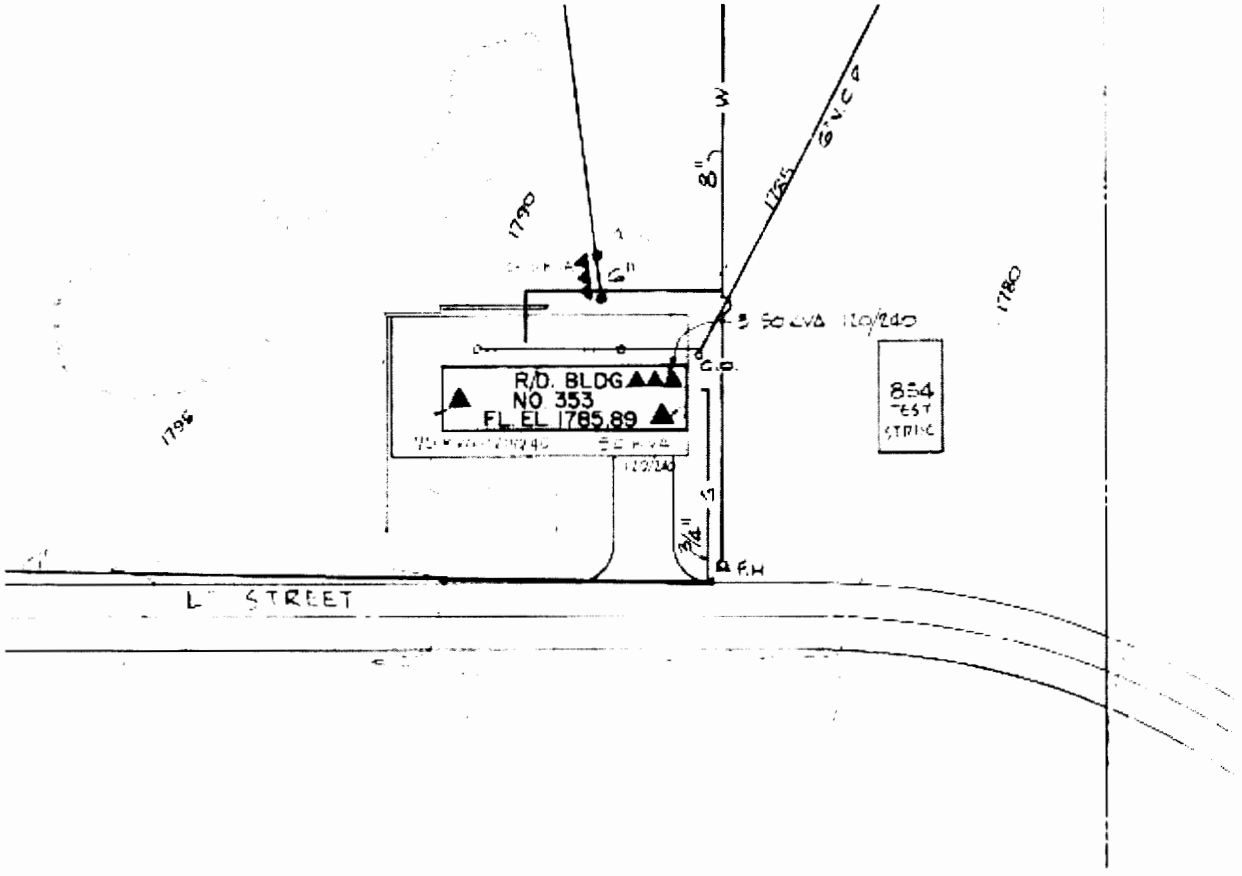
Figure 2.3.1b
Building 4353
Floor Plan



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SANTA SUSANA FACILITY
PLOT PLAN

DRAWN	HAMMAN	DWG.	303-GEN. C-42
CHECKED		SIZE E	
ENGINEER	R.P.HAMMAN	SCALE 1" = 40'	
APPROVED		SHEET NO. 8 OF 14	

Y:/Santa_Susana/EP9038/TM/HSA_5D
(2-3-1c)Bldg4374PP.cdr
Project:EP9038
Revised: 03/22/2011 TJ
Source: Boeing Company, 2008

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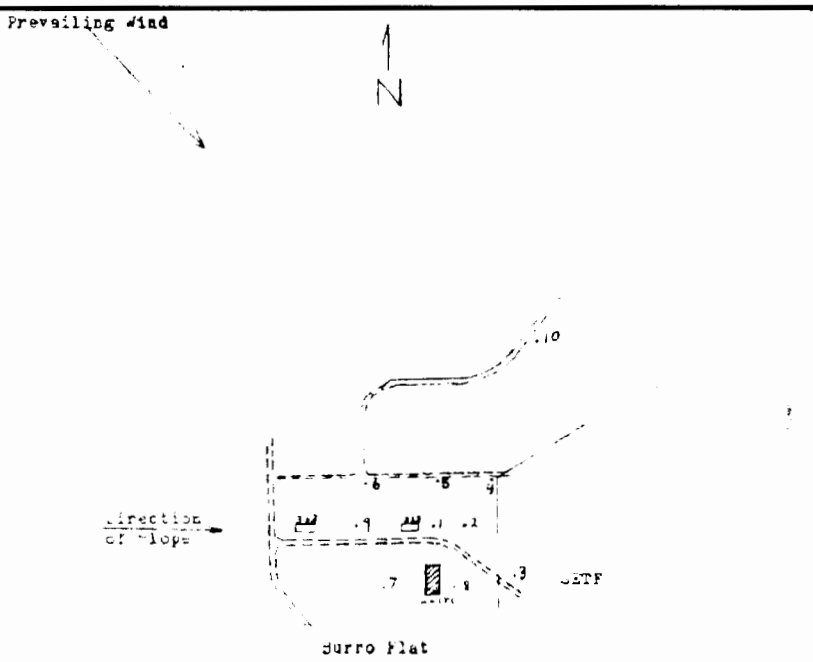
Figure 2.3.1c
Building 4353
Plot Plan



Date 27 February 1959 Location Bldg. 353, Burro Flat SS

Sample	Station	Volume	gm	gm	cc	cc
Soil	1	1.0 gm	7.02×10^{-8}	1.44×10^{-5}		
Veg.		0.3 gm	1.41×10^{-8}	2.44×10^{-4}		
Soil	3	1.0 gm	1.64×10^{-7}	2.45×10^{-5}		
Veg		0.3 gm	1.24×10^{-7}	7.62×10^{-4}		
Soil	5	1.0 gm	3.69×10^{-7}	1.94×10^{-5}		
Veg		0.3 gm	1.81×10^{-7}	7.91×10^{-4}		
Soil	7	1.0 gm	3.72×10^{-7}	6.54×10^{-5}		
Veg		0.3 gm	5.40×10^{-8}	5.09×10^{-4}		
Soil	9	1.0 gm	1.71×10^{-7}	2.05×10^{-5}		
Veg		0.3 gm	M.A.D.	5.28×10^{-4}		
Soil	2	1.0 gm	3.48×10^{-7}	2.93×10^{-5}		
Veg		0.3 gm	1.68×10^{-7}	7.76×10^{-4}		
Soil	4	1.0 gm	1.64×10^{-7}	2.49×10^{-5}		
Veg		0.3 gm	1.08×10^{-7}	4.31×10^{-4}		
Soil	6	1.0 gm	4.05×10^{-7}	1.40×10^{-5}		
Veg		0.3 gm	M.A.D.	5.69×10^{-4}		
Soil	8	1.0 gm	2.57×10^{-7}	6.38×10^{-5}		
Veg		0.3 gm	4.00×10^{-7}	6.11×10^{-4}		
Soil	10	1.0 gm	4.72×10^{-8}	1.73×10^{-5}		
Veg		0.3 gm	M.A.D.	6.78×10^{-4}		

*enc activity detected

Surveyor

Odd numbered samples were processed without washing.
Even numbered samples were washed.

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Project:EP9038
Revised: 03/22/2011 TJ
Source: Boeing Company, 2008

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Figure 2.3.1d
Building 4353
1959 Special Survey

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Project:EP9038
Revised: 03/23/2011 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.3.2a
Parking Lot 4533
Site Photograph

Y:/Santa_Susana/EP9038/TM/HSA_5D (2-3-3a)Bldg4854SP.cdr
Project:EP9038
Revised: 03/23/2011 TJ
Source: Boeing Company, 2008

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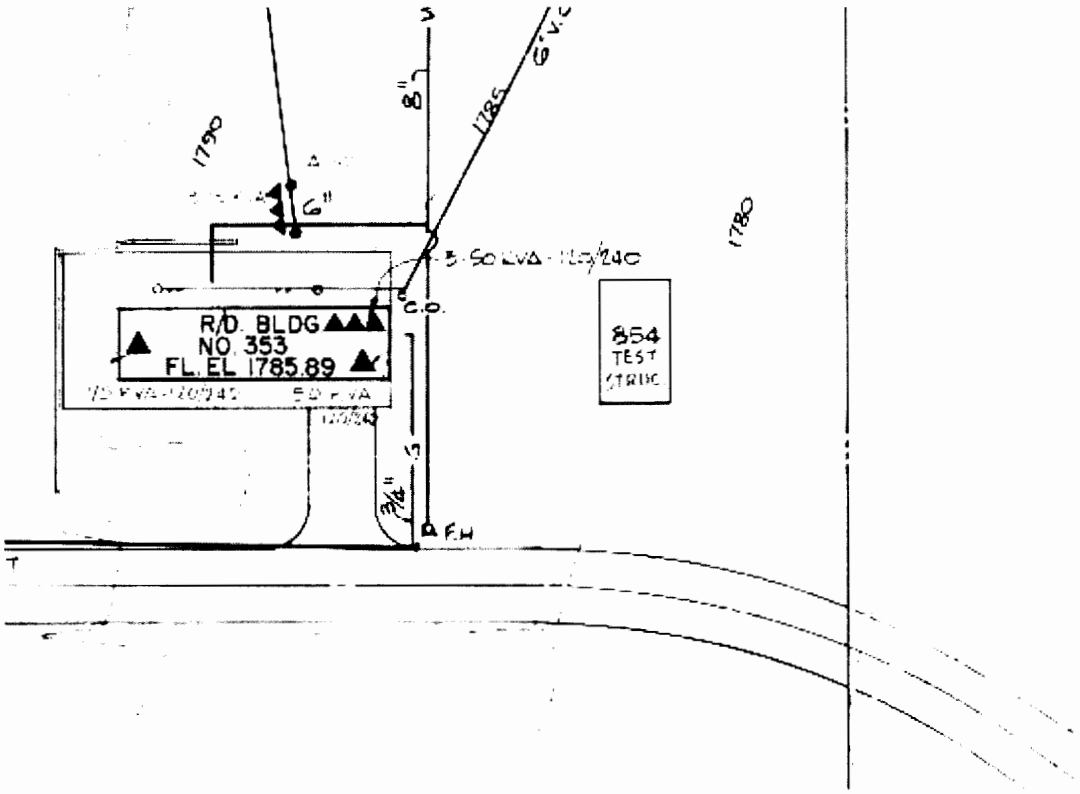
Figure 2.3.3a
Building 4854
Site Photograph



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PLOT PLAN

DRAWN	HAMMAN	DWG. SIZE E	303-GEN. C-42
CHECKED			
ENGINEER	R.P. HAMMAN	SCALE 1" = 40'	SHEET NO. 8 OF 14
APPROVED			

FORM 3-8-R-3 REV. 12-67

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U.S. EPA Region 9

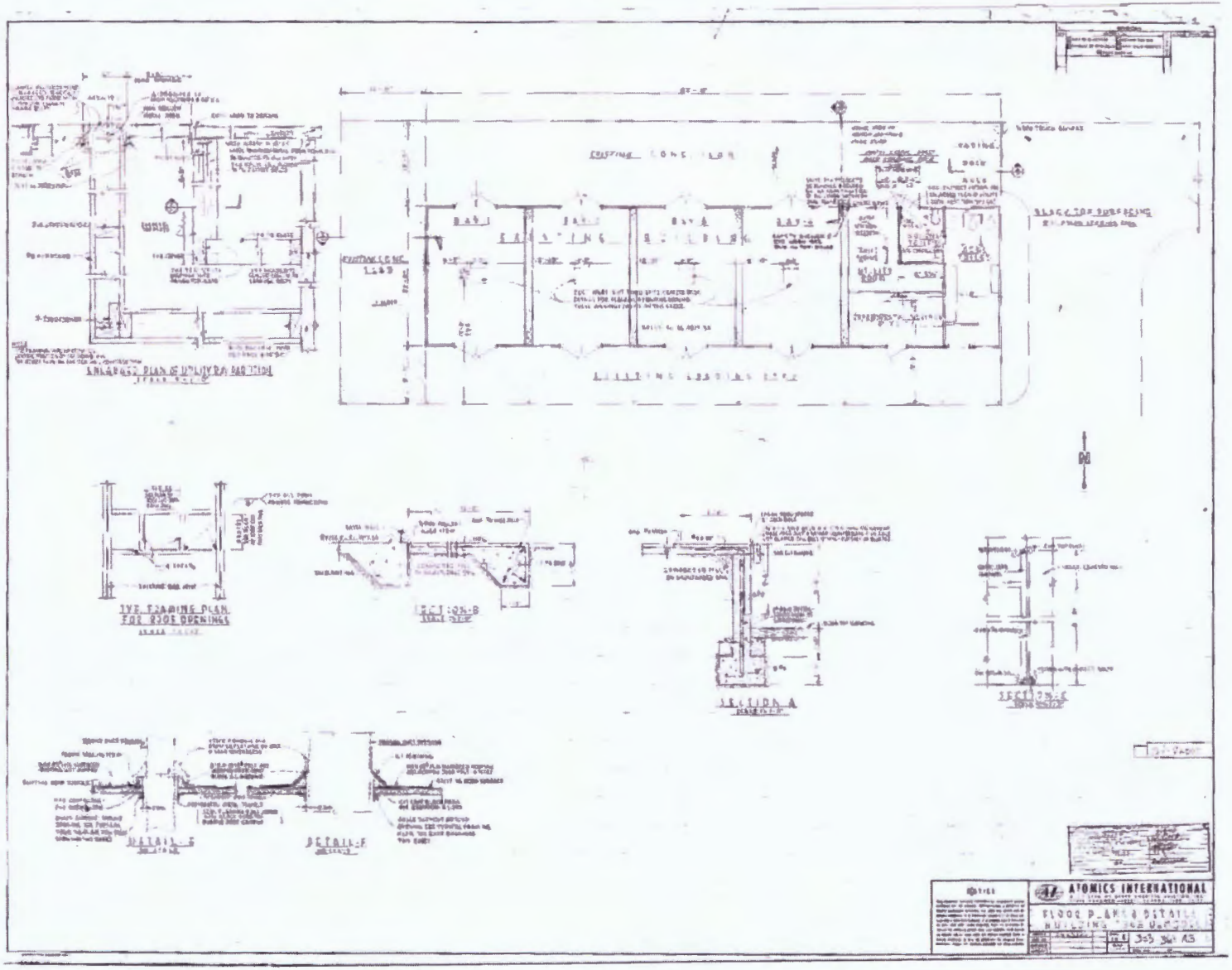
Figure 2.3.3b
Building 4854
Plot Plan

Redacted

Y:/Santa_Susana/EP9038/TM/HSA_5D (2-3-4a)Bldg4363SP.cdr
Project:EP9038
Revised: 03/23/2011 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.3.4a
Building 4363
Site Photograph



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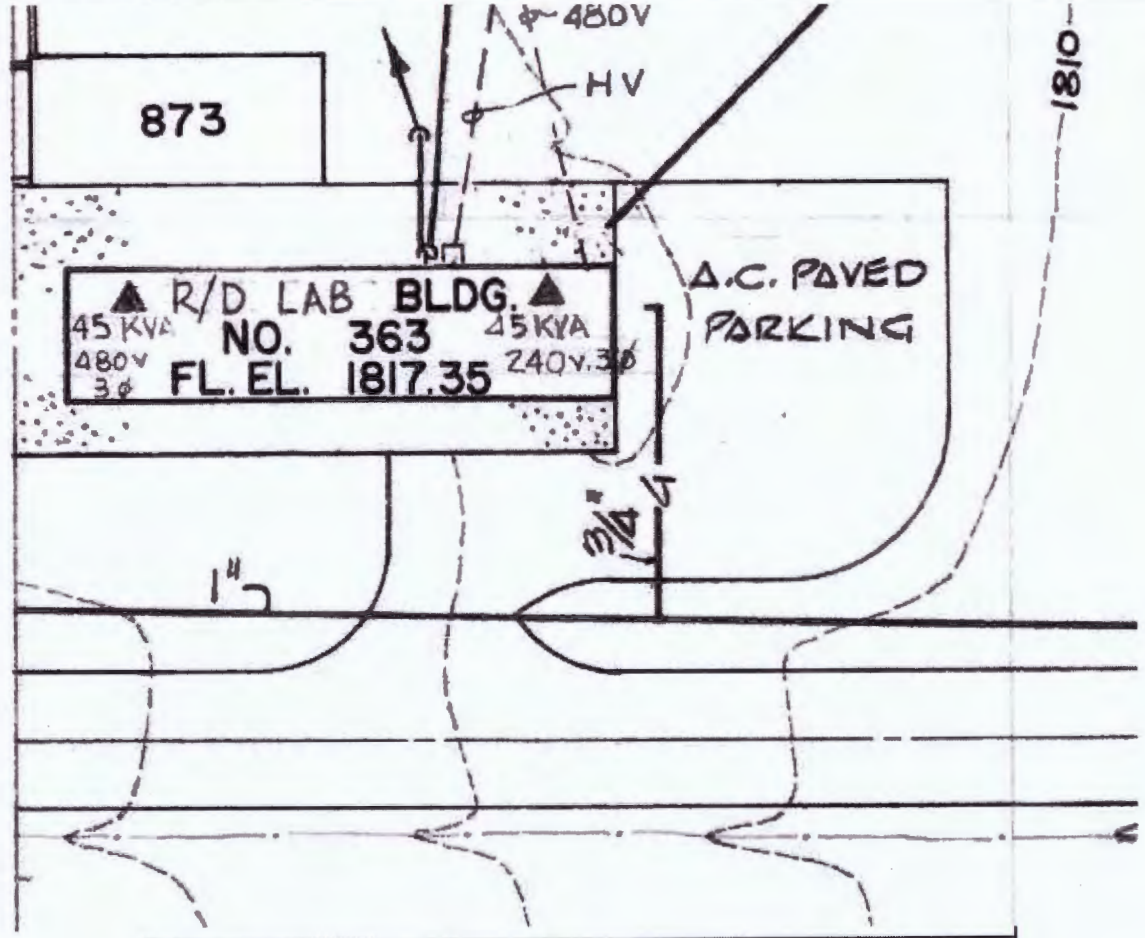
Revised: 03/22/2011 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.3.4b
Building 4363
Floor Plan



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SANTA SUSANA FACILITY
PLOT PLAN

DRAWN	HAMMAN	DWG. SIZE E	303-GEN. C-42
CHECKED			
ENGINEER	R.P. HAMMAN	SCALE 1"=40'	SHEET NO. 8 OF 14
APPROVED			

FORM NSI-R-3 REV. 12-61

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Project:EP9038
Revised: 03/22/2011 TJ
Source: Boeing Company, 2008

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Figure 2.3.4c
Building 4363
Plot Plan

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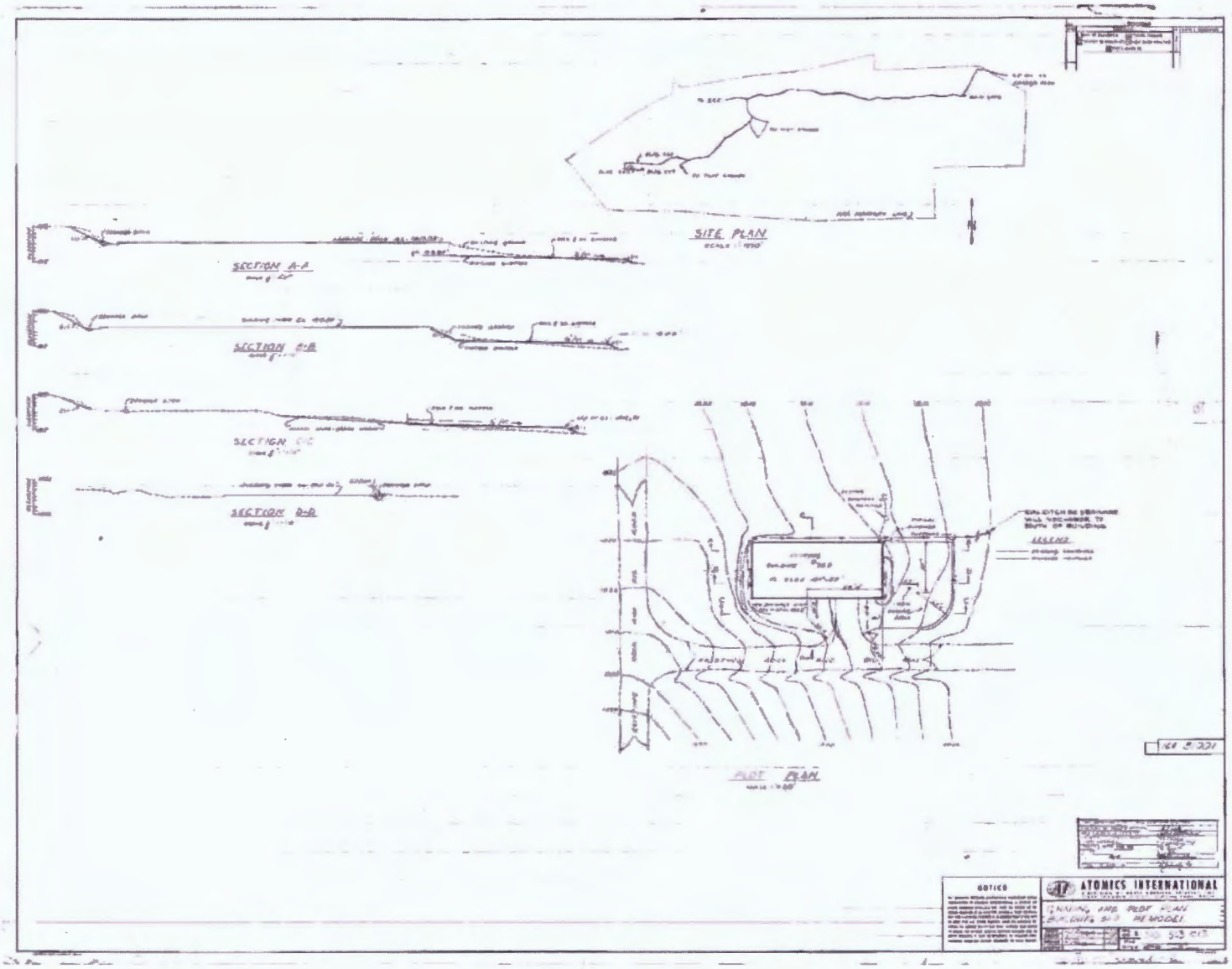
Source: Boeing Company, 2008

U.S. EPA Region 9

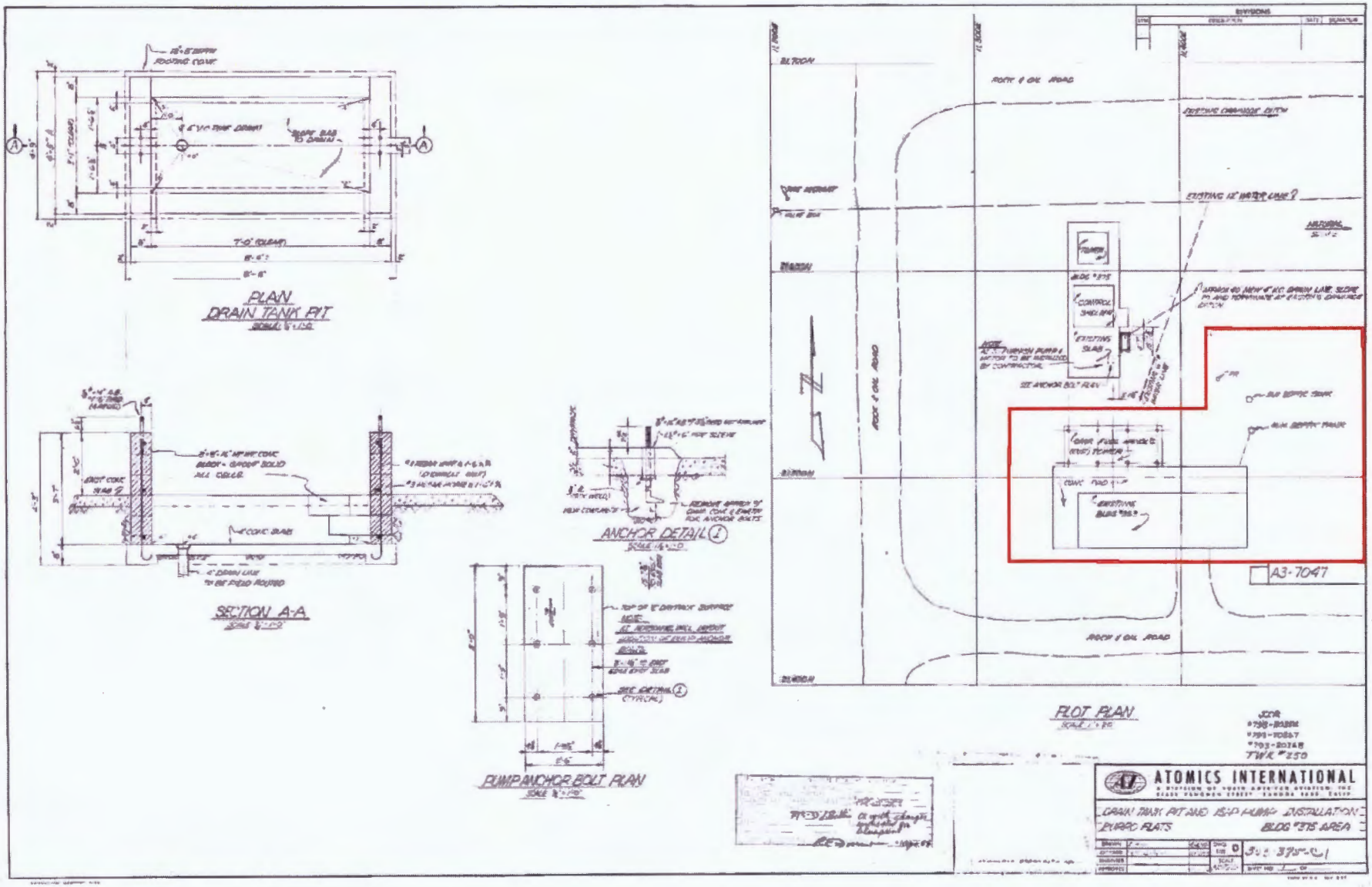
Figure 2.3.4d
Building 4363
Undated Site Photographs



Y:/Santa_Susana/EP9038/TM/HSA_5D (2-3-4e)Bldg4363Drainage.cdr
Project:EP9038
Revised: 03/22/2011 RB
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.3.4e
Building 4363
Drainage



Y:/Santa_Susana/EP9038/TM/HSA_5D (2-3-4f)Bldg4363LeachField_SepticTank_Location.cdr
Project:EP9038
Revised: 03/22/2011 RB
Source: Boeing Company, 2008

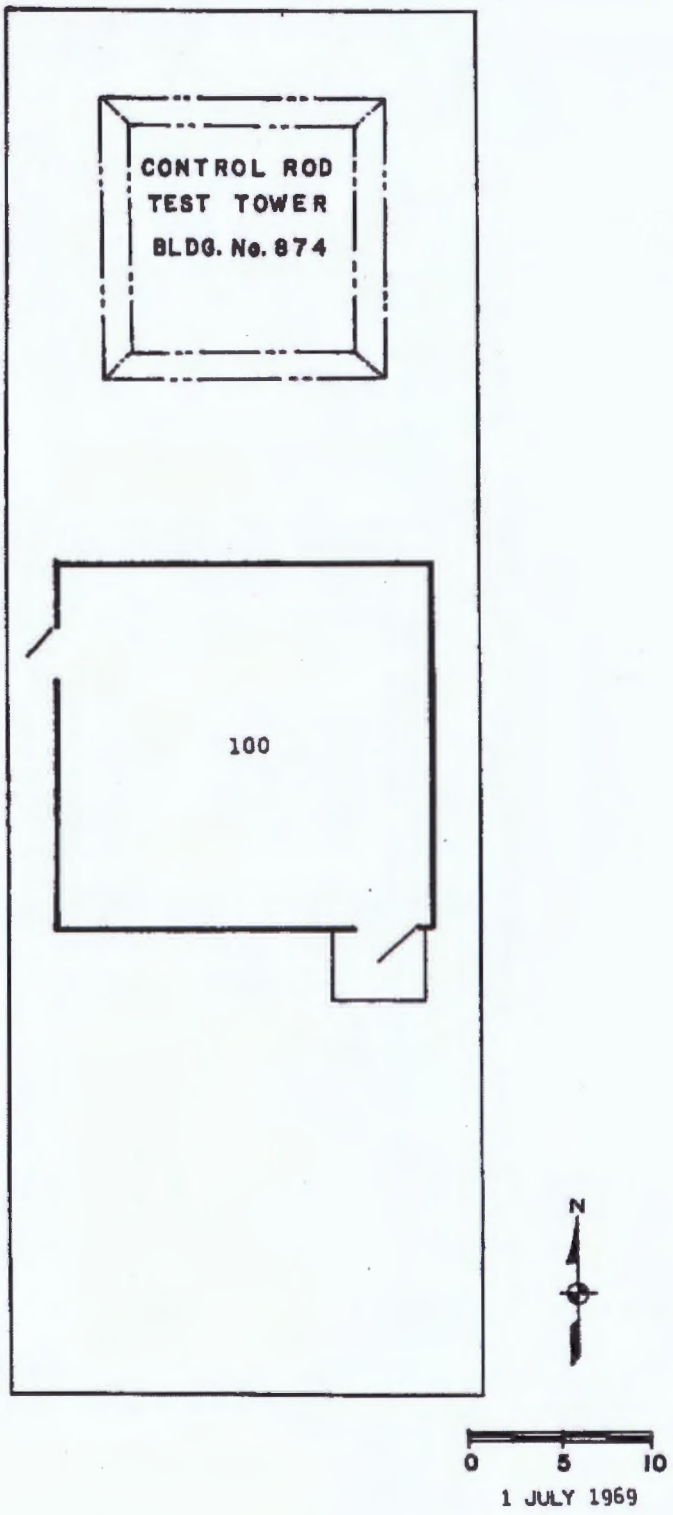
U.S. EPA Region 9

Figure 2.3.4f
Building 4363
Leach Field and
Septic Tank Location

Y:/Santa_Susana/EP9038/TM/HSA_5D
(2-3-5a)Bldg4375SP.cdr
Project:EP9038
Revised: 03/23/2011 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

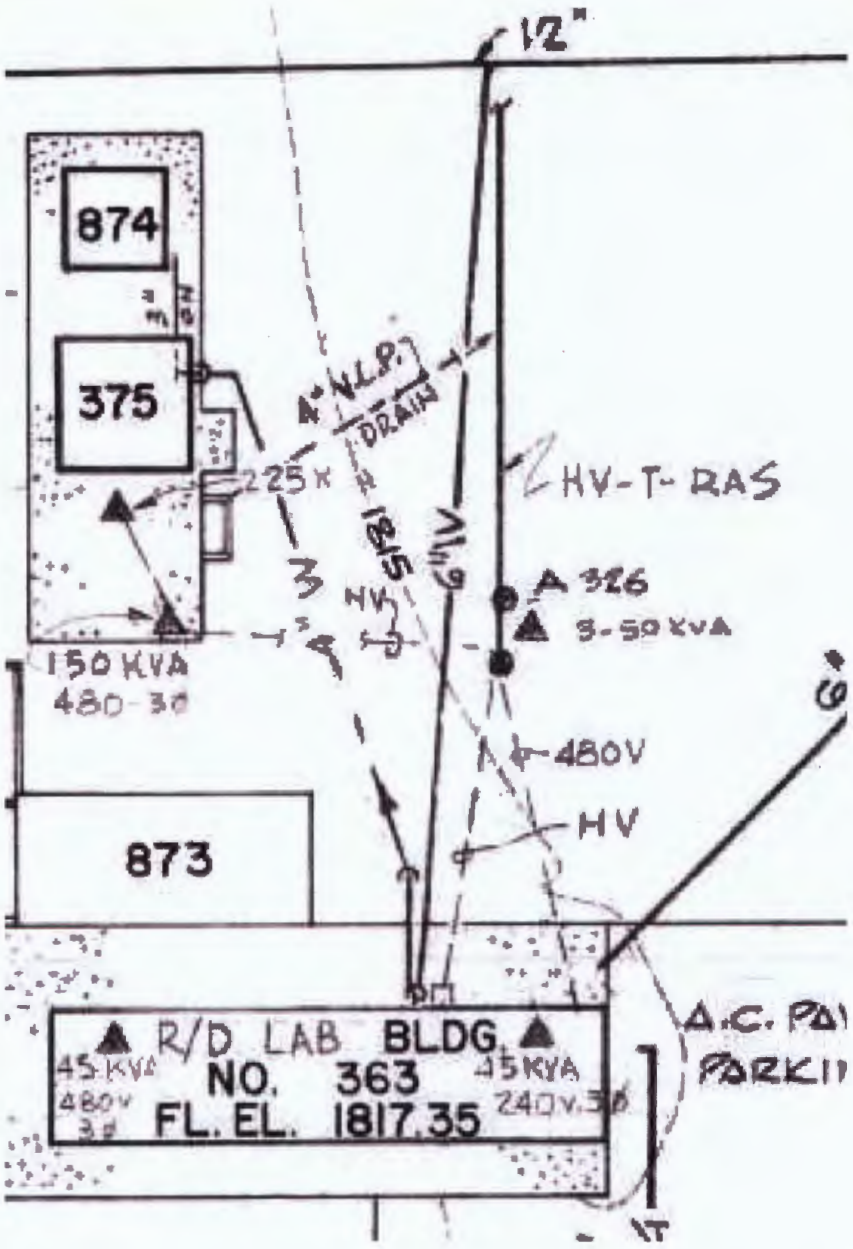
Figure 2.3.5a
Building 4375
Site Photograph



Y:/Santa_Susana/EP9038/TM/HSA_5D (2-3-5b)BldgFloorPlan.cdr
Project: EP9038
Revised: 03/22/2011 RB
Source: Boeing Company, 2008

U.S. EPA Region 9

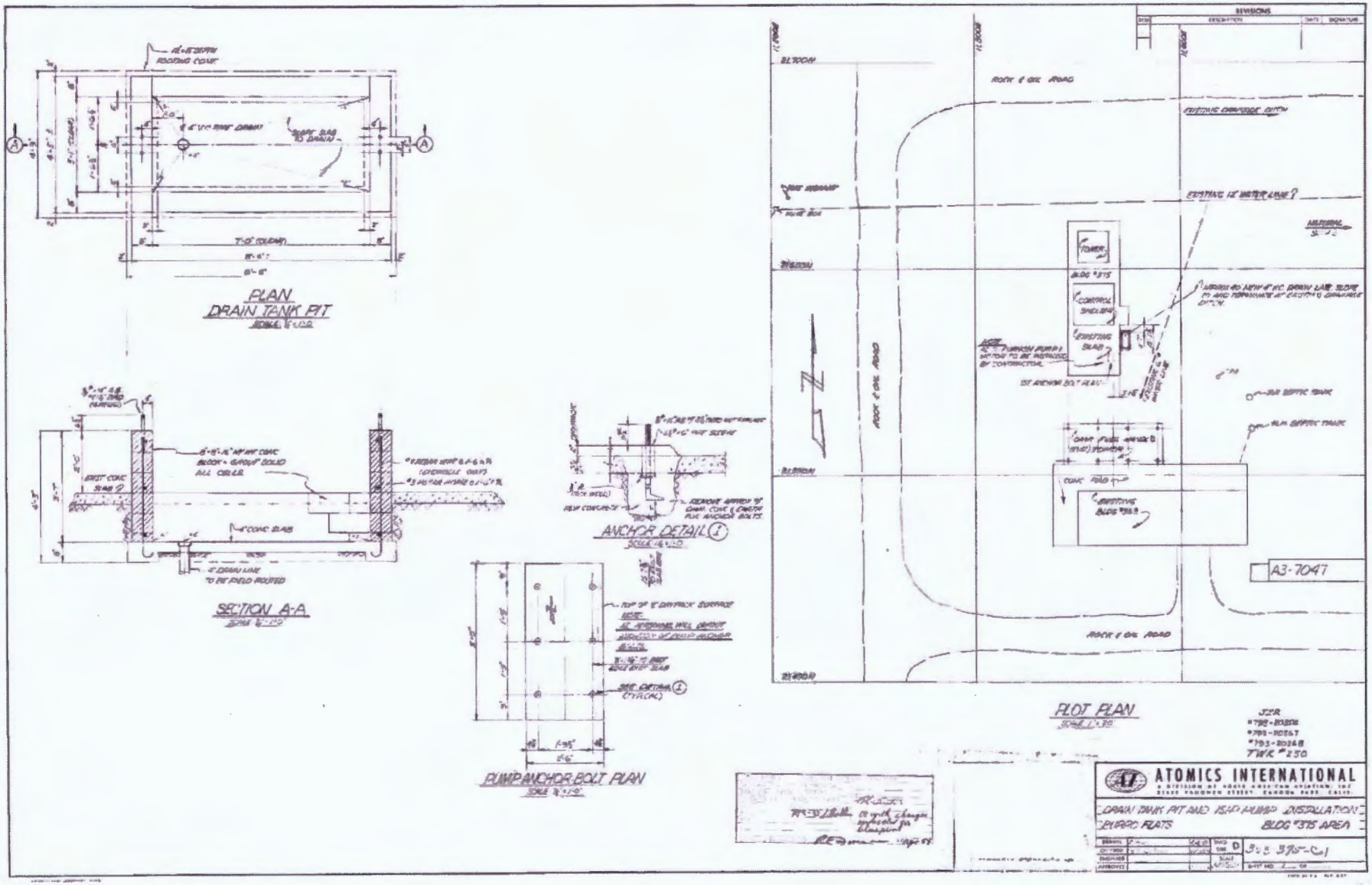
Figure 2.3.5b
Building 4375
Floor Plan



Y:/Santa_Susana/EP9038/TM/HSA_5D (2-3-5c)BldgPlotPlan.cdr
Project:EP9038
Revised: 03/22/2011 RB
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.3.5c
Building 4375
Plot Plan



Y:/Santa_Susana/EP9038/TM/HSA_5D (2-3-5d)Bldg4375DrainTankPitPump Installation.cdr
Project:EP9038
Revised: 03/22/2011 RB
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.3.5d
Building 4375
Drain Tank Pit and Pump Installation

Y:/Santa_Susana/EP9038/TM/HSA_5D
(2-3-6a)ParkingLot4575SP.cdr
Project:EP9038
Revised: 03/23/2011 TJ
Source: Boeing Company, 2008

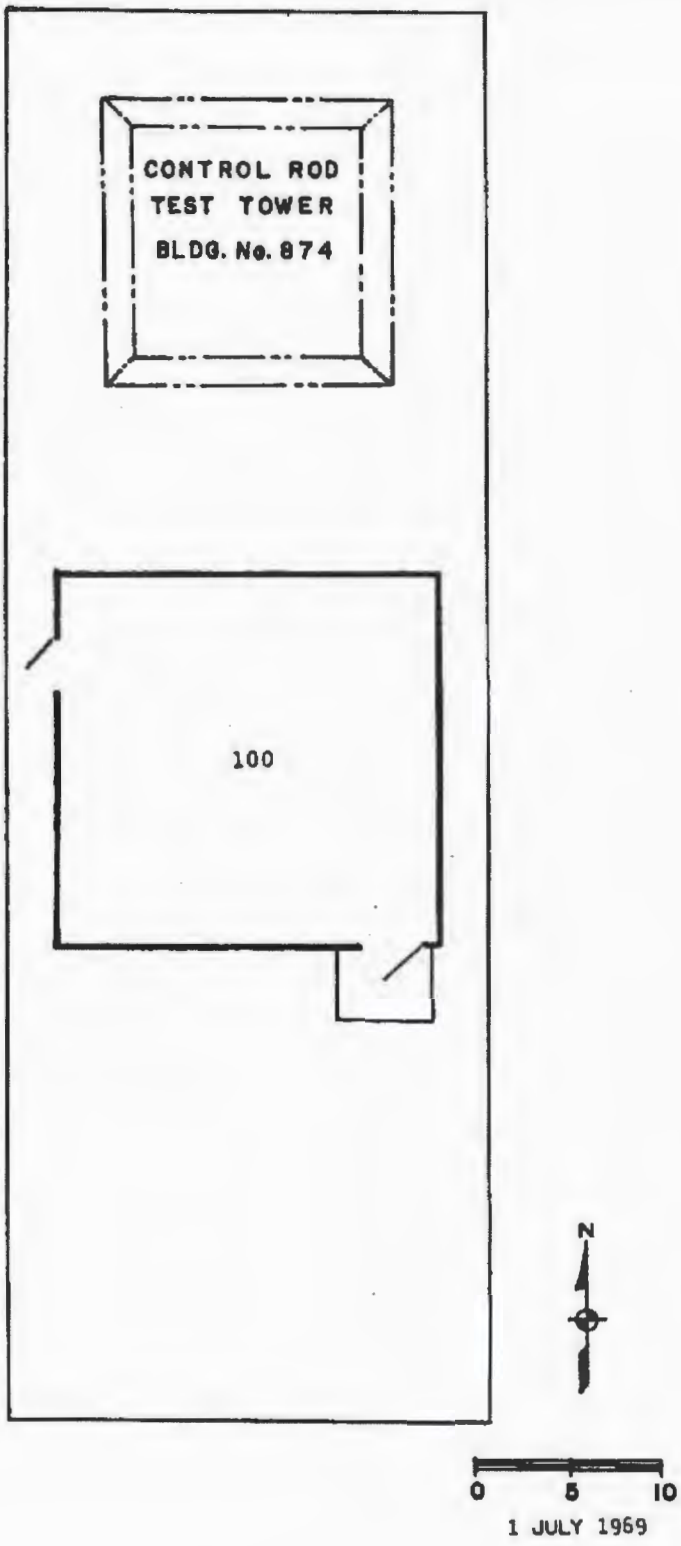
U.S. EPA Region 9

Figure 2.3.6a
Parking Lot 4575
Site Photograph

Y:/Santa_Susana/EP9038/TM/HSA_5D
(2-3-7a)Bldg4874SP.cdr
Project:EP9038
Revised: 03/23/2011 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

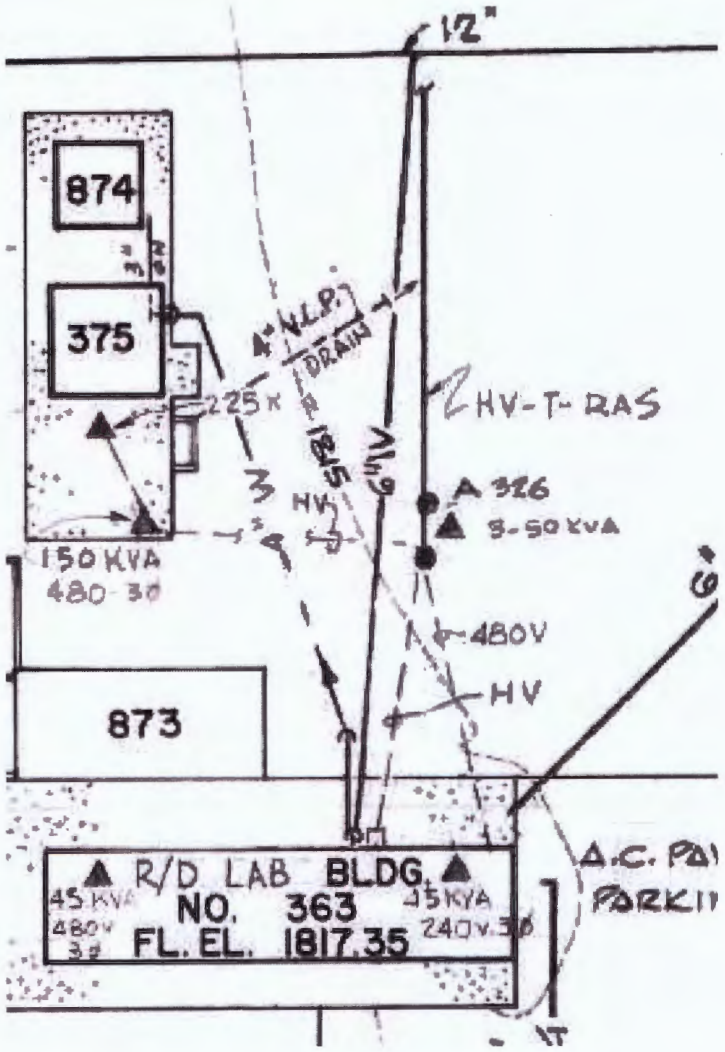
Figure 2.3.7a
Building 4874
Site Photograph



Y:\Santa_Susana\EP9038\TM\HSA_5D (2-3-7b)Bldg4874FP.cdr
Project: EP9038
Revised: 03/23/2011 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.3.7b
Building 4874
Floor Plan



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8900 DESOTO AVENUE, CANOGA PARK, CALIF.

SANTA SUSANA FACILITY
PLOT PLAN

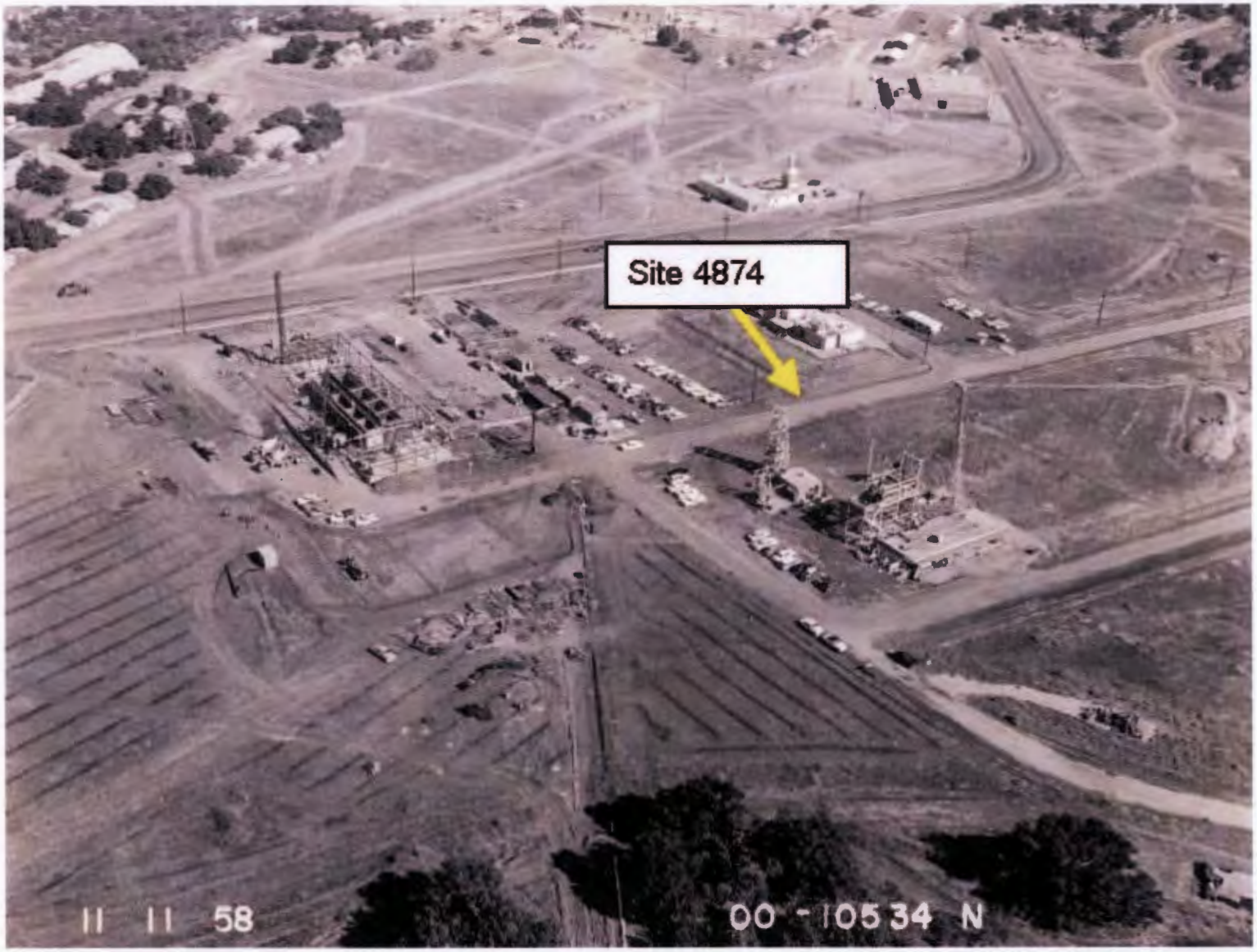
DRAWN	HAMMAN	DWG. SIZE E	303-GEN. C-42	
CHECKED				
ENGINEER	R.P. HAMMAN	SCALE 1"=40'	SHEET NO. 8 OF 14	
APPROVED				

FORM NA-8.3 REV. 10-61

Y:/Santa_Susana/EP9038/TM/HSA_5D (2-3-7c)Bldg4874PP.cdr
Project:EP9038
Revised: 03/23/2011 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.3.7c
Building 4874
Plot Plan



Y:/Santa_Susana/EP9038/TM/HSA_5D (2-3-7d)Bldg4874 AO.cdr
Installation.cdr
Project:EP9038
Revised: 03/22/2011 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.3.7d
Building 4874
Aerial Oblique
Photograph 1958

Y:/Santa_Susana/EP9038/TM/HSA_5D
(2-3-8a)Bldg4875SP.cdr
Project:EP9038
Revised: 03/23/2011 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.3.8a
Building 4875
Site Photograph

Y:/Santa_Susana/EP9038/TM/HSA_5D (2-3-8b)Bldg4875AO.cdr
Installation.cdr
Project:EP9038
Revised: 03/22/2011 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.3.8b
Building 4875
Aerial Oblique
Photograph 1958

Y:/Santa_Susana/EP9038/TM/HSA_5D (2-3-9a)Bldg4473SP.cdr
Project:EP9038
Revised: 03/23/2011 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.3.9a
Building 4473
Site Photograph

Looking East

Looking South

Looking North

Looking West

Y:/Santa_Susana/EP9038/TM/HSA_5D (2-3-9b)Bldg4473FP.cdr
Installation.cdr
Project:EP9038
Revised: 03/22/2011 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.3.9b
Building 4473
Facility Photographs

Y:/Santa_Susana/EP9038/TM/HSA_5D (2-3-10a)Bldg4863SP.cdr
Project:EP9038
Revised: 03/23/2011 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.3.10a
Building 4863
Site Photograph

Looking East

Looking South

Looking North

Looking West

Y:/Santa_Susana/EP9038/TM/HSA_5D (2-3-10b)Bldg4863FP.cdr
Installation.cdr
Project:EP9038
Revised: 03/22/2011 TJ
Source: Boeing Company, 2008

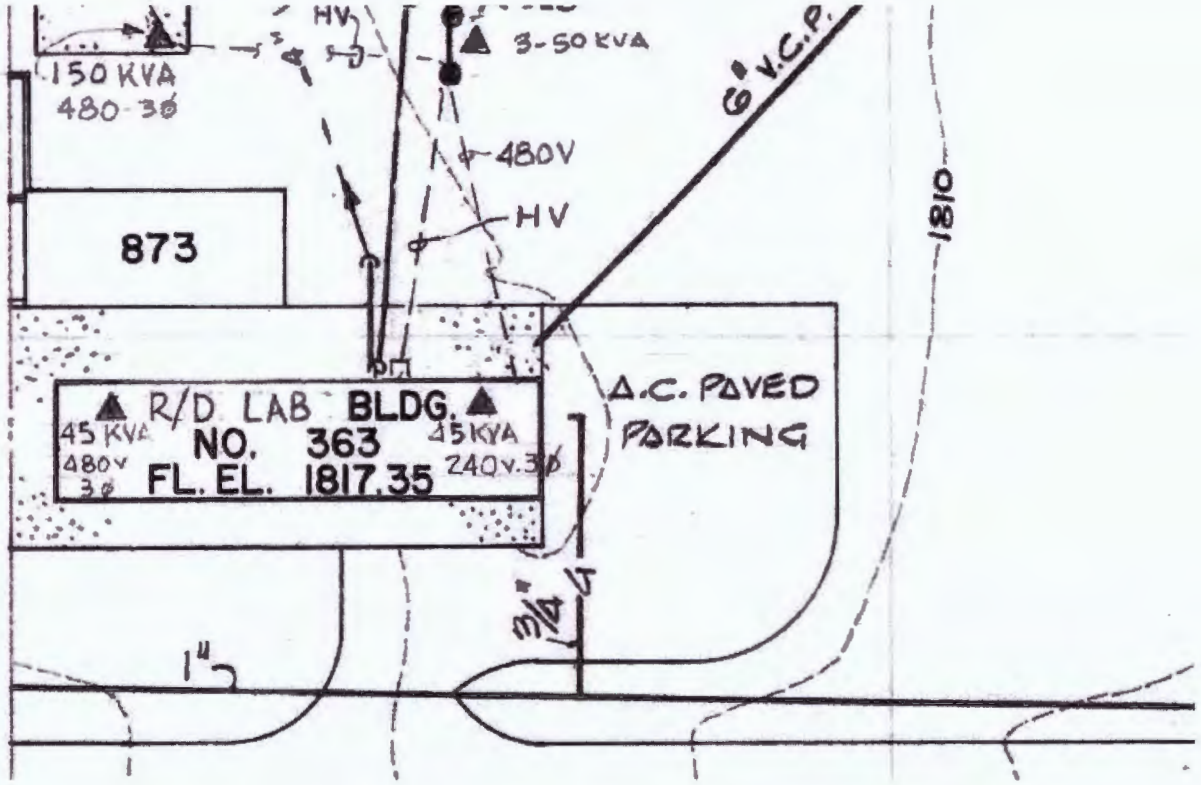
U.S. EPA Region 9

Figure 2.3.10b
Building 4863
Facility Photographs

Y:/Santa_Susana/EP9038/TM/HSA_5D
(2-3-11a)Bldg4873SP.cdr
Project:EP9038
Revised: 03/23/2011 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.3.11a
Building 4873
Site Photograph



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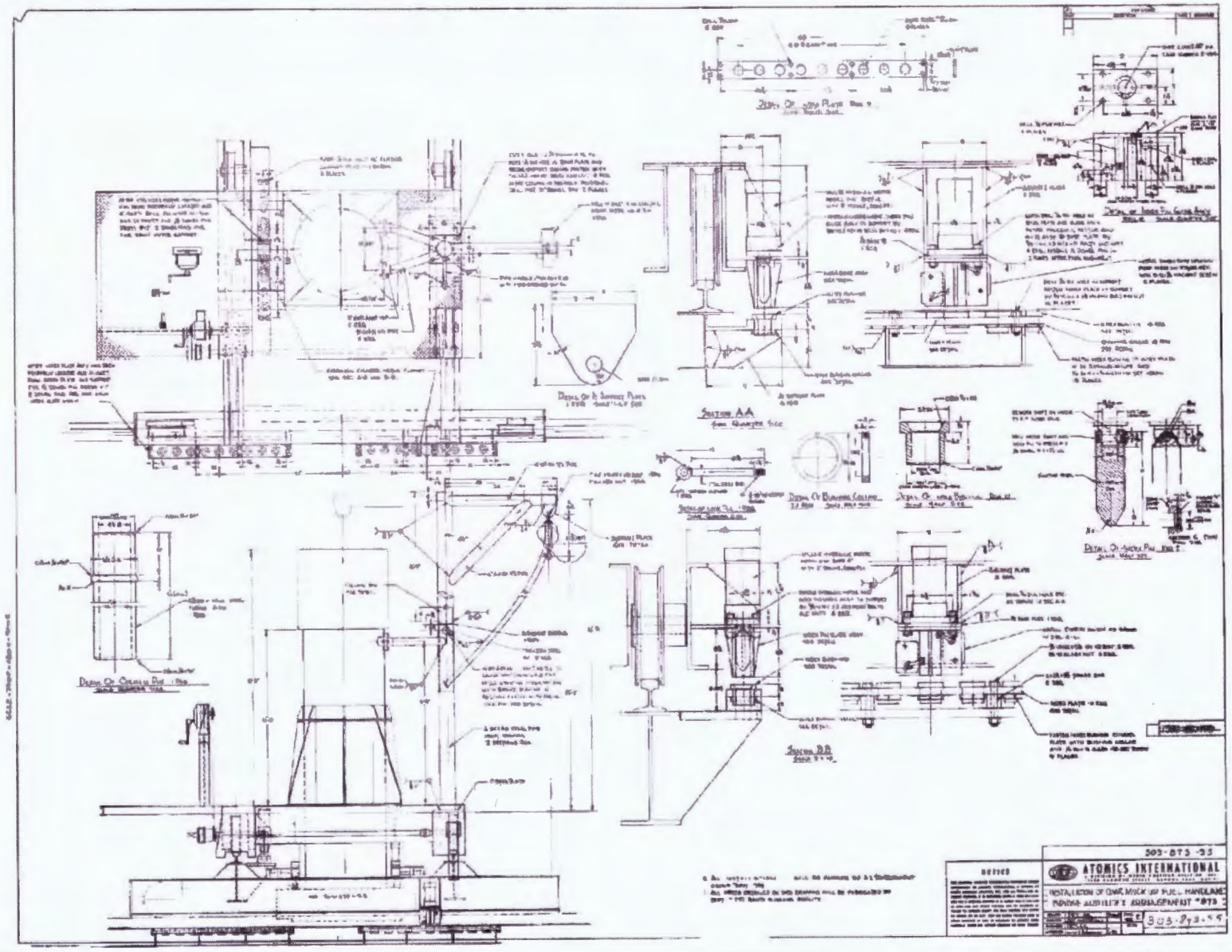
SANTA SUSANA FACILITY
PLOT PLAN

DRAWN	HAMMAN	DWG. SIZE E	303-GEN. C-42
CHECKED			
ENGINEER	R.P. HAMMAN	SCALE 1"=40'	
APPROVED			SHEET NO. 8 OF 14

Y:/Santa_Susana/EP9038/TM/HSA_5D (2-3-11b)Bldg4873PP.cdr
Project:EP9038
Revised: 03/23/2011 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.3.11b
Building 4873
Plot Plan



Y:/Santa_Susana/EP9038/TM/HSA_5D (2-3-11c)Bldg4873MU.cdr
Project:EP9038
Revised: 03/23/2011 TJ
Source: Boeing Company, 2008

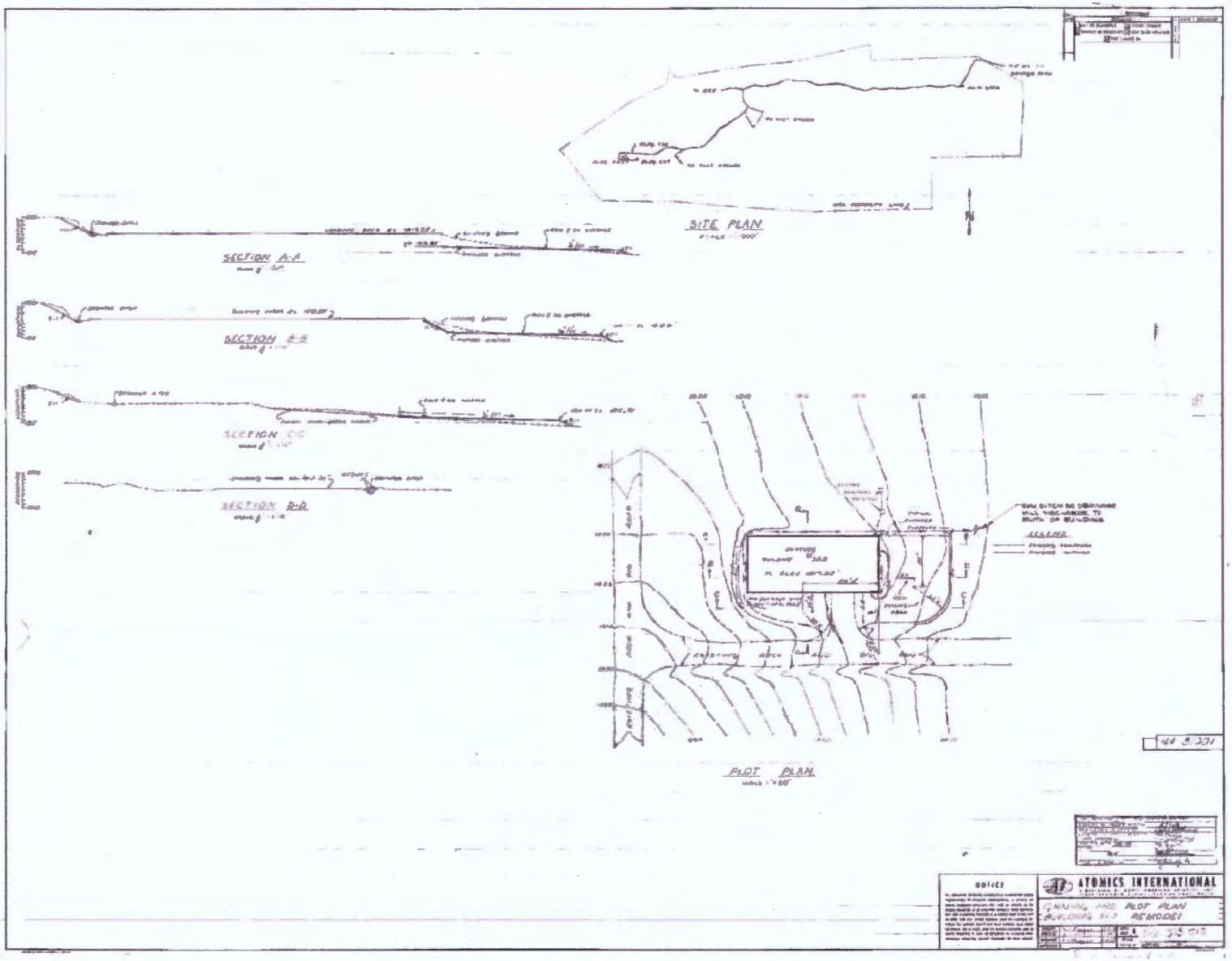
U.S. EPA Region 9

Figure 2.3.11c
Building 4873
OMR Mock-Up Fuel Handling Bridge

Y:/Santa_Susana/EP9038/TM/HSA_5D (2-3-11d)Bldg4873AO.cdr
Project:EP9038
Revised: 03/23/2011 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.3.11d
Building 4873 Aerial Oblique Photograph 1958



Y:/Santa_Susana/EP9038/TM/HSA_5D (2-3-11e)Bldg4873DR.cdr
Project:EP9038
Revised: 03/23/2011 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.3.11e
Building 4873/4363
Drainage

Figure 2.4
Area IV Subarea 5D-4
Santa Susana Field Laboratory

U.S. EPA Region 9

Legend

- Subarea 5D-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
- Proposed Sampling Locations
- 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 25 50 100
Scale In Feet

Y:\Santa_Susana\EP9038\TM\HSA_5D
(2-4)5D-4.mxd
12/1/2011 tjansen
Sorce: Boeing Company, 2008
CIRGIS, 2007

HGL HydroGeoLogic, Inc.

Redacted

RESPONSE TO COMMENTS

Response to Comments on Draft HSA-5D Technical Memoranda Issued on April 8, 2011
Historical Site Assessment, Santa Susana Field Laboratory Site
Area IV Radiological Study, Ventura County, California

Comment	Response
Thank you for the clarification, though I find it deeply troubling that EPA doesn't feel it can use normal descriptive words like "background" to refer to a concept that is used throughout the investigative and regulatory process of cleanup. "Background" is part of normal terminology used within this context, and I will certainly continue to use the word that way. I will also continue to use the words "partial meltdown" as it applies accurately to the SSFL site.	Noted.
I have been reading through the 5d report which is filled with incidents that are of deep concern about some of the handling of these very hazardous materials. I am continuing to formulate my written comments about 5d especially with regard to the many radiological incidents at the hot lab, and appreciate the special attention given to the parking lot area, as we have spoken about this area for a long time (ref. Canvas hot lab enlargements presented to EPA during earlier preliminary employee interview and HSA process discussions), and feel that some dialogue and further understanding is needed with regard to: Building 55 Nuclear materials building (this was a building that was earlier marked as non-radiological) I have to say that i find it completely unacceptable that this nuclear development building continues operations today, contracted out by an "unknown firm". I believe we need to know what is going on in this building and by whom. The subcontract relationship does not excuse the responsibility about the impacts of these facilities, and (like the ESADA and several other glaring examples that are severely lacking in needed documentation to really charactize properly) we cannot afford anything less than full transparency about the operations, by whom, and what isotopes and processes are/were involved in their historical and current operational processes. I hereby request that specific time be set aside to discuss this issue at the next stakeholder meeting on 4/20 as I believe it is crucial to getting a complete investigation to enable appropriate remedial decisions to be made. If there is ongoing current licensing for nuclear work outside of cleanup investigation, i believe that is relevant information we should know about. I have no faith that anyone will be back later to look at these exclusions and therefore, I feel it is crucial that they be addressed here and now.	Agreed. EPA believes that it is important that we correct all errors in our draft HSA Technical Memorandums. These Response to Comment tables present the manner in which each correction will be make in EPA's final HSA Report. EPA's records search effort has produced important information regarding the past operational practices at Building 4055 although our HSA TM did contain some errors concerning current operations in this building. Since issuance of the subject HSA TM, Boeing has provided the following additional information: "The statement, *"The building remains operational today and is operated under contract to Boeing by an unknown firm"* is incorrect. Since the mid 1990's Building 4055 has been used by The Boeing Company to conduct proprietary and classified laser research for the federal government. The work has been conducted by Boeing employees and none of the work in 4055 has been contracted out to "unknown" firms. None of the operations have utilized radioactive materials and therefore there have been no incidents, spills or releases involving radioactive materials. Operations at 4055 are currently terminating and should be completed by mid May. The prior mission of Building 4055 was as the Nuclear Materials Development Facility (NMDF). Manufacture of plutonium and uranium fuels was conducted for the AEC and DOE between 1967 and 1979. In 1987, the Nuclear Regulatory Commission (NRC) contracted with Oak Ridge Associated Universities (ORAU) to perform a post-decommissioning verification survey of 4055. http://www.etec.energy.gov/library/D&D_page/1987-Building_T-055.pdf. Based on the results of this survey, the NRC released the facility for unrestricted use and removed it from the SNM-21 License. http://www.etec.energy.gov/library/D&D_page/4055-nrcrel.pdf. Subsequently, in 2001, the EPA and their contractor, Tetra Tech, conducted an oversight verification survey of building 4055 at the request of the public. http://www.etec.energy.gov/library/D&D_page/Rocketdyne_OV-Confirm_Bldgs_T-011_to_T-100.pdf. The conclusion of the survey report (page ES-2) stated … *"The independent data collected by Tetra Tech during the OV survey are of sufficient quality and quantity to: (1) assess the radiological status of each building, (2) supplement and confirm other documentation of facility conditions, and (3) be used by EPA to develop recommendations and conclusions. The data show: (1) good agreement with prior surveys, (2) that surfaces monitored by Tetra Tech are within NRC-established radiological limits, and (3) that exposure rates measured by Tetra Tech do not exceed NRC-established radiological limits. Tetra Tech's field measurements were compared with the radiological closeout surveys conducted by Rocketdyne and, where applicable, with the confirmation survey by DOE's contractor, Oak Ridge Institute for Science and Education (ORISE) Environmental Site Survey and Assessment Program. Although field measurement techniques and data reporting methods differed, Tetra Tech's field measurements confirm the conclusions reached by both Rocketdyne and ORISE."* ***This information will be integrated into EPA's Final HSA Report.***

Response to Comments on Draft HSA-5D Technical Memoranda Issued on April 8, 2011
Historical Site Assessment, Santa Susana Field Laboratory Site
Area IV Radiological Study, Ventura County, California

Comment	Response
I appreciate these responses regarding questions about building 55. I am a bit confused as it seemed that Dave Dassler was under the impression that this building was contracted out to an "Outside firm" if the term "unknown" is not preferred. What hazardous substances were used/ handled in this building during the years of chemical laser research/activities? Regarding the release for unrestricted use, haven't other released areas since turned up with contaminants found? I just feel that we all agree the standards at the time and my understanding is that subsequent hotspots were found, so now, during the radiological investigation, I would appreciate that this building be investigated, rather than set aside for later, especially since we have no assurances of what "later" will bring us, considering the pending litigation about the cleanup, and the crazy manner in which budget issues have been handled by our government of late. The reason for my concern is about the contaminated tunnels with TRU (transuranic) related isotopes, and the delay, and seemingly incomplete data as to the final disposition of the materials that were stored at the site, as the shipping of this waste was delayed several times. Additionally, where within the building footprint, was it stored? And what were the potential releases/incidents related to this building during the subcontract years? Finally, I think this building is a perfect example of a situation where the EPA is supposed to sample the soil below this building, but are not free to investigate within the fence line and inside. How are they supposed to carry out that responsibility when the building remains atop the soil with these exclusions imposed on the process? How and when will this be done within the funding period of this project as specific timelines are imposed by the AOC?	The EPA is leading the radiological soil investigation within the SSFL Area IV and NBZ. The objective of this effort is to identify areas in SSFL Area IV and NBZ that are above radiological background levels as determined by process described in the DTSC/DOE Administrative Order on Consent (AOC) dated December 2010. EPA's study area includes approximately 23 potentially radiologically contaminated buildings and structures (e.g. existing facilities). These existing facilities, including walls, roofs, floors, piping, parking lots and associated structures, will need to be tested and removed. Because of procedures and efficiencies allowed under the DTSC/DOE AOC, EPA is deferring its sampling under and nearby these existing facilities until the decontamination, demolition, and associated soil cleanup work is complete. Once this cleanup work has occurred, in accordance with the DTSC/DOE AOC, EPA will implement a confirmatory soil sampling effort over these facilities zones to confirm that the remediation goal is achieved.
Group 5d This report is very well organized and presented. Considering the massive inventories of radioactive material that went in and out of building 20 and the level of incidents and emergencies, should it not be listed as a criticality facility? Or if there could be some other designation that provides the proper perspective and context of the hazardous events encountered at this facility. Indicated in this report detailed facility description, cells 2,3, and 4 are described as "criticality workstations"	Noted. Throughout all HSA TMs, EPA has attempted to remain consistent with the use of radiological historical terminology. As indicated in the HSA-5D TM, the Building 4020 was constructed and operated for the remote handling and examination of highly radioactive materials including nuclear fuels, cladding materials, etc. . Although these examinations included a number of tests, measurements, and other operations but none of which included bringing nuclear materials to a "criticality event". EPA agrees that many of the operations at Building 4020 were indeed hazardous and numerous releases of radioactive materials resulted. However, it would be difficult to characterize the building with the designation of a "criticality facility using a consistent definition for this term throughout the HSA.
P27 The issue of the transfer drawers is confusing when reading about the 40,000 lbs fuel cask from the Piqua facility. The indication was that this area was air sealed with leakage prevented through use of inflatable air locks but given the large number of incidents, it seemed to only be prevented under perfect conditions, which was often not the case. Spontaneous burning of o ring seals, paints quite a different picture of "normal working conditions"	Noted. The transfer drawers in Building 4020 were located within the walls between each of the hot cells and were used to transfer material from one cell to another for varying experiments. This would not have included the 40,000-pound Piqua fuel transfer cask. The cask would have been brought into a decontamination room, unloaded, and the various materials would have entered the cells through the large doors between the decontamination room and cell. Small components of the Piqua fuel, if required, would have been transferred from cell to cell through the transfer drawers. The doors in Building 4020 were reported to have included inflatable seals to minimize leakage around the doors and between the areas. EPA is unable to state, based on available historical documents, whether these safeguards were successful.
P37 1.) The decommissioning process as described, leaves me with many questions I feel are not adequately answered, regarding the large volumes of radioactively contaminated water generated that the disposal is not clearly described. In 1997 due to extraordinary rain levels, over 6500 gallons of rainwater had to be pumped from the severely contaminated basement structure remaining and the lacking information as to how this was managed is of deep concern. 2.) Descriptions from interviewees that rain leakage into the building also describes a different problem: if water leaks in, the structural problems including seam contamination found show that the integrity of the "sealing nature of the building" was ineffective and perhaps why so many unforeseen incidents occurred. 3.) The November 27, 2001 dismantling and decommissioning report (Boeing) does not indicate the level of contamination found or how it was dealt	1) Noted. Available documents indicate that in preparation for rains, Boeing installed a cover to the basement area that had been exposed as a result of building demolition. This cover, in late 1996 and early 1997, was compromised allowing approximately 6,500 gallons of rain water to infiltrate the basement. Source documents do not detail how the water was removed or how it was managed after removal. 2) Noted. As discussed during the EPA Stakeholder meeting on April 20, 2011, EPA intends to go deeper than approximately 18 feet (the depth of Boeing's building removal depth) when sampling the Building 4020 footprint. Any leakage of contaminated water from the basement structure into underlying soils will be characterized by EPA's sampling program for this site. 3.) Noted. EPA is in the process of obtaining additional documents from The Boeing Company regarding Building 4020. EPA will include a specific search for records regarding the levels of contamination within the basement. EPA believes that its sampling program from this site will identify remaining residual radiological contamination, if any.

Response to Comments on Draft HSA-5D Technical Memoranda Issued on April 8, 2011
Historical Site Assessment, Santa Susana Field Laboratory Site
Area IV Radiological Study, Ventura County, California

Comment	Response
with, when describing the cutting and storage of the concrete slabs from the basement of hot lab, which leads me to be more concerned with this particular decommissioning process. How were these concrete storage areas labeled as they decayed over time, resulting in potential further contamination of the storage area as water was used to remove contamination from concrete in many earlier descriptions. Would rainwater not also have a similar effect? I have seen bizarre storage of concrete throughout the site and have never thought about it in those terms because of the massive volumes, and neither would workers, being that they see it everywhere. What was done to warn them? I have seen signs that say "clean closed, no dumping" on this high-security, private property, which indicates a tendency to dump in any open space. How were these areas defined with signage? I hereby request that I be directed to example photographs of such areas as I feel this is a very important issue. 4.) The entire section regarding the decommissioning and dismantling process is quite alarming. How much concrete rubble was generated in this manner? I have a very specific worker contact that I feel is crucial that you interview for this issue as they worked in this area involved specifically in this process. I have seen video footage of this process that was particularly alarmed with the dust generated that was not controlled. This was a daily process that went on for some time and now that I read about the technical details involved in the waste generated from this process, I am even more concerned because it would then be part of that wastewater that is seemingly not adequately controlled. This brings me to request that specific care to step - out sampling in drainages leading to area three and beyond (including silvernale pond). 5.) I would also like to request that the silvernale actiflow treatment area be considered for radiological sampling and treatment potential. 6.) It is acknowledged that the floor drains were the most contaminated parts of this process and the trenching and sectioning process described does not include levels of contamination found. Realizing that the 11/27/01 report is not the subject here, but feel that levels of contamination found are crucial for our understanding and ask that they be provided to this group.	4.) Agreed. EPA agrees that based on available information, there do not appear to have been controls in place to control dust generated during the demolition process of Building 4020. As discussed during the April 20, 2011, stakeholder meeting, EPA is aware of potential pathways to Silvernale Pond and is considering these pathways, as well as Silvernale Pond, and released its sampling plan for Silvernale (and other ponds and drainages) for Stakeholder review and comment on August 19, 2011. EPA will keep the stakeholders apprised of sampling activities and data results associated with this sampling plan. 5.) Agreed. Soil samples collected during the Subarea 5C investigation and the soil samples that will be collected during the 5DN investigation target the drainages that lead from the vicinity of former Building 4020 and flow into the R2 retention Ponds. As stated in 4) above, EPA released a sampling for sediments and surface water in the drainages exiting Area IV and flowing into the R2 ponds and Silvernale. Under EPA sampling plan, surface water and sediment samples will be collected from the R2 ponds and Silvernale pond. 6.) Agreed. EPA is in the process of obtaining additional documents from The Boeing Company regarding Building 4020. EPA will include a specific search for records regarding the levels of contamination within the floor drains of Building 4020 and report such information in our final HSA report.
P41 1.) Description of the radiological waste tank states in the final disposition as free of radiological contaminants. How is this possible? Or am I misunderstanding the statement? 2.) Parking lot canvas submitted for reference and discussion at the 4/20 technical group meeting about some of the storage practices during demolitions. 3.) Will the 1ft layer of sand be evident in columnar sampling? Will we be able to push to clean if necessary based on depth step-outs? What will the parameters for decision making in this area with regard to depth sampling and what will be considered clean?	1.) Agreed. The septic tank was found to be free of radiological contamination, not the waste tank. EPA will change the final sentence on page 31 to read "According to Boeing, the final report stated that the septic tank was 'free of radiological contamination and any hazardous biological materials.'" 2.) Agreed. EPA appreciates your submission of the photograph showing the storage of material on Parking Lot 4520. Given these storage activities, EPA has included sampling in the vicinity of the former parking lot. 3.) Agreed. As a result of the previous issues of rain water filling up the 4020 excavation and waste tank secondary containment it is important to characterize the soil on top of the bedrock. Therefore, EPA has designated sampling locations within the 4020 footprint from beneath the sand layer and above the top of the bedrock. The sand layer will be visible in the soil cores. Additionally, select locations outside the footprint have been designated to have samples collected on top of the bedrock. The results of these samples will be compared to the radiological cleanup levels issued by DTSC in accordance with the DTSC/DOE AOC.
P45 Interviewee 166 and his discussions about waste management and that there wasn't a "backside guy" and how waste was handled and frequency of incidents is of great concern, including asphalt spills where excavation went down 10'ft to clean up the asphalt, again leading to more questions about hot asphalt and where and how it was stored.	Agreed. As a result of this line of evidence and available historical documents EPA has identified the area of the former spill and the area to the north and west of Building 4055 as sampling locations.
The hot lab incident list spanning seven pages is of particular concern. The numbers of incidents that include potential releases to the environment indicate a lack of general control considering the hazards involved with these materials. The hot lab removal process is also of special concern given that they excavated to 80 ft when bedrock I thought was believed to be estimated at 12ft bgs. In discussions, I was corrected that it was only 18 ft bgs rather than 80 ft and thought I had mis-heard the information but recalled the photograph I had seen in the past regarding the excavation footprint which is clearly much more than 18 ft since you can see the line where bedrock begins. There are also two deep hole areas that went down much further. I request that specific groundwater sampling data for this area be provided included as an additional line of evidence considering the severe levels if contamination, the number and scale of incidents compared to the rest of the study area is truly stunning.	Noted. Based on the evaluation of the four "lines of evidence" that lead to the identification of targeted sampling in all subareas, including 5DN, 25 sample locations were identified in the FSP Addendum within the building 4020 footprint including the area of the deep holes mentioned in the comment. Groundwater monitoring results are considered by EPA but not used as a primary line of evidence for our soil sampling program. As part of this EPA project at SSFL, EPA collected two rounds of groundwater samples. Once validated by EPA staff, this groundwater data will be summarized in a report and released for public review.

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Interviewee 106 describing enough material to make four bombs and reduced down to one gram each day? Is it possible to see the balance of his interview transcript to better understand this comment?	Noted. The interview summary does not provide any additional context to provide clarification of his comment. The following is an excerpt of the interview transcript containing the text in question: "I started working at Santa Susana in 1954 on the "other side of the fence" at Rocketdyne, on hydraulics for the thrust chamber preflight testing. It took 20 months for me to get my security clearance so that I could work for AI. After that I worked at Building 020 [the Hot Lab], the Engineering Test Building (ETB, Building 003), the hot cell and the SRE. My job titles included: Senior Research Mechanic, Analyst, Process Analyst, and Research Analyst; basically I was a glorified mechanic. At AI, I hydrided zirconium and uranium for the SNAPs 2, 4, 8, and 12 and also melted, alloyed, extruded, and fabricated the fuel elements used in the SNAPs . The SNAP 8 was the only reactor with a fixed fuel element and it was launched from Vandenberg Air Base, then some engineer destroyed it by accident. The SNAP 8 had a ½ meg power delivery and an operational power life of 4,800 hours at maximum power output. It would sure be the means of putting electrical power on the moon in a small compact unit. I also fabricated plutonium into fuel rods. At one time I had enough materials in my safe to make four bombs. I had to balance the radioactive materials every night to 1 gram. People that I worked with included QRS, TUV, WXY, and ZAB. There were an amazing number of people who worked there with a diversity of experience from different lifestyles. I worked back and forth between SSFL and DeSoto and Van Owen. I opened DeSoto and closed down Van Owen for AI. I lived in Whittier and drove 150 miles a day on surface streets; there were no freeways back in those days. I always brought my lunch, but there were many "slop shops" or "roach coaches." We played chess at lunch – there was a chess club with about 200 members and we had a round robin between players from DeSoto and the hill. And the ping-pong matches were quite unique. We would get a lot of snow up there in the winter and the animals would come lie on the asphalted areas because it was warm. I saw a lot of animals: deer, squirrels, foxes, jackasses, and coyotes." It should be further noted that EPA will issue a complete report on its SSFL Former Worker Interview Program (including full transcripts of interviewees) by November 2011.
Interviewee 149 describes cutting fuel rods apart from fermi when it melted down. Was the fuel rod inspection for the SRE accident documented here as well? He also describes throwing sodium blocks into the pond was unauthorized but did happen. This again supports the issue that process was not always followed due to the experimental nature of the work on the hill.	Agreed. EPA weighs such comments in determining sampling locations and the density of samples. Additionally, EPA will review the documents received during the HSA-5D keyword search to determine if additional information regarding the inspection of the SRE fuel rod is available.
Of the seven pages of incidents, it is clear that things were far from controlled in this area, and these many incidents that included nitrogen purging and many evacuations and really large volumes of radiological inventory that make the many serious fires that erupted as a result of these hazardous operations of deep concern.	Agreed. EPA concurs with this assessment and, accordingly, has included over 25 sample locations (50 total samples or more) at and around Building 4020.
October 1967 incident that overflowed contaminated water throughout the controlled area - it states that it was successfully decontaminated but does not provide details as to how it was done. Since this and many other incidents resulted in serious contamination levels that likely drained from the area, I believe these details are important, especially given that several evacuations due to unsafe conditions occurred at this facility.	Agreed. Additional information regarding this incident could not be located in available documents. EPA will review the documents received during the HSA-5D keyword search to determine if additional information regarding this incident may be located.
October 20 1981 "clean ladder incident" I think illustrates the ease of which radioactive contamination is mobilized about the site. From March of 1980 to October of 1981, this ladder was potentially used by many workers in and out of these radiologically confined areas considering how a worker must repeatedly grip a ladder in order to climb up or down, this is particularly troubling to me. Especially considering the level of activity discovered on the ladder.	Agreed. EPA concurs with this assessment; however, information regarding the movement of the ladder during this time period cannot be located or confirmed. EPA has included a high density of samples at and around Building 4020 as a result of similar lines of evidence.
The zirconium fuel pin fines incident March 22 1982 from fermi that resulted in o ring burning and employees evacuated, also details a scenario where dangerous levels of contamination resulted.	Noted.
This is a process to recover the 25% remaining enriched uranium that was environmentally problematic to begin with, and these incidents illustrate those hazardous operations well.	Noted.

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The July 2, 1997 incident of asphalt contamination - it is unclear how that asphalt was eventually dealt with, or if it remains onsite anywhere. Considering the many undocumented piles of asphalt encountered throughout the site, including high gamma readings in existing roads, that have been patched and patched over time as is quite visibly evident, the many documented spills over asphalt of radioactive contamination justify very careful scrutiny and evaluation of each of the high gamma areas GREYS. All of the areas where hotspots were rubblized, generated concrete waste and debris that is found throughout the 5d area.	Agreed. Additional information regarding this incident could not be located in available documents. EPA will review the documents received during the HSA-5D keyword search to determine if additional information regarding this incident may be located. The areas were rubble piles have been identified were scanned for gamma radiation. Soil samples were place at locations with potential gamma radiation anomalies. The location where the most numerous piles of rubble were identified, is near the intersection of former L Street and 24th Street southeast of the Pond Dredge Area. A total of 26 samples will be collected in this area.
Many solutions that were believed to be resourceful ways to manage the radiological activities at the time, we later learn have deeper impacts and I ask that this be considered as we encounter asphalt of unknown content today.	Agreed.
Based on the surveys of 1997 and 1998 indicate more sampling and step-out delineation is needed in order to understand what might remain considering the surrounding area was used as staging and storage throughout the d&d activities and contained radioactively contaminated waste as did the drainages. These need to be followed downgradient to the study boundary, with specific regard to the RIHL drainage sampling isotopes.	Agreed. Samples collected from locations 48, 49, 50, 51, and 53 are downgradient of former Building 4020 (RIHL) and will be tested for the following analytes: Default, Ni-63, Ni-59, Tc-99, I-129, and Pm-147. Surface water and sediment samples that will be collected from the R2 retention ponds will be tested for the same analytes because they receive surface water run-off from the vicinity former Building 4020.
As detailed and confirmed by the 1999 class 2 survey of 4520 parking lot, high levels of radioactivity as a result of these operations support the need for step outs and special attention to be paid to the perimeter areas where storage included high levels and quantities radioactive waste products.	Agreed. Sampling locations number 50 through 60 have been placed in the vicinity of the parking lot and associated drainages. These locations will also be analyzed for Default, Ni-63, Ni-59, Tc-99, I-129, and Pm-147 in accordance with Table 2.4 of the Master Soil Sampling FSP.
Building 55 Thank you for providing the additional information regarding the later use of this building. I believe we need to know what is going on in this building and by whom and appreciate the additional information provided by Boeing. The subcontract relationship does not excuse the responsibility about the impacts of these facilities, and (like the ESADA and several other examples) we cannot afford anything less than full transparency about the operations, by whom, and what isotopes are involved in their processes. The exhaust room clearly indicated radiological contamination as did the glovebox room and transfer tunnels, and I remain troubled about the effort to designate this facility as non-radiological being that smears ranged from 100dpm to 10.000.000dpm. Based on the documentation provided as well as my own interviews of people who worked on the classified programs, it seems that incidents related to classified work are also classified and/or redacted. Please request record search from the Boeing 1.4 million document database related to the work in this building in the eighties and nineties.	Agreed. EPA will seek additional information regarding the operations in Building 4055 from the Boeing document database. Additional information will be incorporated to further characterize the operations in Building 4055 and possible contamination pathways.
1.) Building 73 : class 2? This area had many incidents and even operations after operations supposedly ceased. Log books indicate operations continued up to two years after that time. Please adjust to class 1 (p108) 2.) It is also indicated that this building had certain undesirable aspects such as lacking ventilation for long-range critical experiments, and that the building required modification for that reason. Please request additional documentation from the Boeing database for the missing years of operation. The Feb. 1964 log book entry indicates high levels of contamination on reactor table, and floor where immediate decontamination was requested. This is clearly long after building operations ceased showing clearly it had not. The three hepa filters found had extremely high cesium contamination (found in 1995) at 11,250dpm further indicating the need to better understand the later operational period of this building. Among the other alarming incidents is the birdcage described as having highly radioactive metal chips found in and around the area reading 3000 - 5000 dpm. I have interviewed several workers who described the loading and unloading of birdcages and describing uranium chips on the ground. Please clarify if these would be detected by the em137 or Magnetometer? I have data from worker Dan Kurowski who received an award for a no cost disposal of waste saving the company S 80.000. He also described these chips and another employee "Waco" who had a cask blowup in his face during one of these events. (he died shortly after)	Agreed. EPA has given Building 4373 a preliminary MARSSIM classification of Class 1. Six sampling locations have been placed within the footprint and around former building 4373. Including one location on the west side at the entrance of the former building. EPA will seek additional information regarding the operations in Building 4373 from the Boeing document database. Additional information will be incorporated to further describe operations in the building after 1964. The uranium chips cannot be detected by the EM 31 or the magnetometer because uranium is a non-ferrous metal.
2.2.6 building 74 indicates that the demolition and final disposal of the boiling mercury test loop could not be located. Please request from the Boeing database additional information about this because of the ongoing concern about the mercury problems at the site.	Agreed. EPA will seek additional information regarding the disposal of the mercury test loop from within Building 4374 from the Boeing document database. Additional information will be incorporated, if available.

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Figures: 2.2.4c is unreadable	Noted. The size of the original file is prohibitive to allow distribution of the high-resolution scan of the drawing.
Table 3.2 shows extremely high inventory of thorium and up to 20,000lbs of depleted or natural uranium. I have concern about the process of creating enriched uranium and where the waste products were disposed and stored. Table 3.3 I request that building 73 be modified to be class one due to the level of unknowns and undocumented incidents.	Agreed. Building 4373 and the radioactive material associated with it have been removed and the current Round 1 sampling program for this location has identified over 24 surface and subsurface soil samples to be collected. EPA has given Building 4373 a preliminary MARSSIM classification of Class 1.
Page 94, Final bullet The statement *"EPA anticipates that Building 4055 will be decontaminated and decommissioned in the near future"* appears inconsistent with the discussion of NRC (ORAU) and EPA radiation surveys discussed above, and on pages 87 - 89 of the Tech Memo. The building structure has been decommissioned and decontaminated and released for unrestricted use. The soil underneath the building footprint however is certainly within the EPA's scope of work.	Agreed. EPA proposes to modify the sentence to read: *"EPA anticipates that Building 4055 will be demolished and removed in accordance with the DTSC/DOE AOC dated December 2010.*
Page 168, Section 3.1 Edit the last sentence of this section to read, "Sites Buildings 4020 and 4055 with Subarea HSA-5D operated under License No. SNM-21."	Agreed. EPA concurs with this change and will make the recommended change.
Page 168, Section 3.2 License CX-17 applied to the critical assemblies in Building 4100 in Subarea 5C not Subarea 5D. This section should therefore be removed from the Subarea 5D Tech Memo.	Noted. To date, EPA has included this section with each HSA TM with no regard to the buildings involved with the license. EPA recognizes that the license does not apply to any of the buildings within HSA-5D; however, to remain consistent with previous TMs, EPA will keep the section.
This comment relates to the very last comment submitted by Mr. Hirsch. Craig, I respectfully submit that titles of documents should not be changed just because Mr. Hirsch has asked you to do so. I trust the research and study put into these documents by the EPA and its contractors. I would assume that name was created for a reason. To remove a label that states"Reported Incidents Not Resulting in Radioactive Releases" would indicate that Mr. Hirsch is more qualified than your team to make that determination. To me, reading that document title was reassuring as to what accidents caused releases and which did not. Yes, there are many incidents. Once again, I would recommend that you consider the comments of those who are not professionals on your team. But in cases such as this - that decision must be one made based upon technical information by the scientists employed in this project.	EPA will consider comments by all Stakeholders and document our decision in our final HSA Report. At this time, EPA believes that titles of documents should not be changed as long as the reader of EPA's HSA Report understand the full context and content of each referenced document.
p. 4 I have several times before urged that this table, which appears in all HSA drafts, be modified to indicate more clearly that the estimated radioactivity at end of operations is not EPA's estimate, but that of the site operator (at the time, Rockwell); and that, while useful information, radioactivity at the end of operation of a particular reactor facility may not represent the peak radioactivity during its period of operation. Also, it might be useful to indicate that the Hot Lab, because it worked on highly irradiated fuel from reactors far larger than those at SSFL (fuels shipped in from around the country) and engaged in fabrication of extremely large radioactive sources, likely had far larger inventories of long-lived radioactivity than the on-site reactors. Lastly, it might be useful to indicate the amounts of plutonium in the plutonium fuel fabrication facility. One doesn't want to create the impression that the only facilities of radiological note were the reactors.	Agreed. Although EPA does not have information regarding peak radioactivity at the facilities listed on this particular table (Table 1.2), EPA agrees that it is important to clarify that Area IV contained facilities of radiological operations and concerns in addition to the facilities listed on this table For example, EPA will add text to concerning Buildings 4020 and 4055 to the text of this section.
p. 7	Noted. After a temporary delay be Boeing, EPA has again resumed receiving pertinent documents that EPA requested from

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I remain troubled both by Boeing's refusal to cooperate with EPA in providing access to the SSFL document database, which the HSA report indicates Boeing has suspended, and Boeing's refusal, even when those access wasn't suspended, to permit EPA and its contractor personnel direct access to the database. Having to ask Phil Ruitherford to search the database for particular matters rather than EPA being allowed to search it directly is an unnecessary impediment to a successful site characterization. I note that 10 CFR 1004.3 mandates that contractor records are government records for the purpose of FOIA and generally must be released even to the public, unless Boeing can demonstrate that the government contracts under which the records were generated contained provisions that did not make the records of contract work government property. Certainly EPA should have direct access to the database, at all times, and not have to go through an intermediary to do the searches. I would appreciate a brief discussion of the actions by Boeing that are frustrating EPA's access to the records necessary to effectively carry out EPA's site characterization work.	Boeing's 1.4 million document database. EPA has now received all documents that it requested on Subarea 5D and utilize these documents in our final HSA report and soil sampling plans even if they postdate the draft HSA TMs.
p. 15 refers to a tank for "high-level waste." Is this meant to refer to "HLW" as traditionally defined? If not, how was it defined? How "hot" was that waste? Furthermore, the overflow of these tanks is a troubling incident about which some extra sampling may be in order. To where did they overflow?	Noted. Source documents do not provide additional information to indicate whether the high-level waste is what is more traditionally defined as "HLW." Information, to date, also does not indicate the level of radioactivity in the waste. Should additional information be located to answer these questions be located, the information will be added to the final EPA HSA report. The incidents regarding the overflow of the tanks were localized within the basement of the structure, where the tanks were located. Specific information regarding these overflows and how the areas were cleaned after such an incident could not be located in available documents. As with the information above, should additional information be located, the information will be added to the final HSA report. .
p. 19 top, repeats Boeing's claims that all airflow was from areas of lower contamination to areas of higher contamination within the building. Obviously this cannot be; the only way to maintain "negative pressure" is to vent from the contaminated area to the environment. Later there are claims about HEPA filters, but also some disturbing discussion of filters not working. (I am told there was an additional interview that indicated such trouble, but I don't find it referenced; could that be checked and made sure it is included?)	Noted. EPA is currently reviewing interview statements to determine whether an interviewee has indicated the filters not working. Should any additional information be located that would alter the sampling strategy at Building 4020, EPA will notify the stakeholders and additional information will be added to the final TM.
p. 20 interesting that stack sampling was only performed quarterly. Seems hard to have representative results and catch whatever went up the stack when one only sampled once every three months. Also, the discussion of the attempt to absorb or solidify all highly contaminated waste is interesting and might merit a bit more discussion.	Agreed. Based on available information provided by Boeing and DOE, the stack sampling was performed quarterly to ensure that the controls in place were working properly and that there were no atmospheric releases that were not being detected by alarms that were installed to detect possible elevated releases. However, as discussed with Stakeholders at EPA Technical Stakeholder Meetings and documented in other HSA TMs, there is evidence that HEPA filters and stack monitoring of air emissions may not have been performed in accordance past protocols to ensure accurate estimation of radiological emissions or the safety of such emissions. Should additional information be located regarding the absorption and solidification of contaminated waste it will be added to the final HSA report.
p. 21 bottom, refers to two or three undergrund fission gas tanks. It would be helpful to understand what fission gases one is talking about--just noble gases, or other material as well; and generated how?	Agreed. Handling of spent nuclear fuel can generate gaseous fission products such as Xe-133, Kr-85, and I-131. All three are short-lived and except for iodine they are noble gases and typically they are handled by holding them in a vessel until they have decayed away generally in a few days, thereafter the vessel is typically vented to atmosphere.
p.22 bottom what were the "irradiation test capsules", and why was SSFL getting them from MTR, ETR, GETR, etc. ? Which Hanford reactors, what is "HWOCS"?	Agreed. Additional information regarding irradiation test capsules has not been located to date, and EPA was unable to define HWOCS. However, EPA is in the process of receiving additional documents from Boeing. Should new information be located to address this comment, EPA will add the information to the final HSA report.
p. 23 top, what other rad sources were manufactured there besides Pm-147, and in what quantities (Ci)? What was the Pm-147 used for. And what was the Co-60 machined for? In what quantities? If large enough quantities, even with 4,5, or 6 half-lives (5 yr) we might want to look for Co-60. Does Pm-147 decay into anything radioactive that we may need to look for? And what other exotic rads might have been used? This is somewhat important, given the highly dangerous activity and history of fires and leaks from the Hot Cell.	Agreed. EPA will look at available documents to generate a more comprehensive list of the sealed radioactive sources that may have been manufactured and tested at Building 4020. Should any new radionuclides be identified, this information will be communicated with the EPA soil sampling team. Also, the approximately 50 surface and subsurface soil samples planned for collection at Building 4020 during Round 1 will be analyzed for Co-60 as well as Pm-147. Promethium-147 beta decays to Sm-147 which has a half-life of over 100 billion years and is therefore not of concern. When a radionuclide half-life is so long, the element emits so little radioactivity that it has no health consequence.

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Also, what is "Dowanol?"	Agreed. The final HSA will include more information on Dowanol. Dowanol appears to be a trademarked glycol ether that is manufactured by the DOW Chemical Company. A footnote may be added to the final HSA to define Dowanol. Additional research will be conducted, however, to determine whether Dowanol was available in 1976, when it was reportedly used.
p. 25 bottom Note decladding work on EBR-1 fuel (which had a partial meltdown in Idaho), SRE (which had its own at SSFL), and Fermi (presumably Fermi I, which also melted). Sounds like bad luck; but also that a bunch of fuel from partial meltdowns across the country got decladded at SSFL.	Noted.
p. 26 bottom interesting about spills and leakage at the outside of the Hot Lab area; sampling should be done there. p. 27 fascinating that heavy rains infiltrated into the basement.	Agreed. Three sampling locations have been placed within the area of the A0016 Spill Incident. Samples within the footprint and down-gradient of former Building 4020 will be collected at the bedrock/soil interface in order to characterize the potential contamination as a result of surface water infiltrating from the basement and waste tank excavations down to bedrock.
p. 28 same old problem repeatedly raised in the past: Boeing claims that "any detectable contamination was removed." EPA doesn't know that to be true and shouldn't be making the assertion itself. additionally important neare bottom is that "the roof leaked severely in some areas and rainwater problems were big concerns in part of the building." and that contamination migrated outside.	Agreed. EPA does not, in any way, assert that previous contamination was fully removed. EPA is citing a source document, as indicated in the following sentence. However, to make it clear that EPA is not making this assertion, EPA will modify the sentence in the final HSA report to read as follows: "According to the Boeing report, the exposed soil was surveyed and any detectable contamination was removed. EPA cannot independently confirm or deny conclusions regarding such past decontamination efforts that were not under EPA oversight." EPA has included all potential migration pathways in its sampling strategy for Building 4020.
p. 29 same problem as of old; EPA shouldn't be asserting that "radioactively clean water was held..." before being released to the site sanitary water system. That is Boeing's claim. Some work to determine if rad water got into the sanitary system is needed.	Agreed. EPA will modify the sentence to read: " The Boeing report indicated that radiologically clean water was held for approximately 2 days to allow the solids to settle out and the water was pumped to a holding tank, re-sampled to verify it was free of contamination, and released into the site sanitary sewer system. EPA cannot independently confirm or deny conclusions regarding such past decontamination efforts that were not under EPA oversight"
p. 32 astonishing about one guy having enough Pu in his safe to make 4 bombs!	Noted.
p. 34 Says Pu was used in powdered form, which of course produces a ready way for particulate forms to be released. But was any Pu in metal form, which can burn?	Noted. Documents regarding the Pu used in Building 4055 is limited. At this time, it is unknown whether Pu in metal form was handled at Building 4055. Should additional information become available upon receipt of documents from the Boeing document database, this information will be incorporated into the final HSA.
p. 36 What do we know about the nuclear laundry? Onsite? Where did the dirty water go?	Noted. To date, it is believed that laundry facilities were located within the boundaries of Areas 6 and 7. EPA continues to research these areas and will present any relevant information in the final HSA report.
p. 37 obviously the area where the spill occurred should be sampled. And where the chemicals were dumped on the ground down the bank--and DTSC and DOE take some special chem samples there.	Agreed. Three samples have been placed where the spill occurred and DTSC/DOE will collect co-located samples for chemical analysis. The area where chemicals were poured down the bank is inside the Building 4055 fence which is a future D&D zone. In accordance with the DTSC/DOE AOC, radiological and chemical samples will be collected during the cleanup work of Building 4055 and subsequently EPA will collect confirmatory samples for radionuclides.
p. 38 That one worker got 85 R is amazing. also, at bottom, the practice of painting over contamination is a problem.	Noted. It appears that painting wall and floor surfaces to fix loose surface radiological contamination was a common radiological control practice at SSFL facilities and other similar facilities nationwide in the past.
p. 39 that Bldg 5, 24, Hot Lab, and RMHF had rad in the drains is a sign of poor controls: one needs to try to sample where those drains went.	Agreed. Samples have been placed within the 4020 footprint with the drain lines and sumps in mind. Although it is difficult to determine the exact locations of these features, a considerable amount of time was spent evaluating plan and schematic drawings to guide the placement of these sample locations. The same attention was also given to the 3000 gallon waste tank, the fission gas

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	USTs and their associated lines.
p. 43 Just a note again that the old release criteria were unacceptable; some of the soil figures proposed are orders of magnitude too high. Even the gross gamma is well outside what EPA says is acceptable for any public exposure	Noted.
p. 45 and thereafter re accidents at Hot Lab-- a troubling history, lots of fires, etc. Says clearly that a lot of samples should be aimed at the Hot Lab area, very critical. (note on p. 47, unclear why the SRE fuel slug burning is said to have only released Kr-85).	Agreed. A total of 28 samples have been planned within the footprint of former Building 4020. A total of 12 samples have been placed down-gradient of former building 4020. In all, 108 samples have been planned in the vicinity of former Building 4020.
p. 71 and following -- Plutonium Building This is one of the most important facilities on the property from a safety standpoint, given plutonium's unique hazard, and yet there is very limited information available about it. It has always seemed to me to be the "dog that didn't bark." I wish there were more effort put into reviewing its history. At minimum, the soil in the area should be subject of a large number of samples targeted at Pu.	Agreed. To date, EPA has reviewed all available documents regarding Building 4055. It is anticipated that additional documents will be made available and additional information may be incorporated into the final HSA report. EPA will keep the stakeholders apprised of any new information regarding Building 4055. Building 4055 is in a future D&D zone; therefore, no soil samples will be collected within the fenced area around the building. Sampling locations just outside the fence have been placed to characterize surface water run-off from the facility. Additionally, sampling locations have been placed along the east side of the fence to characterize potential radiological contamination associated with the waste pit and associated underground pipeline. In accordance with the DTSC/DOE AOC, EPA will take confirmation soil samples inside the Building 4055 fenced area.
p. 74 how did the molten salt TRU combuster work? What release mechanisms possible? TRUs other than Pu used?	Noted. Additional information regarding these operations has not been located to date. It is possible additional information may become available upon receipt of the Boeing document database keyword search results. Any new information will be communicated with the sampling team and will be incorporated in the final HSA.
p. 75 Now we finally have the answer to why Pu-238 was found at Brandeis. SSFL did indeed work on separated Pu-238. We need to be sure to be sampling for Pu-238 in addition to 239. BUT HOW WAS PU-239 FUEL FABRICATED? What was the process? Did it start out in oxide form, and was it pressed, heated to high temperatures, what? HOW MUCH PU WAS ALLOWED? My memory is hundreds of kilograms. [p. 76 refers to a brief period with a limit of 350 grams. But what was the maximum limit during its operational life? Note that Pu was removed from protected areas of 4055 to 4100 and 4172.	Noted. EPA will attempt to obtain additional information regarding the fabrication of plutonium fuel from documents to be obtained from the Boeing document database. However, should this information not be located, EPA intends to conduct a full suite analysis for samples located at and around Building 4055. Both Pu-238 and Pu-239 are included in the default suite which all samples all samples will be analyzed for.
p. 77 More detail is needed about the combustion tests on Pu-contaminated waste. They were burning Pu waste? What were the release implications?	Agreed. EPA will request additional information regarding the combustion tests from documents in the Boeing document database.
p. 78 amazing -- up to 10 million dpm found inside the building.	Noted.
p. 79 same comment as made throughout prior HSAs--when you refer to prior release criteria, one needs to caveat it by showing how far weaker those standards were than today's 25 pCi/g Pu-239 in soil is 10 times the suburban PRG and 4000 times the rural residential PRG. Even the 0.1 mrad/hr average limit is 876 mrem/year, ten times background and vastly over what any agency permits for public exposures, even DOE and NRC.	Agreed. EPA will review these types of references. In EPA's final HSA report, data will be provide in standardized units, where possible. In addition, appropriate caveats will be added to convey the relative exceedances of specific standards.
p. 82 the limited info on use of the building from 1986 is unacceptable: Boeing needs to be forthcoming. This hiding of activity is unseemly.	Agreed. Since the drafting of the HSA-5D TM, Boeing has re-commenced providing EPA with additional information regarding the use of Building 4055 since 1986 (see previous comments above). This additional information, as well as any new information obtained from the Boeing document database, will be incorporated into the final HSA. Any new information affecting the soil sampling by EPA or by DTSC will be communicated immediately to appropriate agency staff and project stakeholders.
p. 83: Amazing, claiming too much waste was put in a container, "which went critical." Needs more detail. There was a criticality accident with plutonium	Agreed. EPA may attempt to follow up with this interviewee to determine if additional information is available. EPA has also sought additional information from within the Boeing document database and will document any new findings in our final HSA

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waste? Important to learn more.	report.
p. 85 are you sure the data in the first bullet are right? strange way to notate them, e.g., 0.01 x 10-8 microCi/g.	Noted. The units are presented as they were presented in the source document.
p. 86 again, it would be helpful to put figures in perspective. The 0.6 pCi/g Pu-239/240 value is 100 times the rural residential PRG.	Agreed. EPA will review these types of references in the TMs and, where possible, in the final HSA report provide data in standardized units and appropriate caveats to convey the relative exceedences of specific standards.
p. 98 beryllium--DTSC and DOE, there need to be measurements here of Be. The discussion of 93% enriched U --weapons grade -- and all the discussion of birdcages, for Pu and apparently HEU, suggest large quantities of weapons-usable materials, and potential criticality control problems.	Noted. This comment is noted by EPA and has been communicated to DTSC staff.
p. 132 Very hot stuff -- 17 rad/hr.	Noted.
p. 150 what is a "control rod test tower?"	Noted. Additional descriptions of the control rod test tower could not be located in available source documents. Additional information may be obtained from the Boeing document database. Any new information will be incorporated into the final HSA.
p. 168 You indicate that SNM-21 was amended numerous times. But what was the maximum possession limit for Pu? My memory is that it was huge. The discussion of the Pu building needs to make that clear -- they were doing Pu fuel fabrication. Operated then by Rockwell, which also operated Rocky Flats, which had lots and lots of trouble and Pu releases.	Agreed. EPA will add additional information regarding the quantities of Pu used in Building 4055 in the final HSA.
CONCLUSION --SUBAREA 5D CONTAINED TWO OF THE MOST HAZARDOUS FACILITIES, BY FAR, AT SSFL--THE HOT LAB AND THE PLUTONIUM FUEL FABRICATION BUILDING. ONE SHOULD REALLY FOCUS A LOT OF SAMPLING AROUND THOSE TWO FACILITIES (FOR THE PU BLDG, ONE CAN STREAMLINE THE SUITE OF COCS TO FOCUS ON PU AND SAVE SOME MONEY AND DO SOME MORE SAMPLES). But one needs a lot of samples around Hot Lab and Pu Bldg.	Agreed regarding the need for high density of soil samples at Buildings 4020 and 4055. Approximately 160 surface and subsurface samples will be collected in these areas combined during Round 1 sampling alone. Dozens more samples will likely be collected during Round 2 sampling, altogether the total number of samples is likely to exceed 200 samples.
One other comment: Attachment C should not be labeled "Reported Incidents Not Resulting in Radioactive Release." It is not clear that those incidents did not result in rad release. I would suggest just calling it "reported incidents."	Noted. EPA is making a determination regarding the naming of Attachment C. A similar attachment will be presented in the HSA-6 TM and EPA anticipates making a final determination at that time. The final HSA will be modified accordingly.
In Section 2.1.1 of the HSA 5D (Parking Lot 4509 AREA -- Shown Above Far Left) please note that for the past several years there have been Baker Tanks staged on this platform to collect tainted stormwater runoff that could impact this area and the areas around. I have spoken with a former employee who alleges cleaning of sodium contaminated items on this lot. Click on the link below to read the Rockwell Unusual Occurrence Report regarding Building 4009 that connects to this parking lot. Has HGL or EPA asked The Boeing Co. for these reports or are they unaware of these reports? These reports could help in the remainder of the HSA groupings. http://www.acmela.org/images/Building_4009_at_SSFL_Unusual_Occurrence_Report_June_1986.pdf	Agreed. EPA will verify that unusual occurrence reports are reviewed and referenced where applicable. Four sampling locations have been placed around the perimeter of the parking lot. Thank you for the link to the referenced document and EPA HSA Team has reviewed in information in that document.
In Section 2.2.1 of the HSA 5D (Building 4020 Rocketdyne International Hot Lab (RIHL) or Components Development Hot Cell (CDHC). This was a 20,000 sq ft facility that was constructed initially for the study of Radiation Effects on Fuel Elements and other Reactor Components. Below is the Hot Lab Closure Notice and List of Accidents. http://www.acmela.org/images/Hot_Lab_Closure_and_Accidents.pdf	Noted. This comment is noted by EPA. Thank you for the link to the referenced document and EPA HSA Team has reviewed in information in that document.
Please note the mounded material in the above and below photos, investigation is needed.	Agreed. Approximately 80 surface and subsurface samples will be collected from the footprint of Bldg 4020 during Round 1. Soil

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Also note in the below photo the location of the yellow "Casks" or "Coffins" that are storing radioactive waste on the West end of the RIHL, please investigate as well.	samples were also collected from the site of the apparent "concrete casks".
The Decontamination Plan for the RIHL needs to be investigated to determine the depth of excavation of the facility and core sampling needs to go down at that depth and further. http://www.acmela.org/images/Decon_Hot_Lab_SNM-21.pdf	Agreed. Samples will be collected of the native soil that is on top of bedrock within the footprint of former Building 4020 and at select locations down-gradient.
In Section 2.2.3 of the HSA 5D is 4520, the (RIHL) Hot Lab Parking lot (Photos Below). This area is non-radiological, yet should be investigated as radiological as (seen in photos) was a staging area for the Demolition Activities of the closure of Building 4020 RIHL and could have radiological impact potential.	Agreed. A total of 16 soil samples have been planned within the vicinity of Parking Lot 4520 to characterize potential radiological contamination left from demolition activities conducted at former Building 4020.
In Section 2.2.4 of the HSA 5D Building 4055 was the Nuclear Materials Development Facility (NMDF – Next Page FIVE) where the manufacturing of Plutonium and Uranium Fuels were contracted for the Atomic Energy Commission (AEC) and the United States Department of Energy (DOE) between, 1967 and 1979.	Noted.
Prior to the development of Building 4055 it was a Gun Club and with the known projectiles of depleted uranium the ground under the building needs investigation.	Noted. The location used as a gun club was further to the south. The footprint of Bldg 4055 was not used as site of a gun club.
Why is the Pond Dredge area or the Borrow Pit not in the scope of this HSA? I feel they both should be, in the case of the Borrow Pit, it has a potential of "Borrow and Return" and the soils could have come from other excavated areas of the SSFL that are radiologically impacted. The Pond Dredge area could be a potential drop area of the now infamous 1964 "Missing" Uranium Slug, please investigate.	Noted. The Pond Dredge Area is discussed briefly in the HSA-5D TM; however, it should be noted that very limited information is available regarding the Pond Dredge Area. During the stakeholder meeting it was noted by DTSC that the reference to this area as a Pond Dredge Area may not be accurate as historical information regarding this area could not be located. EPA will seek additional information regarding this area from Boeing. And, as presented in the April 20, 2011, stakeholder meeting, this area is included based on other lines of evidence in the sampling plan. A total of 68 soil samples have been placed within the area defined in the RFI documents as the "Pond Dredge Area" as part of the 5D North investigation. Additional soil samples will be collected in the vicinity of the Borrow Pit during the 5D South investigation. The borrow pit will be sampled as part of the sampling plan for HSA-5D South.
Keep in mind the majority of the HSA 5-D of the Santa Susana Field Laboratory (SSFL) AREA IV surface drainage of the SSFL drains into the Los Angeles River via Bell Creek and we need to protect the people below from any potential health risks.	Noted. Sediment samples will be collected from select drainage ways within Areas II and III and sediment and surface water samples will be collected from the Silvernale, R2A and R2B retention ponds.
The first is Interviewee 267 and his/her claim on page 83 of a criticality incident. *"Building 55 generated low level radioactive waste that was shipped off site for disposal in small boxes. I remember someone putting too much waste in a container, which went critical. I don't remember how it was mitigated."* Creation of a critical configuration from any combination of low level waste is physically impossible. The critical mass of bare plutonium metal or oxide is on the order of 10 kg and a randomly packed aggregation of pieces of scrap thrown into a waste container would be considerably more, if it could go critical at all. The above statement of a criticality incident is without merit and should be so noted. Report LA-13638 describes all criticality accidents worldwide and shows none at SSFL. Considering all of the emphasis on preventing criticality accidents by the AEC and subsequent agencies, it is inconceivable that your interviewee has identified a previously unidentified criticality accident. From the perspective of the SSFL cleanup, you are already sampling for a full spectrum of possible radionuclides and the impossible criticality accident is irrelevant.	This comment is noted and is being considered by EPA. However, EPA is not inclined to comment on or otherwise caveat statements made by former SSFL workers .
The second concerns the statements regarding Pu-238 on page 75, et. seq. Additionally, Dan Hirsch takes this to substantiate his claim of a valid hit of Pu-238 at Brandeis-Bardin, without the presence of Pu-239 or reconfirmation in a follow-up analysis. Regardless of what is said in your reference or your document, for the record, as can substantiated by available documentation, Pu-238 does not exist in a pure form, except for a few microgram quantity sources created for instrument standardization. It was produced in reactors as a by-product of the production of Pu-239 for nuclear weapons, and requires a chemical separation and a re-irradiation. As a result, it always occurs in the presence of other plutonium and transuranic isotopes. The plutonium isotopes cannot be separated from each other and require electromagnetic separation which has not been done except in the few instances noted. Pu-238 is not used in power reactors and because of its high heat generation rate is used only as a heat source for radioisotope power sources. The highest assay of Pu-238 used for these applications is in the range of 85-90%.	This comment is noted and is being considered by EPA.

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EPA should be aware in its rad survey that Pu-238 will not be found by itself. This fact is amply demonstrated by the data shown below from page 85. Note that Pu-238n is never significantly greater than Pu-239.			Noted.
-57 (Building 4055) Soil Plutonium Radioactivity Data Date	**Pu-238**	**Pu-239 + Pu-240**	
June 8, 1978	(-2.13 ± 2.2) x 10-9 µCi/g	(1.04 ± 2.3) x 10-9 µCi/g	
December 13, 1978	*	(6.21 ± 3.5) x 10-9 µCi/g	
July 9, 1980	(1.4 ± 3.4) x 10-9 µCi/g	(9.5 ± 4.8) x 10-9 µCi/g	
December 22, 1980	(-0.3 ± 2.3) x 10-9 µCi/g	(5.6 ± 3.2) x 10-9 µCi/g	
July 8, 1981	(-3.7 ± 1.4) x 10-9 µCi/g	(0.04 ± 1.7) x 10-9 µCi/g	
December 17, 1981	(-3.4 ± 1.5) x 10-9 µCi/g	(4.8 ± 3.1) x 10-9 µCi/g	
July 9, 1982	(1.0 ± 0.4) x 10-9 µCi/g	(3.9 ± 0.6) x 10-9 µCi/g	
December 16, 1982	(-8.0 ± 1.5) x 10-9 µCi/g	(5.1 ± 2.2) x 10-9 µCi/g	
June 22, 1983	(1.4 ± 1.9) x 10-9 µCi/g	(2.4 ± 2.4) x 10-9 µCi/g	
December 7, 1983	(0.3 ± 0.6) x 10-9 µCi/g	(3.8 ± 2.2) x 10-9 µCi/g	
June 25, 1984	(0.1 ± 0.1) x 10-9 µCi/g	(5.2 ± 0.7) x 10-9 µCi/g	
December 4, 1984	(0.4 ± 0.1) x 10-9 µCi/g	(2.2 ± 0.4) x 10-9 µCi/g	
June 26, 1985	0 ± 0.0001 pCi/g	0.0038 ± 0.0004 pCi/g	
December 4, 1985	0.003 ± 0.0003 pCi/g	0.0028 ± 0.0005 pCi/g	
June 25, 1986	0.0004 ± 0.0003 pCi/g	0.0005 ± 0.0003 pCi/g	
December 8, 1986	0.0003 ± 0.0002 pCi/g	0.0010 ± 0.0004 pCi/g	
June 22, 1987	0.0001 ± 0.0001 pCi/g	0.0012 ± 0.0003 pCi/g	
December 7, 1987	0.0006 ± 0.0002 pCi/g	0.0031 ± 0.0004 pCi/g	
June 29, 1988	0 ± 0.0001 pCi/g	0.0039 ± 0.0005 pCi/g	
December 1, 1988	0 ± 0.0001 pCi/g	0.0032 ± 0.0005 pCi/g	
July 19, 1989	0.0004 ± 0.0001 pCi/g	0.0049 ± 0.0005 pCi/g	
December 5, 1989	0.0002 ± 0.0002 pCi/g	0.0054 ± 0.0006 pCi/g	

ATTACHMENT A

REPORTED INCIDENTS
NOT RESULTING IN ENVIRONMENTAL RELEASE

BUILDING 4020

- On August 26, 1959, a personnel injury occurred at Building 4020. During routine entry into Cell #3, an employee was struck across the hands by a heavy steel ramp that dropped suddenly when the cell door opened. At the time of the injury, the employee was holding a Juno survey meter in each hand to monitor the radiation levels at the doorway. The employee was assisted to the hot change room and all protective clothing was removed. The employee was surveyed and no significant contamination was detected. The employee was taken to the plant hospital at Rocketdyne in Canoga Park. Hospital smears near the wounds also found no significant contamination. The incident report does not indicate what constitutes a significant amount of contamination (Incident Report A0002).[1]

- On April 16, 1960, two employees entered Decontamination Room (Decon) #4 to perform decontamination of the cut-off saw assembly, which has been used to cut irradiated sodium reactor experiment (SRE) fuel slugs. These employees were in violation of the 300 millirem (mrem) exposure limits for one week (Incident Report A0392).[2]

- On April 18, 1960, an employee in Decon #3 called another employee over to the area and asked if he felt brave, then placed an unknown object in his hand. The employee holding the small cylindrical object approximately 2.5 inches long and 0.75 inches in diameter quickly saw that the object was stamped E-2, indicating a batch of SRE fuel slugs. The employee immediately tossed the SRE slug into the airlock. The slug was picked up with 6-foot tongs and placed in a can filled with lead shot. The slug measured 25 R/hr at 10 inches and 25 RAD/hr at 21 inches (Roentgens per hour is generally defined as R/hr and rads per hour is generally defined as rad/hr; units may be incorrectly presented in the source document). Another employee took the can containing the slug into Decon #4. By this time, the employees in the service gallery and connected to the operation were going to the hot change room to change out of contaminated clothing and go to lunch. The incident was reported to the health physics department (Incident Report A0003).[3]

- On May 12, 1961, a lead shipping cask containing 9,500 Curies (Ci) of fission products was placed on a flat rail car for transport into the airlock when it was observed that the rails to the moveable dock had not been secured to either the dock or floor of the airlock. Operating personnel were requested to hold up the operation until the rails were aligned and bolted down, but the car was already moving and it ran off the rails and tilted to one

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[1] Bold, F.O. Atomics International Internal Letter, *Re: Personnel Injury at CDHC Building 20, Santa Susana*, September 29, 1959.
[2] Health Physics, Atomics International, *Notice of Radiological or Industrial Safety Rule Infraction*, April 22, 1960.
[3] Clow, H.E., Atomics International Internal letter, *Re: Radiological Safety Incident Report, Cell #3 CDHC Bldg. #20, 4/18/60*, June1, 1960.

side. A corner of the car caught the edge of the dock and stopped leaving the cask at a 15 degree angle. A fork lift was brought in to remove the cask from the car and place it on the ground. No radiological exposure resu lted from the incide nt (Incident R eport A0011).[1]

- On May 21, 1961, two em ployees were transferring radioactive wa ste in Building 4020 when a dust was observed being generated fr om the transfer operation. The oper ation was discontinued and the m en were taken to the change room for monitoring. One employee was found to have approxim ately 1,500 counts per m inute (cpm) of be ta-gamma contamination on his forehead. The other em ployee had approxim ately 1,100 cpm beta-gamma contam ination on his pants. One em ployee had a nasal sm ear of 850 cpm beta-gamma contam ination. A health and safety representative noted that the m en were only wearing lab coats and shoe covers, not the appropri ate protective clothing for operations (Incident Reports A0347 and A0505).[2,3]

- On June 2, 1961, an employee doing routine work in De con #3 pinched a flexible supplied air hose to his supplied air m ask causing the hose to explode. The em ployee immediately stopped breathing and moved to the clean door where he removed his m ask, put on an assault m ask and waited for an addi tional supplied air m ask and hose. A nasal smear indicated no signific ant contam ination of m ixed fission products (Incident Report A0283).[4]

- On June 19, 1961, personnel entered Decon #2 prior to entering Cell #2 to repair a balance in the cell. The door to C ell #2 was being opened when a front side operator controlling the door opening noticed two Systems for Nuclear Auxiliary Power (SNAP) Experimental Reactor (SER) fuel elements lying on the floor and ordered the door closed. An unknown radiation field from the two SER fuel elem ents was estim ated at approximately 1,500 rads/hr at 1 foot. No first air or health physics sam pling was required for the em ployees entering the cell. The incident report called for a more thorough examination of cells prior to entering and recommended a re mote area monitoring system to monitor c ells before actually entering them (Incident Report A0012).[5]

- On September 4, 1962, the repair of a copper inlet line between the fission gas sa mpling apparatus and Cell #3 caused high airborne ac tivity, resulting in the c ontamination of personnel and the lab. A routine radiation survey taken on August 31, 1962 revealed

[1] Badger, F.N., Atomics International Internal Letter, *Re: Radiological Safety Incident Report, CDHC Bldg. 020, May 12, 1961*. May 15, 1961.
[2] Yarrow, A.R., Atomics International Internal Letter, *Re: Radiological Safety Incident Report, Building Number 20, 5-20-1961*, May 26, 1961. (Corrects incident date from May 20, 1961 to May 21, 1961)
[3] Yarrow, A.R., Atomics International Internal Letter, *Re: Radiological Safety Incident Report, Building Number 20, 5-20-1961*, May 26, 1961. (It is unclear why this incident has two different reports and report numbers associated with it.)
[4] Badger, F.H., Atomics International Internal Letter *Re: Radiological Safety Incident Report, CDHC Decontamination Cell #3, June 2, 1961*. June 15, 1961.
[5] Clow, H.E., Atomics International Internal Letter, *Re: Radiological Safety Incident Report, DeCon #2 & Cell #2 at CDHC, 6-19-1961*. June 21, 1961.

excessive contamination building up inside th e copper line. Radiation levels reached a maximum of 1.5 r/hr (units m ay be incorrectly presented in the source docum ent). The copper line was removed and placed in a plastic bag and a new line was installed. Health and Safety was called to s mear the area. During this operation, the Health and S afety representative found his hands and shoes cont aminated and an air m onitor recorded an increase in airborne activity from 250 curies per meter (Ci/m) to 1000 Ci/m.

Personnel were evacuated from the operating gallery and an air sam ple was taken with a portable sampler. Airborne activity was f ound to be 5.4 x 10-10 µC/cc beta-gamm a. A smear survey revealed floor cont amination averaging 10,000 dpm /100 cm^2, with a maximum of 130,000 dpm /100 cm^2 beta-gamma. Sm ears of desks, benches, and other horizontal surfaces revealed rem ovable contamination of 15,000 dpm/cm2 beta-gamma. The floors of the office areas, rest room s, and mock-up shop were found contam inated to a maximum level of 1,000 dpm /100 cm^2 beta-gamma, presumably as a result of tracking from the operating gallery.

Smears of the removed copper tube and its plastic bag showed contamination of 140,000 dpm/100 cm^2 beta-gamma inside the bag, 20,000 dpm /100 cm^2 beta-gamma on the tube surface, and 2,000 dpm/100 cm^2 beta-gamma on the exterior bag surf ace. Radiation levels of 25 rad/hr were found at t he open end of the copper tube. The copper tube contained sufficient contam ination to cause the levels found on the floor and other surfaces, but it was considered an unlikely source for such widespread contamination. It was also hypothesized that at the tim e the copper tube was being rem oved Cell #3 was being purged leading to contam ination of the operating gallery. Oper ations at all cells were suspended until th e complete area was decontamination to "perm issible levels." The incident report does not define "permissible levels" (Incident Report A0018).[1]

- On December 15, 1962, a worker found contam ination on his shoes during a visit to Building 4020. The surface dose rate on the worker's sh oes was 20 m rad/hr and the activity on a smear sample was 10^5 dpm/100 cm^2 beta-gamma. Floor smear surveys were conducted in areas visited by the worker. Beta-gamma measurements were found as follows: Health and Safety Office (100 dpm /100 cm^2); Engineering Office (200 dpm/100 cm^2); Supervisors Office (90 dpm /100 cm^2); Operating Gallery (~30 to 400 dpm /100 cm^2); Cold Change Room (2,000 dpm /100 cm^2); Men's Restroom (200 dpm/100 cm^2); and hallways connecting th ese locations (~200 dpm /100 cm^2). Sm ears taken from the shoes of other personnel were found to have contamination ranging from 30 dpm/100 cm^2 to 1,200 dpm /100 cm^2. It was not clear w here the con tamination originated. The entire building was m onitored with a portable survey m eter and no contam ination levels as high as 20 mrad/hr were found (Incident Report A0020).[2]

- On January 25, 1963, an e mployee was monitoring Cell #3 and tore open his right glove with a pair of cutters. The e mployee found his hand and s hoes contaminated. After an

[1] Hanseon, W.D., Atomics International Internal Letter, *Re: Contamination Incident at the CDHC*, October 26, 1962.
[2] Bergstrom, W.H., Atomics International Internal Letter, *Re: Incident Report CDHC*, January 17, 1963.

hour and a half of repe ated scrubbing in the "hot shower" with scouring powder and permanganate treatment the contamination was eliminated. The em ployee's shoes could not be decontam inated and read 10 mrad/hr beta-gamma when disposed (Incident Report A0021).[1]

- On May 8, 1963, two janitors waxing the m ock-up area floor dragged a m op through a highly contaminated trough by the side door of Cell #4 and then used the mop to wax the remainder of the floor, spreading m ixed fission product contam ination throughout the mock-up area. Upon departing the area, the ja nitors checked themselves in the hand and foot counter and found that their shoes were contaminated to as high as 1 m rad/hr beta-gamma. A hot spot of 5 m rad/hr beta-gamma was identified on th e mock-up room floor near the side door of Cell #4. A sm ear survey of the floor revealed contam ination ranging from less than 30 dpm /100 cm^2 to 90,000 dpm/100 cm^2 beta-gamma. The floor wax appeared to have sem i-fixed the cont amination. Personnel were notified and the mock-up area was roped off and tagged. Measurement taken two days later indicated that the floor contam ination had dissipated and the area could be reclassified as non-tagged (Incident Report A0433).[2]

- On September 26, 1963, a fire occurred in the doorway between Decon #3 and Cell #3 during the cleaning of the fission gas rig with butyl alcohol. The fire was apparently caused by residue of NaK in the fission gas rig that reacted with the alcohol. The fire lasted 2 minutes and was extinguished with calcium carbonate. No injuries occurred and no increases in airborne contamination were found (Incident Report A0024).[3]

- On September 26, 1963, an employee emerged from Cell #3 after conducting cell cleanup and found his dosim eter was off scale. The contamination was thought to have been the result of contact with a drip pan in the cell. A survey of the pan s howed a dose rate of 3 rad/hr at surface and 25 rad/hr at 1 ft. The employee's film badge showed an uncorrected dose of 295 mrem (Incident Report A0025).[4]

- On October 9, 1963, it was discovered that a fi re occurred in Cell #2 during the night. Investigation found the furnace in Cell #2 ha d been left on without any contro lling thermocouples. The temperature o f the furna ce could have reached 2,300 degrees Fahrenheit. Approximately 100 ft^2 of blotter paper, which is used as a floor cov ering in the cell, was burned. A check of the stack monitor and the operating gallery showed no increase above norm al activity for the pre ceding 24 hour period. Spot sm ears of the floor, cell face, and equipment in the operating gallery were all 30 dp m/100 cm^2. The incident report notes th is is the thir d fire in the last thre e weeks at Building 402 0 and

[1] Bergstrom, W.H., Atomics International Internal Letter, *Re: Contamination Incident at CDHC*, February 12, 1963.
[2] Lane, W.B., Atomics International Internal Letter, *Re: Radiological Safety Incident Report, Mock Up, CDHC, Room 125, May 8, 1963*. May 13, 1963.
[3] Lane, W.D. and D. Tworek, Atomics International Internal Letter, *Re: Radiological Safety Incident Report, CDHC, 9/26/63*. Undated.
[4] Tworek, D. and W. Lane, Atomics International Internal Letter, *Re: Radiological Safety Incident Report, Building 020 CDHC, 9/26/63*. Undated.

suggests the lead man should make a thorough check of all equipment before leaving the facility (Incident Report A0026).[1]

- On March 20, 1964, the door of Cell #4 was opened at the same time a nitrogen purge and "UC" (presumably uranium carbide) fuel cutting occurred in Cell #3, resulting in increased airborne beta-gamma activity. The maximum airborne concentration was 5 x 10^{-9} µCi/cc with no smearable detectable contamination above limits. The incident report does not note what the contamination limits were (Incident Report A0031).[2]

- On June 8, 1964, an employee repairing in-cell hacksaws without authorization and proper protection was contaminated. The hacksaws had a maximum of 2.5 rad/hr mixed fission product contamination. Smearable contamination on tools was as high as 2 x 10^{5} dpm/100 cm^2 beta-gamma. The employee was surveyed and decontaminated in the hot shower (Incident Report A0551).[3]

- On June 16, 1964, a Piqua fuel element in Cell #3 was repositioned in the cell such that the element was in line with the cell manipulator port opening and north operating gallery probe. Because there is no shielding at the port opening, excessive radiation streamed through the port. A radiation survey found contamination levels at the port opening to be 1,000 mr/hr (units may be incorrectly presented in the source document). All future operations involving the movement of high level radiation sources were to be scrutinized to prevent a recurrence of this type of incident (Incident Report A0443).[4]

- On July 10, 1964, the health physics department observed that the Decon #3 doors, the service gallery doors, and the airlock outer doors were all in the open position during loading of a cask into the airlock. This situation allows for a potential spread of contamination to clean areas. A smear survey of the outside area failed to detect any contamination. The incident report notes that this problem had occurred during similar operations in the past and is mostly due to negligence. A modification of the airlock door latching devices was expected to minimize recurrence (Incident Report A0338).[5]

- On July 23, 1964, an employee cleaning Cell #4 inadvertently contacted wet spots on the false flooring where mixed fission products up to 25 rad/hr contaminated his knees to a maximum of 0.3 mrad/hr and 270 dpm/100 cm^2 beta-gamma. Loose contamination was removed and the employee was released to the medical department for further treatment.

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[1] Tworek, D.D and W. Lane, Atomics International Internal Letter, *Re: Radiological Safety Incident Report, CDHC Cell #2, 10/8/63-10/9/63*. October 17, 1963.
[2] Ericson, G.I. and W. Lane, Atomics International Internal Letter, *Re: Increased Airborne Activity at Building 020*. April 2, 1964.
[3] Ericson, G. and W. Lane, Atomics International Internal Letter, *Re: Incident Report, Yellow Tag Manipulator Repair Room, Bldg. 20, June 8, 1964*. June 11, 1964.
[4] Ericson G. and W. lane, Atomics International Internal Letter, *Re: Incident Report, CDHC Cell #3 and Operating Gallery, 6-16-64*. June 24, 1964.
[5] Ericson, G. I., Atomics International Internal Letter, *Re: Incident Report, CDHC Airlock Service Gallery and Decon #3, 7-10-64*. July 20, 1964.

Recommendations include wearing knee pads during cleanup and using clean plastic sheeting on the floor where personnel are working (Incident Report A0554).[1]

- On August 27, 1964, an alarm in the operating gallery went off when the air activity increased to 2.5×10^{-3} cpm with normal background levels at 500 cpm. The operating gallery was evacuated. Ten minutes air samples showed air activity gradually decreasing from 3.8×10^{-9} µCi/cc to 3.6×10^{-10} µCi/cc. The release was attributed to loss of an airborne controller in Cell #3 used during purging of the cell. The controller was replaced (Incident Report A0354).[2]

- On September 3, 1964, an employee surveyed his work area in Cell #1 and found a vacuum cleaner hose was reading 25 rad/hr gamma. A front side man moved the vacuum cleaner to a far corner of the cell and the in-cell man began work. The in-cell employee later discovered that the polishing cloth he was using read 25 rad/hr gamma and the vacuum cleaner was only 10 rad/hr. The employee had failed to resurvey the work area after the vacuum cleaner was moved. The employee received 270 mrem on his dosimeter and a corrected dose of 1,145 mrem on his film badges. His ear was contaminated to 0.2 mrad/hr and less than 30 dpm /100 cm^2 of removable contamination (Incident Report A0415).[3]

- On October 15, 1964, an employee acting as the cold man on a Cell #3 entry removed his mask in the service gallery while bagging shielding blankets. Investigation found that a blanket was contaminated to 5 mrad/hr beta-gamma. A smear survey indicated maximum contamination levels of 2.7×10^{5} dpm/100 cm^2 beta-gamma in the immediate area. The employee contaminated his leg to a maximum of 0.5 mrad/hr and a nasal swipe found 600 dpm/100 cm^2 beta-gamma. A new method of bagging the shielding blankets was put in effect as a result (Incident Report A0337).[4]

- On November 18, 1964, an employee working in Cell #3 found particulate contamination on his head when he conducted an exit survey. Investigation revealed a maximum of 100 mrad/hr contamination and less than 30 dpm /100 cm^2 beta-gamma. After five attempts, the particulate contamination was washed off the employee's head and he was found to be free of contamination (Incident Report A0574).[5]

- On December 7, 1964, an inspection of the radioactive holdup yard at Building 4020 revealed the storage of numerous unidentifiable barrels, boxes, shipping containers, and pigs in various states of disarray. Some of the items have been in state for more than 2

[1] Ericson, G.I. and W. Lane, Atomics International Internal Letter, *Re: Incident Report, CDHC Cell #4, 7-23-64*, July 28, 1964.
[2] Lane, W.D., Atomics International Internal Letter, *Re: Incident Report, Building 020, Operating Gallery, CDHC, 8-27-64*. September 22, 1964.
[3] Lane, W.D., Atomics International Internal Letter, *Re: Incident Report, Cell #1CDHC, 9-3-64*. October 5, 1964.
[4] Ericson, G.I., Atomics International Internal Letter, *Re: Incident Report, CDHC Service Gallery, 10-15-64*. October 20, 1964.
[5] Ericson, G.I., Atomics International Internal Letter, *Re: Incident Report, CDHC Cell #3, 11-18-64*. December 17, 1964.

years. A radiation survey indicated a maximum of 50 mR/hr gamma at the outer perimeter of the holdup yard, a violation of 10 C.F.R. 20.105 and 20.203 (Incident Report A0034).[1]

- On July 16, 1965, it was discovered that a fuel wafer had disintegrated on a vacuum filter and caused buildup of 2.2 Ci of mixed fission products. In Cell #2 an in-cell vacuum distillation cold trap was measured at 100 R/hr and the lines extending to the cell face were measured at 25 R/hr. A filter was removed from the cell and bagged, but a release occurred between the time the filter was removed and when it was bagged. Contamination had been transported through the operating gallery, cold change room, and into the service gallery. When the extent of contamination was discovered, movement was restricted and the facility underwent cleanup. No radioactive material was released outside the building (Incident Report A0037).[2,3]

- On September 21, 1965, the constant air monitor located at the north end of the operating gallery triggered the lower alarm (~1,000 cpm). Operations personnel were decladding SNAP 8 Experimental Reactor (S8ER) fuel in Cell #3 and were purging the cell with nitrogen. All systems and possible sources were checked, but no abnormal conditions were noted. A 10 minute air sample indicated 2.5×10^{-8} µCi/cc beta-gamma immediate count. The constant air monitor was still climbing and indicated 7,000 cpm. Further checks of equipment were made and spot smears were taken throughout the area. Smears were normal and no problems were noted. A call to other buildings and a check of other areas of Building 4020 indicated the problem was localized. A second air sample indicated 4.2×10^{-8} µCi/cc beta-gamma. The constant air monitor was leveling off at 9,000 cpm. A third air sample indicated 4×10^{-10} µCi/cc beta-gamma. The incident report notes that no radioactive material was released to the environment and no increase in surface contamination was found. There was no apparent cause for the increase, although it was generally believed to have come from Cell #3 (Incident Report A0038).[4]

- On February 2, 1966, two employees inadvertently exposed one hand each to the radiation field from a mounted irradiated S8ER fuel metallographic sample. The estimated doses to the hands were 58,000 mrem and 2,000 mrem for the two men involved. A fixture was being transferred remotely into Cell #1 by way of the metallograph tunnel. The fixture jammed in the tunnel and an S8ER fuel sample fell off the transfer train. An employee impulsively picked up the fuel sample and placed it back in the train bucket. Realizing what he had done, the employee immediately called the health physics department. Another employee was also present and received a lesser

[1] Ericson, G.I., Atomics International Internal letter, Re: *Radioactive Materials Holdup Yard at CDHC Building 020*. December 7, 1964.
[2] Author Name Redacted, Atomics International Internal Letter, *Re: Contamination Spread on Friday, July 16, 1965*. July 28, 1965.
[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. AA-3.
[4] Badger, F.H., Atomics International Internal Letter, *Re: Excessive Concentration of Airborne Radioactive Material*. September 28, 1965.

exposure. A recreation of the incident was used to determine exposure time and estimated dose (Incident Report A0039).[1]

- On February 24, 1966, three men who had been working in the service gallery, Decon #3, and Cell #3 were found to have nasal contamination ranging from 450 dpm to 4,500 dpm beta-gamma and slight skin contamination. Contaminated fine powders generated during operation of an electronic discharge machine (Elox machine) settled in and around the screw holes of the machine. When one of the employees removed the screws to replace an electric motor, the powder circulated into the air. The employee replacing the motor received the greatest contamination. Another employee in the vicinity who was not wearing respiratory protection and received the second highest level of contamination. A third person removed his mask in an area of high floor contamination and received the least amount of contamination. The men were decontaminated.

  A spot smear of the service gallery showed floor contamination outside Decon #3 of ~75,000 dpm beta-gamma with several areas in the direction of the change room reading ~12,000 dpm beta-gamma, indicating the spread of contamination as the men left the area. It was recommended that a low purge be on during decontamination and cleaning operations (Incident Report A0040).[2]

- On August 16, 1966, an electrical power failure occurred in Building 4020 and the emergency generator for equipment such as the radioactive exhaust failed to engage. Emergency power was established 15 minutes later. The constant air monitor in the operating gallery showed an increase from 2,000 cpm to 5,000 cpm. A high volume air sample was taken after power was reestablished and indicated an airborne concentration of 3×10^{-8} µCi/cc beta-gamma. Smear samples indicated less than 30 dpm/100 cm^2 and additional air samples indicated a maximum of 5×10^{-9} µCi/cc beta-gamma. A second high volume air sample taken approximately 45 minutes after the power failure and showed 4×10^{-10} µCi/cc beta-gamma. At this time the area was released. According to the incident report, no injuries, loss of equipment, or significant release of radioactive materials occurred as a result of the power failure (Incident Report A0042).[3]

- For the week ending December 31, 1966, personnel involved in the promethium-147 (Pm-147) heat source fabrication were found to have extremity overexposures in excess of quarterly limits as indicated by finger ring film dosimeters. However, reevaluation of the film dosimeters indicated no legal overexposure had occurred. It was known that extremity exposure would be a controlling factor in the radiologically safe fabrication of Pm-147 heat sources. Numerous problems in the fabrication operations extended the estimated time of completion from 5 days to 20 days. Project schedules and budgets were extremely tight and investigation of the incident disclosed that some procedural

[1] Badger, F.H., Atomics International Internal Letter, *Re: Accidental Excessive Exposure.* February 8, 1966.
[2] Mooers, A.R., Atomics International Internal Letter, *Re: Personnel Contamination Incident – February 24, 1966 A.I.H.L.* March 16, 1966.
[3] Badger, F.H. Atomics International Internal Letter, *Re: Power Failure at Bldg. 020, Santa Susana.* August 29, 1966.

violations occurred in an effort to accomplish the job on schedule at a minimum cost. Examples of problems encountered include: a powder volume 30 percent greater than anticipated, which required three pressings per pellet instead of two pressings; breaking or cracking of pellets; a broken fuel hopper that spilled 5,000 Ci of fuel on the floor; and unsuccessful welding of capsules. These problems and more led to increased dose rates for operators (Incident Report A0044).[1]

- On January 28, 1967, an employee in the Slave Shop contaminated his coveralls by leaning across a piece of equipment. Unaware of the contamination he brushed his gloves over the coveralls, flaking the contamination onto his shoe covers. The employee then walked about the Service Gallery and Hot Shop spreading the contamination. Contamination ranged from 10^5 to 4×10^5 dpm/100 cm^2 beta-gamma, but was brought down to less than 500 dpm/100 cm^2 beta-gamma in a single cleaning with a scrubber and vacuum. No contamination was tracked outside of a controlled area (Incident Report A0607).[2]

- On April 6, 1967, a fire occurred in Cell #3 during the cutting of a uranium fuel sample. Hot sparks ignited the cut-off wheel coolant (isopropyl alcohol), which in turn ignited three absorbent pads. The fire was extinguished using a low volume nitrogen purge. No significant release of radiological material was detected (Incident Report A0613).[3]

- On May 17, 1967, a Pm-147 release occurred during transfer of wet Kimwipes into glove box B through the air lock. Maximum airborne contamination levels of 2×10^{-9} µCi/cc were detected by air samplers located at the glove box face. The radiation concentration guide is 1×10^{-7} µCi/cc. Nasal swabs of the two men working in the area revealed a maximum 1,050 dpm/100 cm^2 (Incident Report A0617).[4]

- On June 10, 1967, approximately 55 gallons of Pm-147 waste were removed from glove boxes A and B in Building 4020. During the procedure, which involved bagging-out the waste through the airlock, an air monitor detected high airborne activity immediately following the cutting of a bag for separation from the glove box. Filters from the air samplers indicated activity of 8×10^{-8} µCi/cc when average over 8 hours. The air concentration standard is 1×10^{-7} µCi/cc for 40 hours. No personnel were affected because they were all wearing supplied air at the time of release. The area was decontaminated prior to proceeding with the operation (Incident Report A0619).[5]

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[1] Badger, F.H. and F.C. Schrag, Atomics International Internal Letter, *Re: Extremity Exposure Associated with Primary Encapsulation of Pm-147*. February 3, 1967.
[2] Alexander, R.E., Atomics International Internal Letter, *Re: Radiation Safety Weekly Newsletter for Period Ending January 28, 1967*. January 31, 1967.
[3] Alexander, R.E. Atomics International Internal Letter, *Re: Radiation Safety Unit Weekly Newsletter for Period Ending April 8, 1967*. April 13, 1967.
[4] Alexander, R.E., Atomics International Internal Letter, *Re: Radiation Safety Unit Weekly Newsletter for Period Ending May 20, 1967*. May 24, 1967.
[5] Alexander, R.E., Atomics International Internal Letter, *Re: Radiation Safety Unit Weekly Newsletter for Week Ending June 10, 1967*. June 15, 1967.

- On October 11, 1967, an employee received an internal exposure from Pm-147 while working on glove box A in the hot shop. After transferring waste from glove box A to glove box B and cleaning glove box A, two employees followed normal procedures for leaving the area and monitoring themselves. One employee found no contamination on himself, while the other employee found a spot between his nose and lip that was contaminated to ~1,000 cpm. He removed the contamination. After showering, the employee went to the health physics office and was resurveyed. When he opened his mouth the count rate increased from 50 cpm (normal background) to 150 cpm. A smear sample taken from his mouth revealed contamination of 550 dpm. His mouth was rinsed of water until free of detectable contamination. Surface contamination of the top of glove box A was found to be as high as 4.3×10^{5} dpm/100 cm^2. Both gloves on the left window were contaminated to 1.7×10^{5} dpm/100 cm^2. Other smears samples and air samples in the area indicated contamination levels of less than 5,000 dpm /100 cm^2. The contamination was suspected to have been transferred to the top surface of glove box A by a contaminated cover plate from the left glove. The employee working at glove box A then ingested the contamination through licking of his lips (Incident Report A0047).[1]

- On July 22, 1970, a small alcohol fire occurred in Cell #3 during the disassembly of a NaK-bonded SNAP 8 Development Reactor (S8DR) fuel element. The fire started when an end cap of the fuel element was placed in a pan of alcohol to dissolve NaK accumulation from the cap. The fire was immediately suppressed by placing a lid on the pan. No damage resulted from the fire and there was no evidence of airborne or surface contamination (Incident Report A0050).[2]

- On October 11, 1970, an alarm activated on the constant air monitor located in the operating gallery of Building 4020. Pressure gauges were reading normal. The scale on the air monitor was switched, but the monitor did not respond immediately so it was assumed to be malfunctioning. Further investigation showed the air monitor to be working properly. A high volume air sample was taken in the vicinity of the constant air monitor and showed 5×10^{-10} µCi/cc beta. An identical high volume air sample was taken outside Building 4020 and produced the same result. A smear survey from the floors and equipment tops located in the operating gallery showed less than 30 dpm / 100 cm^2. No problem was found in the building. It was noted that the natural airborne concentrations on October 11, 1970 were approximately five times higher than those observed in the previous two years and after 24 hours the air sample results were back to background activity levels (Incident Report A0051).[3]

- On September 30, 1977, in preparation for removal of old radioactive liquid waste tanks from the basement of Building 4020, employees cut into a pipes and failed to cap them, causing an unexpected drop in air pressure. A spot smear survey was taken and

[1] Lane, W.D., Atomics International Internal Letter, *Re: Pm-147 Internal Exposure Incident of October 11, 1967.* November 6, 1967.
[2] Klostermann, J.P., North American Rockwell Internal Letter, *Re: Small Alcohol Fire in AIHL Cell #3.* July 27, 1970.
[3] Klostermann, J.P., North American Rockwell Internal Letter, *Re: Investigation of CAM Alarm – Bldg. T020.* October 13, 1970.

compared to a spot survey taken September 26, 1977. The average of the smear area was 250 dpm/100 cm^2 beta-gamma on September 26. The average smear on September 30 was 1,380 dpm/100 cm^2. No increase in airborne activity was detected (Incident Report A0060).[1]

- On April 25, 1978, while attempting to change one of the 3-quart collection cans on the evaporator that contained caustic solution from the sodium digester, an employee dropped the collection can spilling radioactive solution over one fifth of his body. The employee was instructed to use the radiologically controlled drainage shower. Maximum activity detected in a quick survey was 30,000 cpm (12 mrad/hr) on the employee's right forearm. A 15 minute shower produced 100 gallons of radioactive liquid. After the shower, 500 cpm contamination remained on the employee's right knee and forearm. A bactine scrub removed contamination on the forearm, but immediate efforts to decontaminate the knee were unsuccessful and would have to be continued in the medical department. Dressings applied to sore spots were removed by the company doctor and returned to Building 4020 for disposal (Incident Report A0067).[2]

- On May 3, 1978, the alcohol evaporator in Decon #2 caught on fire, burning most of the insulation off the electrical wires before it was extinguished by a nitrogen purge. No personal injury, exposure, or facility damage resulted. The evaporator has been routinely filled with alcohol from the sodium digester in the morning. The evaporator was turned on and about 1.5 hours later a fire was observed. The fire was extinguished within 5 minutes. Inspection the following morning, indicated an electrical fire, but no cause for an electrical short was found. The incident report notes that the evaporator is being redesigned with an emphasis on heavier insulation and simpler loading (Incident Report A0069).[3]

- On February 9, 1979, alcohol from the Hallam fuel bonding sodium digester system spilled after the salt preparation and before distribution. Approximately 1 to 2 gallons containing mixed fission products spilled. The personnel involved required no first aid and nasal smears were at background levels (Incident Report A0076).[4]

- On August 21, 1981, personnel were loading bags of equipment contaminated with mixed fission product from the hot storage room into a box in the airlock. Routine personnel survey after removing protective clothing indicated nasal, facial, and hair contamination up to 4,400 dpm per nasal swipe. Personnel were decontaminated. Investigation indicated two possible sources of the contamination. One bag was cut open to remove lead bricks and facilitate lifting with a fork truck. The second possible source was a bag containing a furnace that broke open on a 5 rad/hr source. Smears of the hot storage room measured up to 200,000 dpm /100 cm^2 beta-gamma and smears of the airlock measured up to 57,000 dpm /100 cm^2 beta-gamma. Personnel were familiar with good

[1] Badger, F.H., Rockwell International Internal Letter, *Re: Radiological Occurrence – Bldg. T020.* October 3, 1977.
[2] Badger, F.H., Rockwell International Internal Letter, *Re: Radiological Occurrence - Decon 2.* April 26, 1978.
[3] Badger, F.H., Rockwell International Internal Letter, *Re: Evaporator Fire,* May 15, 1978.
[4] Badger, F.H., Rockwell International Internal Letter, *Re: Radiological Safety Incident Report, Decon 2, RIHL (T020), 9 Feb 79.* February 12, 1979.

operating techniques, but in haste did not execute them properly (Incident Report A0088).[1]

- On July 13, 1982, SEFOR fuel pin #662 was declad, crushed, and loaded into a transfer tube. The tube was crimped and leak checked. The leak check revealed the tube to be leaking grossly. The tube was returned to the crimping station in Decon #4 and recrimped between the bad seal and the fuel. Operators were not wearing respirators and on the second try they were not wearing gloves. Apparently, the primary crimping forced contamination out of the faulty seal contaminating the crimper and in turn the hands of the operators. The health physicist took some smears and went to count the smears while operators continued to work further contaminating equipment and clothing before realizing the problem. Personnel were contaminated up to 350,000 dpm alpha on their hands, elbows, shoulders, shirts, pants, shoe covers, and shoes. Air monitors in the area did not immediately indicate any activity increase. Decontamination of two employees was difficult. The SEFOR fuel contained plutonium and uranium oxide. The fines included approximately 2 µCi of mixed fission product and emitted approximately 2 µCi of alpha activity (Incident Report A0105).[2]

- On August 16, 1982, a radioactive alarm from Building 4020 went off. The emergency team arrived and saw a red warning light on flashing on top of Building 4478, the radioactive liquid waste building associated with Building 4020. Approximately 30 minutes after the alarm signaled, the emergency team had entered Building 4020 and 4478 and reported that normal readings. The maintenance department replaced and tested the radioactive alarm system and all areas were secured (Incident Report A0325).[3]

- On October 11, 1982, an employee was working at the SEFOR decladding glove box repairing some remote equipment. He removed his gloved hands from the box and as he walked to the alpha survey meter to survey his gloves he wiped sweat from his brow with the inside of his lab coat. Upon surveying, he discovered his lab coat to be contaminated to approximately 80,000 dpm alpha and his forehead to be 8,400 dpm alpha. He also contaminated his hand to 2,400 dpm alpha when removing his coat and gloves. Another employee trying to assist contaminated his shirt to 400 dpm alpha. The floor was found to have 750 dpm of alpha contamination. The SEFOR fuel contained plutonium oxide (PuO) and uranium oxide (UO^2) (powder). Personnel, clothing, equipment, and the floor were decontaminated to background. The ruptured glove box was changed out (Incident Report A0110).[4]

- On December 22, 1982, an employee was operating manipulators in the SEFOR glove box and had a seizure. The employee collapsed on the floor in Decon #4, a secondary

[1] Badger, F.H., Rockwell International Internal Letter, *Re: Radiological Safety Incident Report, T020-Hot Storage Rm. & Airlock, 08-21-81*. August 26, 1981.
[2] Badger, F.H., Rockwell International Internal Letter, *Re: Radiological safety Incident Report, RIHL – T020, 07-13-82*. July 15, 1982.
[3] Oliver, D.E., Rockwell International Internal Letter, *Re: R.A. Alarm, Bldg. 478*. August 17, 1982.
[4] Badger, F.H., Rockwell International Internal Letter, *Re: Radiological Safety Incident Report, T020 – Decon 4, Box, 10-11-82*, October 15, 1982.

plutonium-239 (Pu-239) containment area. The employee was taken to the hospital. All personnel were found free of contamination. Decon #4 was mopped as a precaution, but no activity was found (Incident Report A0112).[1]

- On April 21-22, 1983, while fuel rods were being transferred between Building 4020 and RMHF, an error in SEFOR rod identification caused Building 4020 to exceed its established fuel transfer control criticality limit of 1,900 grams (g) of Pu overnight. When one of the rods was bagged into the glove box a check determined the rod number to be A-03 instead of 803. Rod A-03 contained an additional 213.58 g of Pu than Rod 803 and thus the transfer records and Hot Lab balances were incorrect. The additional Pu caused an exceedance of the control limit. However, all but 600 g Pu was secured in transfer casks as only one rod was out of the cask and in the glove box at any time. A handwritten note from R.J. Tuttle states that the established criticality limit of three rods was not exceeded. It was recognized that the numbers stamped or etched on fuel rods are often in poor condition and are difficult to identify. RMHF personnel had misread Rod A-03 and Rod 803. Further fuel transfers were stopped when the error was discovered. No contamination was released (Incident Report A0262).[2]

- On July 15, 1983, an employee was preparing to change out a leaded glove with a plastic bag in the SEFOR glove box in Decon #4 when he checked his gloved hands and detected alpha contamination. He proceeded to the Decon Room doorway to request health physics support and plastic bags to collect waste. At this point the air monitor at the glove box alarmed. Two employees and another operator decided to complete the change out operation. They donned respiratory protection and the operator also donned a hood and reentered the area. An alpha survey indicted contamination only on the glove port. The employees proceeded with the change out and during this operation the inside glove keeper rings, installed as an additional precaution because of the stiffness of the leaded glove, snapped off. A quick survey indicated gross alpha contamination (greater than 50,000 cpm) on the hood, mask, and lab coat of the operator as well as the glove port and the immediate surrounding area. They immediately evacuated. Two health physicists carefully removed contaminated articles from the operator. Activity levels between 30,000 and 50,000 cpm alpha were detected. The gross activity was removed before the operator's face respirator was removed. The operator was released to the showers. The area in front of Decon #4 was covered with plastic and the remainder of the service gallery was made a shoe cover area and secured. This area and the Decon Room were decontaminated to background levels (Incident Report A0120).[3]

[1] Badger, F.H., Rockwell International Internal Letter, *Re: Radiological Safety Incident Report, Decon 4 T020, 12/22/82.* December 23, 1982.
[2] Allen, D.C., Rockwell International Internal Letter, *Re: Excessive Pu Balance in RIHL, Building 20, MBA-54.* May 13, 1983.
[3] Badger, F.H., Rockwell International Internal Letter, *Re: Radiological Safety Incident Report, T020, Decon Room 4, Alpha Box, 07-15-83.* October 18, 1983.

- On August 8, 1983, a leaking transfer tube contaminated an employee and the decontamination room (Incident Report A0119).[1]

- On October 11, 1983, an anti-siphon valve was not closed on a pump in Cell #3 used to pump distilled water into SEFOR electropolish acid for neutralization and solidification. When the pump was shut off, acid was siphoned back into the 5-gallon container of distilled water, contaminating the water to an activity level between 2 and 6 microcuries per milliliter (μCi/ml). Another pump was then tested in the supposedly clean distilled water reservoir and transferred to the shop area. Water was spilled at the disconnect point, work table floor, and at the work bench in the shop. A cell operator at Cell #3 discovered the contamination and further surveys of the facility revealed contamination has been unknowingly spread throughout the building, with the exception of the Equipment Room, Generator Room, Battery Room, and their hallways.

  Contamination levels ranged from 1,500 cpm (~6,000 dpm/15 cm^2) beta-gamma to more than 100,000 cpm (450,000 dpm / 15 cm^2) beta-gamma. Ninety-five percent of the gamma emission was Cs-137 and the other 5 percent was cobalt-60 (Co-60). Only the sample from the distilled water reservoir indicated any trace of americium-241 (Am-241), and thus the presence of transuranic (TRU) contamination. The liquid spill was estimated at 25 ml. Smears of the area indicated approximately 0.1 percent alpha activity. Decontamination of the suspect low-level areas was accomplished by masslinn mops. Areas of higher contamination were hand wiped, stripped, and/or disposed of. A section of tile in front of Cell #3 had to be removed as did patches of carpeting in the front office. No contamination was found outside Building 4020 and no airborne activity was detected (Incident Report A0118).[2]

- On January 30, 1984, a contaminated electrode was worked on a clean grinder. Contamination was discovered on floors and on the clothing of the grinder operator. No other personnel, tools, or locations were found to be contaminated (Incident Report A0122).[3]

- On August 20, 1984, an employee entered Cell #3 for repair of a laser. During the course of the operation, the employee bumped his head on a metal frame causing an abrasion that drew blood. The abrasion was covered with a surgeons cap, canvas hood, and plastic hood. A survey and smear of the wound after exiting the cell did not indicate any activity (Incident Report A0125).[4]

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[1] The original incident report is identified as missing from Boeing's incident files. No other details are available on this incident at this time.
[2] Badger, F.H., Rockwell International Internal Letter, *Re: Radiological Safety Incident Report, T020 and Cell 3 Face, 10-11-83*. October 13, 1983.
[3] The original incident report is identified as missing from Boeing's incident files. No other details are available on this incident at this time.
[4] Badger, F.H., Rockwell International Internal Letter, *Re: Radiological Safety Incident Report, T-020 – Cell 3, 8-20-84*, Undated.

- On August 21, 1984, two new employees dressed in lab coats, shoe covers, and gloves were doing general cleanup in Decon #3. They found an open bag of tools and wiped the tools down. After exiting Decon #3, a routine survey showed contamination on their pants up to 50,000 dpm beta-gamma. The employees removed their pants and were found to be clean. A survey of the tools indicated up to 1 x 10^6 dpm beta-gamma. All areas involved were surveyed and decontaminated. The incident report notes that a more experienced employee may have recognize the potential for release of contamination and bagged the tools before removing them from the cell (Incident Report A0126).[1]

- On October 15, 1984, during remote decontamination of Cell #3, a small puddle of alcohol ignited. A nitrogen purge was started and the fire went out almost immediately. There was no nuclear fuel in the cell at the time. No increase in stack monitor activity was observed and the incident report states that there was no release to the environment (Incident Report A0127).[2]

- On October 26, 1984, an employee inadvertently grabbed a bag of radioactive waste in the Manipulator Repair Shop with his bare hands and contaminated his left hand to approximately 5,000 dpm and his right hand to approximately 7,500 dpm. His hands were successfully decontaminated below detection levels after three applications of soap and water (Incident Report A0128).[3]

- On December 6, 1984, an employee conducting routine cleanup in Cell #1 reached his arm up causing his protective clothing to separate from his taped-on surgeon gloves. The employee immediately went to the Decon Room for repair. Upon completion of his work, the employee surveyed his right forearm/wrist and found it was contaminated to 500,000 dpm beta-gamma. The contamination was from irradiated Fermi fuel fines in Cell #1. After considerable effort, the contamination level on the employee's arm was reduced to background and the employee was released (Incident Report A0129).[4]

- On December 10, 1984, an exit survey of an employee conducting cleanup in Cell #1 revealed contamination on his neck at 25,000 dpm beta-gamma and contamination on his forearm at 5,000 dpm beta-gamma. The contamination was from irradiated Fermi fuel fines in Cell #1. The employee was decontaminated to background levels (Incident Report A0130).[5]

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[1] Badger, F.H., Rockwell International Internal Letter, *Re: Radiological Safety Incident Report, T-020 Decon Room 3, 8/21/84*, August 27, 1984.
[2] Badger, F.H., Rockwell International Internal Letter, *Re: Radiological Safety Incident Report, T020 Cell 3, 15 Oct. 84*. October 16, 1984.
[3] Dickson, F.A., Rockwell International Internal Letter, *Re: Radiological Safety Incident Report, RIHL Manipulator Repair Shop, 10/26/84*. November 5, 1984.
[4] Badger, F.H., Rockwell International Internal Letter, *Re: Radiological Safety Incident Report, T-020 Cell 1, 12/6/84*. December 11, 1984.
[5] Badger, F.H., Rockwell International Internal Letter, *Re: Radiological Safety Incident Report, T020 Cell 1, 12/10/84*. December 13, 1984.

- On December 10, 1984, an exit survey of an employee conducting cleanup in Cell #1 revealed 1,500 dpm beta-gamma contamination on his left hand. The contamination resulted from irradiated Fermi fuel fines in Cell #1. The activity was successfully removed and the employee was released (Incident Report A0131).[1]

- On December 10, 1984, an incident report was filed concerning an employee who had made two entries into Cell #1 to decontaminate the cell and remove equipment that had been used for a Fermi fuel decladding task. After the second entry found his company thermoluminscent dosimeter (TLD) finger rings indicated 11,954 mrem on his right hand and 5,927 mrem on his left hand. The employee was excluded from further radiation work and the vendor TLD finger rings were sent for emergency processing. The vendor TLDs measured 7,750 mrem for the right hand and 7,710 mrem for the left hand. These measurements exceeded the Atomics International Energy Systems Group Health and Safety internal limits of 4,500 mrem per quarter. The employee was temporarily restricted from work with radiation exposure and recommendations for improved safety were made (Incident Report A0133).[2,3]

- On January 14, 1985, an employee moved a bag of contaminated material in Decon #1 that had not been properly taped closed. A section of hose came out of the bag and contacted his right leg. The employee immediately exited the area. A survey of his pant leg showed a detectable activity of 2,500 dpm beta-gamma radiation. The pants were removed and no skin contamination was found (Incident Report A0134).[4]

- On January 15, 1985, an employee repairing radiologically contaminated master manipulators accidentally sliced his glove with a screwdriver and caused a 3/8-inch cut in the knuckle of his left hand. The employee immediately exited the area. A survey of the wound revealed no detectable activity and a smear of blood from the wound found no activity above background. A shielded high purity germanium detector found a slightly positive peak of cesium at about 100 dpm. The employee's hand was decontaminated (Incident Report A0132).[5]

- On February 20, 1985, an employee working on a gear shaft for Cell #4 door cut his finger on a sharp edge of the shaft. A 1/4-inch cut on his finger was scanned for potential

[1] Badger, F.H., Rockwell International Internal Letter, *Re: Radiological Safety Incident Report, T020 Cell 1, 12/10/84*. December 13, 1984.
[2] Badger, F.H., Rockwell International Internal Letter, *Re: Radiological Safety Incident Report, T-020 Cell 1, 12/7 and 12/10/84*, Undated.
[3] Meyer, R.D., Rockwell International Internal Letter, *Re: Hand Exposure Incident RIHL, December 10, 1984*, December 20, 1984.
[4] Giesler, C., Rockwell International Internal Letter, *Re: Radiological Safety Incident Report, T-020 Decon #1, 1/14/85*, January 21, 1985.
[5] Badger, F.H., Rockwell International Internal Letter, *Re: Radiological Safety Incident Report, T-020 Hot Manipulator Repair Shop, 1/15/85*, January 17, 1985.

radioactive contamination, but no detectable activity was found on finger. A smear survey of the shaft found no detectable activity (Incident Report A0135).[1]

- On March 4, 1985, an employee working in Cell #1 had sharp objects pierce his clothes and two pair of plastic booties. This allowed water being used for decontamination to leak into the booties and contaminate both shoes. Attempts at decontamination were unsuccessful. A final survey showed a maximum of 25,000 dpm contamination on the shoes and they were discarded as radioactive waste. No skin contamination was found on the employee (Incident Report A0136).[2]

- On March 20, 1985, two employees were assisting during the removal of solidified EBR-II liquid waste from Cell #2. One of the 55-gallon drums that the waste was to be placed in contained a "5-20 pig" that was removed from Cell #1 during cleanup operations for that cell. The pig was radioactively contaminated from Fermi fuel operations in Cell #1. The pig was wrapped in three plastic bags and placed in the drum with cement added for additional shielding. When personnel pulled off the lid of the drum contaminated rust, dirt, and concrete spilled and was spread to personnel and the surrounding area. One employee's lab coat sleeves had a reading of approximately 100,000 dpm beta-gamma and a masslinn wipe showed a maximum contamination of approximately 500,000 dpm beta-gamma in the area of the spill. The employees and area were decontaminated to below 20 dpm/ 100 cm^2 alpha and below 50 dpm /100 cm^2 beta-gamma (Incident Report A0137).[3]

- On June 6, 1985, an employee was decontaminating manipulators from Cell #3 in the Hot Manipulator Repair Shop when a radiologically contaminated solution of nitric and hydrofluoric acid seeped through his coveralls onto his left forearm. His arm was found to have 1,500 cpm beta-gamma contamination, but no alpha contamination. The employee was eventually decontaminated to background (Incident Report A0139).[4]

- On August 15, 1985, an employee packaging contaminated glass from a SNAP program hydrogen analyzer had a small splinter of glass protrude through his protective gloves. It caused a small puncture wound to his index finger. A frisk survey found no detectable beta-gamma contamination, but a blood smear from the wound showed less than 10 dpm/100 cm^2. An "MCA" scan of the hand showed a small amount of Cs-137 (Incident Report A0140).[5]

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[1] Giesler, C.A., Rockwell International Internal Letter, *Re: Radiological Safety Incident Report, T020/Shop Area, 2/20/85*, February 22, 1985.
[2] Giesler, C.A., Rockwell International Internal Letter, *Re: Radiological Safety Incident Report, T020, 3/4/85*, March 14, 1985.
[3] Giesler, C., Rockwell International Internal Letter, *Re: Radiological Safety Incident Report, T020 Service Gallery, 3/20/85*. April 2, 1985.
[4] Badger, F.H., Rockwell International Internal Letter, *Re: Radiological Safety Incident Report, T020 Hot Slave Shop, 6/6/85*,. June 10, 1985.
[5] McGinnis, R., Rockwell International Internal Letter, *Re: Radiological Safety Incident Report, SSFL/T020 Decon #1, 8/12/85*. August 15, 1985.

- On October 4, 1985, a cold em ployee was assis ting in the service gallery during the loading of radioactive contam inated materials from Cell #2 into a containm ent box. The employee was dressed in red-line coveralls, booties, gloves, and was wearing his personal clothing underneath. Upon exiting the area a personnel survey indi cated the employee's shirt was contam inated with up to 2,000 dpm beta-gamma a nd his pants were contaminated up to 1,000 dpm beta-gamma. Decontamination was successful o n the employee's pants, but his shirt had to be di scarded as radioactive waste (Incid ent Report A0142).[1]

- On October 17, 1985, an em ployee size reducing contaminated material in Cell #3 had sharp metal material penetrate two pairs of plastic booties and one pair of cloth booties contaminating the employee's shoes to approximately 2,500 cpm beta-gamma. The sharp metal pieces were produ ced from the power saw used to size reduce material b efore it was removed for disposal. Decontam ination of the em ployee's shoes was unsuccessful and the shoes were discarded as radioactive waste (Incident Report A0141).[2]

- On October 25, 1985, an e mployee existing Cell #3 discovered several parts of his body were contaminated. Contamination was a high as 10,000 cpm beta-gamma. The activity appeared to com e from the protective cove ralls he was wearing. The incident report notes that strong evidence suggests the cont amination came from the laundry and that future laundry will be surveyed prior to acceptance (Incident Report A0147).[3]

- On November 4, 1985, an em ployee performing decontamination activities in Cell #3 found 10,000 cpm beta-gamma contam ination on his forearm s in a routine exit survey. The contamination was reduced to 200 cpm and the em ployee was release. A survey taken the following day did not detect any ac tivity on his forearm s. The incident report notes that the contam ination appears to have been the result of im properly laundered protective clothing even though the clothing wa s checked before use and found to be below 1 mrad (Incident Report A0148).[4]

- On November 13, 1985, an e mployee working in Cell #3 discovered that his shoes had become contaminated to 30,000 dpm/100 cm^2 beta-gamma. The suspected cause of fixed contamination on the shoes was leaching of contamination from red-line socks during sweating. According to the incident report, the laundry service had discovered a problem in their water cleanup system. The laundry service noted the problem was corrected and

[1] Giesler, C., Rockwell International Internal Letter, *Re: Radiological Safety Incident Report, T020/Cell #2, 10/4/85.* October 29, 1985.
[2] Giesler, C.A., Rockwell International Internal Letter, *Re: Radiological Safety Incident Report, T020/Cell #3, 10/17/85.* October 28, 1985.
[3] Badger, F.H., Rockwell International Internal Letter, *Re: Radiological Safety Incident Report, T020 – Cell #3, 10/25/85.* December 9, 1985.
[4] Badger, F.H., Rockwell International Internal Letter: *Re: Radiological Safety Incident Report, T020 Cell #3, 11/4/85.* December 10, 1985.

contaminated socks were being isolated a nd removed from the system (Incident Report A0145).[1]

- On November 20, 1985, an em ployee discovered beta-gamma contam ination on his left shoe after exiting Cell #4. Further investiga tion showed that the source of contam ination was fixed contam ination from his red-line sock s sweating through to his shoes. It is not clear from the inciden t report where the orig inal source of fixed contam ination came from. The em ployee's shoe was contaminated to 250,000 dpm /100 cm^2. Decontamination attempts were unsuccessful. A note on the incident report states "[t] his is one of several incidents related to br eak down at vendor laundry" (Incident Report A0143).[2]

- On November 21, 1985, an em ployee working in Cell #3 discove red his shoes had become contaminated to 50,000 dpm /100 cm^2 beta-gamma. Inve stigation found the source of fixed contamination was inside his shoe from the leaching of contam inated red-line socks during sweating. D econtamination of the shoes did not work. The laundry service was contacted and it found a problem with its wate r cleanup system. According to the laund ry service, the problem had been corrected and contaminated socks were being isolated and removed from the system (Incident Report A0144).[3]

- On November 22, 1985, an e mployee in Decon #4 discovered his shoes were contaminated to 25,000 dpm /100 cm^2 beta-gamma. The source of contam ination was suspected to be leaching of contam inated red-line socks during sweating. The laundry service was contacted and it found a problem with its wate r cleanup system. According to the laund ry service, the problem had been corrected and contaminated socks were being isolated and removed from the system (Incident Report A0146).[4]

- On December 10, 1985, an em ployee loading contaminated material into a containm ent box inside the Hot Storage Room got his right hand pinched between the box and a piece of equipment. He re moved his outer pair of gloves and noted that his m iddle finger was bleeding. The inner glove was not penetrated and no detectable contamination was found through blood smears or other surveys (Incident Report A0149).[5]

- On January 14, 1986, a review of recent non-reportable inci dents at Building 4020 was conducted (Incident Report A0150).[6]

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[1] McGinnis, R., Rockwell International Internal Letter, *Re: Radiological Safety Incident Report, SSFL, T020, Cell #3, 11/13/85*. November 27, 1985.
[2] McGinnis, R., Rockwell International Internal Letter, *Re: Radiological Safety Incident Report, SSFL: Building T020; Cell #4, 11/20/85*, November 25, 1985.
[3] McGinnis, R., Rockwell International Internal Letter, *Re: Radiological Safety Incident Report, SSFL, T020, Cell #3, 11/21/85*, November 27, 1985.
[4] McGinnis, R., Rockwell International Internal Letter, *Re: Radiological Safety Incident Report, SSFL, T020, Decon #4, 11/22/85*, November 27, 1985.
[5] Giesler, C., Rockwell International Internal Letter: *Re: Radiological Safety Incident Report, T020 Hot Storage, 12/10/85*, December 16, 1985.
[6] The original incident report is identified as missing from Boeing's incident files. No other details are available on this incident at this time.

- On February 4, 1986, an employee working in Cell #4 was instructed to leave when the breathing air system shut down. The employee was able to breathe due to residual air still within the system. Once the employee had exited the area, a personal survey showed no detectable activity. The breathing air system was eventually reset from the control box on the west side of Building 4020 (Incident Report A0151).[1]

- On February 19, 1986, an employee working in the Glove Box Room (Room No. 139) picked up the top cover of a filter bank unit and a sharp edge pierced his plastic gloves and cut his right index finger. He exited the area and a blood smear and survey were taken. No detectable activity was found (Incident Report A0152).[2]

- On March 4, 1986, an employee was cleaning radioactive contaminated tools in the mask cleaning area of Building 4020. He accidentally splashed the cleaning solution of Alconox and water in his eye. The employee, who was wearing safety glasses at the time, immediately left the area. A radiation survey of the eye showed no detectable activity and the employee was sent to medical to have his eye flushed. A 250 mL water sample of the cleaning mixture was collected and scanned. No detectable activity was found (Incident Report A0155).[3]

- On April 16, 1986, a routine inventory leak check found that a 1.5 mCi Sr-90 check source was missing. A search of Building 4020 failed to identify its location. A recent effort to remove all contaminated equipment from the Hot Storage room and decontaminate the area generated several 19a boxes of radioactive waste. It was felt with a good degree of confidence that the missing source that was wrapped in a plastic bag marked "save" was instead disposed of in one of the waste boxes (Incident Report A0156).[4]

- On October 28, 1986, sparking of Fermi fuel assembly #204 occurred, igniting zirconium saw chips during the sawing phase of disassembly operations in Cell # 4. Saw cutting operations were halted and the cell atmosphere was immediately purged with nitrogen to extinguish the ignited chips. Further disassembly operations were halted until the incident was investigated and preventive measures implemented. It was determined that the band saw got close enough to the uranium fuel during cutting of the zirconium end caps that the friction of the saw on the uranium metal sparked and ignited the zirconium chips collecting at the bottom of the saw blade. To prevent further incidents numerous action items were carried out. A drip system was installed on the saw and a wet vacuum

[1] Giesler, C.A., Rockwell International Internal Letter: *Re: Radiological Safety Incident Report, T020 Cell #4, 2/4/86*, February 17, 1986.
[2] Giesler, C., Rockwell International Internal Letter: *Re: Radiological Safety Incident Report, T020 Rm#139, 2/19/86.* February 19, 1986.
[3] Giesler, C.A., Rockwell International Internal Letter: *Re: Radiological Safety Incident Report, T020 Service Galley, 3/4/86.* March 13, 1986.
[4] Badger, F.H., Rockwell International Internal Letter, *Re: Radiological Safety Incident Report, T020, SSFL, 4/16/86.* April 21, 1986.

was modified for remote handlin g to rem ove saw chips after cuttin g each asse mbly (Incident Report A0165).[1]

- On March 12, 1987, during a routine work in Cell #4, an employee began com plaining about not feeling well. He was advised to begin exit procedures. With assistance from another hot m an and a hot/cold m an, the employee's outer protective clo thing was removed. The em ployee then blacked out, but was caught and placed onto clean plastic sheeting. A Radiation & Nuclea r Safety Group representative was called to help with contamination control and the rem ainder of the em ployee's protective clothing was removed. The em ployee regained consciousne ss and was dressed in a clean pair of coveralls after being found free of radiol ogical contamination. He was taken to Rockwell's Santa Susana Field Test Laborator y Medical Station for m onitoring. It was determined that the employee was suffering from heat exhaustion due to increased cell air temperature, high er than norm al face m ask pressure, and a difficult working pos ition. All personnel and equipm ent were monitored pr ior to leaving the controlled area and no contamination was detected (Incident Report A0173).[2,3]

- On July 10, 1987, an employee exiting Cell #2 was found to have approxim ately 20,000 dpm/beta-gamma contamination on his ri ght wrist. The em ployee's wrist was successfully decontaminated using dry wipes. The incident report notes that personnel should take m ore precaution when tap ing up prio r to entries into rad ioactive contaminated areas (Incident Report A0174).[4]

- On July 14, 1987, an employee exiting Cell #2 found radioactive contamination up to 70,000 dpm beta-gamma on his neck. The employee's neck wa s successfully decontaminated using dry and wet wipes. T he incident report notes that excessive sweating by personnel who are suited up som etimes causes the tape to clothing seal to come loose and if this is noticed the ope ration should stop and the clothing should be retaped (Incident Report A0175).[5]

- On July 20, 1987, an employee working in Cell #2 found contam ination on his neck after an exit survey (Incident Report A0177).[6]

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[1] Harrison, D.J., Rockwell International Internal Letter, *Re: Report on Ignition Incident during Disassembly of Assembly #204 on October 28, 1986 and Minutes of Review Committee Meeting on October 29, 1986*, October 30, 1986.
[2] Badger, F.H., Rockwell International Internal Letter, *Re: Radiological Safety Incident Report, RIHL T020, Cell 4, 3/12/87*, March 20, 1987.
[3] Babcock, E.L., Rockwell International Internal Letter, *Re: Cell 4 Fainting Incident*, April 24, 1987.
[4] Giesler, C.A., Rockwell International Internal Letter, *Re: Radiological Safety Incident Report, T020 Cell #2, 7/10/87*, Undated.
[5] Giesler, C.A., Rockwell International Internal Letter, *Re: Radiological Safety Incident Report, T020 Cell #2, 7/14/87*, Undated.
[6] The original incident report is identified as missing from Boeing's incident files. No other details are available on this incident at this time.

- On October 15, 1987, an employee performing a personal survey after bagging radioactive waste from Decon #1 found the right knee of his pants was contaminated to approximately 5,000 dpm beta-gamma. The pants could not be decontaminated below 2,500 dpm beta-gamma so they were taken as radioactive waste (Incident Report A0178).[1]

- On December 1, 1987, an employee caught his thumb between a forklift cross member and chain while removing a shield plug for Cell #1. Blood was noticed inside of his glove and he immediately exited the controlled area. A blood smear and survey of his thumb found no detectable contamination (Incident Report A0181).[2]

- On December 17, 1987, an incident occurred at a sump pump and employees entered a confined space without the proper permits or approval (Incident Report A0182).[3]

- On June 13, 1988, two security guards became concerned when a radiation monitor in a basement alcove of Building 4020 went off-scale and alarmed in their presence. They called the facility health physicist, who told the guards that no radiation exposures could occur in that area based on current activities in the building, but that they should put on shoe covers and survey their shoes in the lobby of Building 4020 as a precaution and call the health physicist back if there were any problems. The alarm had shorted in the past and was not trusted. The security guards requested an independent reading of their film badges to ease their fears as they were new to operations on "the hill" and didn't know who or what to believe. Independent analysis found no radiation exposure. The radiation monitor was tested the next day and alarmed erroneously three times. It was replaced and sent for repair (Incident Report A0185).[4,5]

- On September 30, 1988, an employee was performing a personal radiological survey upon exit from Cell #1 and found a maximum of 3,500 dpm beta-gamma on his right knee. After repeated use of wet and dry wipes the area was successfully decontaminated. The employee notes he could have become contaminated when picking up a piece of material with clear hydraulic fluid on the outside (Incident Report A0190).[6]

- On October 10, 1988, an employee was performing a personnel survey upon exit from Cell #1 and found his forearms and left knee were contaminated. A maximum of 10,000

[1] Giesler, C.A., Rockwell International Internal Letter, *Re: Radiological Safety Incident Report, T020/Decon #1, 10/15/87*, March 23, 1987. (Either the incident date or the letter date are incorrect.)
[2] Giesler, C.A., Rockwell International Internal Letter, *Re: Radiological Safety Incident Report, T020 Operating Gallery, 12/1/87*, December 21, 1987.
[3] The original incident report is identified as missing from Boeing's incident files. No other details are available on this incident at this time.
[4] Rowles, J.A., Rockwell International Internal Letter, *Re: June 13, 1988 Security Guard Incident at T020*, July 1, 1988.
[5] Badger, F.H., Rockwell International Internal Letter, *Re: After Hours Alarm*, June 16, 1988.
[6] Giesler, C.A., Rockwell International Internal Letter, *Re: Radiological Safety Incident Report, Building 20 Cell #1, 9/30/88*, October 17, 1988.

dpm beta-gamma was found on his left forear m. Repeated use of wet and dry wipes decontaminated the area (Incident Report A0191).[1]

- On November 14, 1988, an employee was doing decontamination and demolition (D&D) work in the Hot Storage Room (Room #153) and when cutting wire m esh a sharp piece punctured his left glove and cu t his finger. The em ployee immediately left the area. A blood smear and survey did not detect any ra dioactive contamination (Incident Report A0192).[2]

- On January 4, 1989, an em ployee performing a personnel survey upon exit from Cell #1 found that his chin was contam inated. A survey meter found approximately 3,500 dpm beta-gamma contamination. A nasal s mear found a m aximum of 127 dpm beta-gamma contamination. Another sample found approximately 250 dpm of Cs-137. The employee was dressed out in full face respirator with cartridge, coveralls, gloves, hood, and booties. The incident report implies the e mployee's tape seal cam e loose and he ultimately inhaled radioactive materials (Incident Report A0193).[3]

- On June 6, 1989, two employees conducting D&D operations in Cell #1 were found to be contaminated upon exiting the cell. The em ployees were removing inner cell windows that had been in place several years and ha d collected con tamination over tim e. The employees had to hold the windows next to their protective coveralls and the contamination penetrated their coveralls. One employee contaminated his left inner thigh (12,000 cpm beta-gamm a) and both forearms (800 cpm beta-gamma). The other employee contaminated his right knee (6,000 cp m beta-gamma). After repeated use of wet and dry wipes and decontam ination in the hot shower, the employees were surveyed and found to be clean (Incident Report A0198).[4]

- On June 29, 1989, two e mployees became contaminated while working on electropolishing operations in Cell #2 a nd Decon #1. One e mployee received a maximum of 7,000 cpm and the other employee received a maximum of 1,000 cpm. The personnel were successful decontaminated us ing wet and dry wipes and a final survey showed no skin contam ination. The incident report states that the contam ination was thought to come from the red-line laundry as several articles of clothing were surveyed and found to have higher than norm al readings. These item s were packaged and sent back to the laundry cleaning company (Incident Report A0199).[5]

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[1] Giesler, C.A., Rockwell International Internal Letter, *Re: Radiological Safety Incident Report, Building 20 Cell #1, 10/10/88*, November 8, 1988.
[2] Giesler, C.A., Rockwell International Internal Letter, *Re: Radiological Safety Incident Report, Bldg 20 Room #153, 11/14/88*, November 21, 1988.
[3] Giesler, C.A., Rockwell International Internal Letter, *Re: Radiological Safety Incident Report, Building 20 Cell #1, 1/4/89*, January 11, 1989.
[4] Giesler, C.A., Rockwell International Internal Letter, *Re: Radiological Safety Incident Report, Building 20 Cell #1, 6/6/89*, June 29, 1989.
[5] Giesler, C.A., Rockwell International Internal Letter, *Re: Radiological Safety Incident Report, Building 20 Cell #2 & Decon #1, 6/29/89*, July 18, 1989.

- On October 4, 1989, an employee punctured the skin on his right forearm while working in the glove box room for plutonium handling. Although Pu-239 contamination was possible, a survey found no contamination above background (Incident Report A201).[1]

- On December 15, 1989, during a scabbling operation of contaminated concrete on the loading dock pad one of two absolute vacuums in use lost filtration. Concrete dust was released from the vacuum and became airborne in the airlock. Operations were stopped and both vacuums were shut down until a survey could be performed. No personnel were in the airlock at the time of the incident (Incident Report A0587).[2]

- On April 18, 1990, an employee working in Cell #2 cut his radial artery when a steel chip from the top of a jackhammer chisel penetrated his left wrist. The chip was contaminated to 120 pCi (Incident Report A0205).[3,4]

- On July 17, 1990, an employee working in Cell #3 had a ladder slip out from under him and contaminated his left forearm and elbow to 300 cpm (Incident Report A0207).[5,6]

- On October 17, 1990, employees dropped a duct section, causing elevated airborne activity (Incident Report A0210).[7]

- On December 17, 1990, employees arriving for work in the morning observed a red beacon alarm on Building 4020. The emergency response team responded and found the gamma monitor in Liquid Waste Building 468 to be reading 100 mR even though the actual gamma radiation in the area was 2 mR. The alarm set point was approximately 20 mR above background. The gamma monitor in Building 468 was disconnected and the Building 4020 alarm immediately ceased. The monitor in Building 4020 remains in service, while the Building 468 monitor was removed for repair (Incident Report A0213).[8]

- On August 26, 1991, during decontamination activities in Cell #3, three plugs used as a contamination barrier were blown out of cell ports by sandblasters into the operating gallery clean area. A small amount of dry sandblast grit from Cell #3 was discharged onto the operating gallery floor and on one wall. Initial large area masslinn wipes in the

[1] Badger, F.H., Rockwell International Internal Letter, *Re: Radiological Safety Incident Report, Bldg. 20 Rm 139, 10/4/89*, October 30, 1989.
[2] Unknown Author, Rockwell International Internal Letter, *Re: Radiological Safety Incident Report, Airlock, 15 Dec 89*, Undated.
[3] Badger, F.H., Rockwell International Internal Letter, *Re: Radiological Safety Incident Report, Cell 2 Bldg. 020 RIHL, 4/18/90*, Undated.
[4] This incident report is extremely brief and cites an attachment to the report. This attachment has not been located.
[5] Badger, F.H., Rockwell International Internal Letter, *Re: Radiological Safety Incident Report, Bldg 20 Hot Cell #3, 7/17/90*, July 31, 1990.
[6] This incident report is brief and cites an attachment to the report. This attachment has not been located.
[7] The original incident report is identified as missing from Boeing's incident files. No other details are available on this incident at this time.
[8] Schrag, F.C., Rockwell International Internal Letter, *Re: Radiological Safety Incident Report, Occurrence #RD-90-4-RIHL-90-3*, December 17, 1990.

area showed a contam ination of approximately 1,000 dpm/100cm2 in the spill area and 300 to 500 dpm/100cm2 on the entire floor of the operating gallery. The continuous air monitor was in service and did not alarm or show any increase in airborne radioactivity. Masslinn smears were taken in adjacent rooms and s howed no activ ity above background. The operating gallery area was de contaminated using a vacuum cleaner for visible deposits and masslin and moist towels for floors and horizontal surfaces (Incident Report A0267).[1,2]

- On June 17, 1993, an em ployee became contaminated during deco mmissioning and decontamination operations of a radioactive exhaust duct in the Building 4020 basement. The employee was contam inated up to 2,000 cpm , and was taken to the RMHF for decontamination. All contam ination was removed to less than background levels (Incident Report A0571).[3]

- On September 15, 1993, an em ployee jack hammering drain piping in Cell #3 found his dosimeter went off scale after working in th is high radiation area. The work involved repeatedly jack hammering in the high radiation area then moving to a low dose waiting area and the em ployee became complacent with this repetitive task. Investigation of the incident revealed that w orker error caused the unacceptable exposure. The em ployee's dose for the week (204 m rem), quarter (500 mrem), and year (650 m rem) were all below Rocketdyne's administrative limits of 300, 1,000, and 2,000 m rem respectively (Incident Report A0575).[4]

- On May 10, 1995, two operations m echanics dumped a vacuum catch drum into a waste box during repackaging operations. Vacuum catch drums were not authorized for dumping because of the light dens ity of the m aterial and the contam ination levels. This activity had the potential to cau se a loss of contamination control by release radioactivity to the air. A survey of the area found a m aximum of 2,589 dpm /100 cm^2 beta-gamma contamination. Results found inside a re spiratory protective device were 9.0 x 10^{-14} µCi/cc alpha contam ination and 7.4 x 10^{-12} µCi/cc beta co ntamination. The area was decontaminated to less than 20 dpm/100 cm^2 beta within one hour of the incident. No personal contamination was discovered (Incident Report A0662).[5]

- On April 15, 1996, an employee's right shoe be came contaminated with a particle from saw cutting operations of conta minated concrete. The particle read 600 net counts per minute (ncpm) by direct frisk survey. Th e particle was rem oved with tape and the

[1] Cutting, R., *U.S. Department of Energy Occurrence Report, Occurrence Report #SAN-RD-RIHL-0005*, August 27, 1991.
[2] Meyers, R.L., *Handwritten Notes Re Occurrence on August 26, 1991.*
[3] Hickman, D.W., Rockwell International Internal Letter, *Re: Radiological Safety Report, Building 20 Basement, 6/17/93*, June 29, 1993.
[4] Harcombe, R., Rockwell International Internal Letter, *Re: Radiological Safety Report, RIHL T020, 9/15/93*, September 16, 1993.
[5] Harcombe, R., Rockwell Internal Letter, *Re: Radiological Incident Report, Dumping of Vacuum Catch Drum Without Notification, A0662, SSFL, Area IV, T020, Decon 3, 5/10/95*, June 13, 1995.

employee was determined free of contamination. A particle survey of the work area was conducted, but no additional particles were detected (Incident Report A0668).[1]

- On August 15, 1997, a contract worker found his boot had a hole in it and the boot was wet and contaminated. A health physics technician surveyed the boot and found 1,400 ncpm on the pancake frisker. The contamination was too embedded to decontaminate. Personnel were reminded check protective clothing prior to donning and to not use worn out articles of clothing (Incident Report A0679).[2]

- On August 15, 1997, a health physics technician observed a worker at the step-off pad undressing improperly. The worker was removing a paper suit barehanded because he had improperly removed his glove first. The technician intervened and frisked the worker's hand finding 1,400 cpm on it. The worker's hand was decontaminated. The worker was informed of the proper undress procedure and that additional instances could result in suspension of access privileges (Incident Report A0678).[3]

[1] Harcombe, R., Rockwell Internal Letter, *Re: Radiological Incident Report, Contaminated Right Shoe, A0668, SSFL, Area IV, T020, Service Gallery, 4/15/96*, April 16, 1996.
[2] Deschamps, R., Boeing Internal Letter, *Re: Incident Report, Contamination Found on the Shoe of Contractor for Heil, A0679, T020, 8/15/97*, April 15, 1998.
[3] Deschamps, R., Boeing Internal Letter, *Re: Incident Report, Radioactive Contamination Found on the Left Hand of Contractor for Heil, A0678, SSFL, T020, 8/15/97*, April 15, 1998.

BUILDING 4055

- On May 9, 1970, an employee was involved in a contamination incident while working in Glove Box #9 at Building 4055. According to the incident report, upon withdrawing his hands from the glove box, the employee discovered a hole in the glove box glove. Upon discovery of the hole, the employee left his arms in the glove box. Upon arrival of the facility's health physics representative, the alpha scintillator contamination monitor located approximately 4 feet behind the employee was "off scale." An alpha meter was brought into the area and contamination levels of 100 cpm were measured on the employee's left arm. The employee was monitored and it was found that his shirt sleeves were contaminated to 50 cpm. The shirt was disposed of as radioactive waste.

  Cover plates were placed over the glove box gloves and the gloves were changed without incident. A survey of the floor and surfaces around Glove Box #9 found elevated concentrations of 60 cpm on the floor in one spot. The spot was cleaned up with "windex and a kimwipe." Contamination levels on all other surfaces were at "normal background levels." The incident report does not state what the normal background levels were in 1970 (Incident Report A0286).[117]

- On June 27, 1973, a comprehensive smear survey of the glove box room found that contamination was spread throughout the room, including the overhead pipes and ductwork. The absolute filters located adjacent to Glove Box #17A were surveyed and the Model FM-5 Alpha Survey meter indicated 10,000 cpm on Filter 5 and 9,000 cpm on Filter 6. During the survey, it was noted that a considerable amount of dust was present on the top of the boxes, cabinets, pipes, and ductwork. According to the report, it was thought the use of an absolute type vacuum cleaner could remove a majority of the contamination along with the dust. The incident report did not provide information to indicate how the glove box room was ultimately decontaminated (Incident Report A0222).[118]

- On December 21, 1977, a contaminated roll of green tape was discovered in the glove box room. A monitor of the tape read approximately 3,700 cpm. A low level of alpha activity was discovered on the bench underneath the tape and was contained. The incident report did not indicate the levels located on the bench; however, the report stated that "clear spray" was used to seal the contamination in place. No other contamination was found in the glove box room (Incident Report A0224).[119]

- On January 10, 1978, an employee became slightly contamination while foam-decontaminating Glove Box 26 when a rubber glove failed. The process of foam-decontamination, according to the incident report, involves introducing foam into the glove box, and scrubbing all accessible areas. The rubber glove had a small puncture tear

[117] Lane, W.D., Internal Letter *Re: Contamination Event in Building 055, A0286, May 21, 1970.*
[118] Klostermann, J.P., Internal Letter, *Re: Glove Box Failure in Building T055, July 5, 1973.*
[119] Owens, D.E., Internal Letter, *Re: Incident Report A0224, January 4, 1978.*

at the glove-to-box m ounting ring. The incident reported noted that no liquid escaped from inside the box. The em ployee was found to be contaminated at his right side-burn hair area, with the Ludlum alpha meter indicating about 2,000 to 3,000 dpm activity. The hot sink at Building 4055 and m ild soap were used to d econtaminate the employee but residual contamination remained (630 dpm). The employee was instructed to shower at Building 4020, which resulted in no additional activity being detected on his head or body. The incident reported that there was no spread of contamination to any other area beside the glove box (Incident ReportA0063).[120]

- On May 10, 1978, a lost seal dur ing the replacement of a rubber glove with a plastic bag caused loss of vacuum in Glove Box #22. C ontamination of 100 dpm was subsequently discovered on the outside window area. The areas identified as being contaminated were "immediately decontaminated using standard methods and procedur es." The incident report did not indicate what the standard m ethods and procedures were (Incident R eport A0335).[121]

- On June 15, 1978, an employee compacted radio active waste in a compactor reserved for non-radioactive "suspect" waste. Although compacting radioactive waste m ay have generated high airborne activity, the compactor had a filter th at minimized the release of such contamination to the building (Incident Report A0071).[122]

- On July 16, 1978, a destructive electrical power surge on the main line causing damage to the main Building 4055 air sampling vacuum pump. The backup pump did not take over because of an internal leak in the water cooling jacket. This resulted in the loss of normal air sampling capability in the facility, includ ing the stack monitors for approxim ately 12 hours. The incident report stat ed that the exhaust fans that maintained differential room pressures and glove box vacuum s were not a ffected by the power failure. A check of each HEPA filter b ank indicated no abnorm al conditions or failures in the filtration system. The inciden t report noted that the only material that was availab le for release included a sem i-fixed contamination on th e interior surfaces of the glove box lines; however, all accountable material had previously been removed from the boxes (Incident Report A0072).[123]

- On July 24, 1978, floor contam ination was found in the waste handling area. This contamination was assum ed to have been caused by le akage from a stored waste container although none of the containers had external contamination (Incident Report A0073).[124]

[120] Owens, D.E., Internal Letter, *Re: Radiological Occurrence at NMDF Involving Minor Personnel Contamination, January 10, 1978, February 15, 1978.*
[121] Owens, D.E., Internal Letter, *Re: Radiological Occurrence at NMDF, May 15, 1978.*
[122] Owens, D.E., Internal Letter, *Re: Notice of Safety Rule Violation. June 15, 1978.*
[123] Owens, D.E., Internal Letter, *Re: Incident Report, July 24, 1978.*
[124] Owens, D.E., Internal Letter, *Re: Incident Report Room Contamination at NMDF, August 1, 1978.*

- On June 26, 1979, airborne activity was releas ed during the maintenance of a glove box. Personnel were rem oving and rep lacing the furnace heating element of Glove Box #4 when the "short-term" release of airborne alpha activity occurred. The activity consisted of plutonium and a mericium particles. Sm ears in the immediate area of Glove Box #4 found contamination of up to 75 dpm /100 cm2. The area floor was wet-m opped and the glove box furnace and immediate area was decont aminated. Following decontam ination, a complete contamination survey of the building was perform ed with no detectable contamination found (Incident Report A0582).[125]

- On May 10, 1980, the air sam ple vacuum pump stopped working. There was no indication of a release of contaminants (Incident Report A0081).[126]

- On October 31, 1980, a health physicist was call ed to Building 4055 to survey four pair of green line coveralls that were returned w ith the blue line laundry. One pair of green line coveralls was found to have a small ball of "tar" inside at the belt line. The "tar ball" had beta contamination of 446,000 dpm. The other three pair of coveralls were surveyed for alpha and beta-gamm a and were found to not be contam inated. The incident report did not indicate where the "tar ball" had or iginated from or how it was handled or disposed of following its discovery (Incident Report A0250).[127]

- On May 30, 1981, the air sam ple vacuum pump failed, resulting in the failure of the facility air monitoring system . The system was repaired and placed back in service on May 31, 1981. According to the incident report, radiation and nuclear safety personnel were not notified of the incide nt at the tim e of occurrence; however, it was determ ined that no release of contaminants was suspected (Incident Report A0085).[128]

- On November 7, 1981, a high airborne alarm at Building 4055 went off. When the health physicist arrived, the ALPHA III at Station "C " was alarm ing. Upon inspection, it was found that ALPHA III was functioning properly. A smear and direct s urvey of the area showed no contamination (Incident Report A0091).[129]

- On March 24, 1982, trace am ounts of suspected plutonium contamination resulted when an employee was compacting suspect waste into a new "sphincter can," and a petri dish broke and cut the em ployee's right hand. A h ealth physicist performed a contam ination survey of the wounded area and no contam ination above background was detected. The incident report recommended that glass item s that are too large to be easily p laced in a shipping can could be broken in a contro lled area, an d then the pieces cou ld be

[125] Meyer, R.D., Internal Letter, *Re: Radiological Safety Incident Report, July 20, 1979.*
[126] Bradbury, S.M., Internal Letter, *Re: Radiological Safety Incident Report, May 29, 1980.*
[127] Bradbury, S.M., Internal Letter, *Re: Radiological Safety Incident Report, November 25, 1980.*
[128] Badger, F.H., Internal Letter, *Re: Radiological Safety Incident Report, June 1, 1981.*
[129] Bradbury, S.M., Internal Letter, *Re: Radiological Safety Incident Report, November 12, 1981.*

transferred to the shipping can. The incident report did not note the origin of the contaminated petri dish (Incident Report A0100).[130]

- On February 7, 1983, an employee was disassembling a balance in Glove Box #3A, when he jammed a small screwdriver through the box glove and surgeon's glove and inflicted a puncture wound at the base of his left index finger. A survey of the wound and finger indicated approximately 3,500 dpm alpha, and the surgeon glove indicated approximately 30,000 dpm alpha. Blood samples of his finger found contamination of 414 dpm alpha. The area was flushed with clean water and encouraged to bleed. A second blood sample taken indicated 39 dpm alpha. The process was repeated and the employee was taken to Building 4020 for an In-Vivo scan and for further decontamination. The area around the wound was decontaminated to background level and the employee underwent a 1,000 second count. The count data was found to convert to 2,300 dpm of AM-241 and the total activity in the wound was assumed to be approximately 7 nCi of plutonium plus americium. An area was set up at the SSFL First Aid Station and "debridement" of the wound site was performed. All equipment and waste were collected and the surgery area surveyed clean after the surgery was completed. Additional scans of the wound area indicated contamination of 2.8 nCi of plutonium plus americium. The employee underwent additional surgery to remove radioactive material from the wound site on March 16, 1983. A post surgery scan determined that between 90 to 100 percent of the active material was removed.

  the incident report did not provide any information to indicate whether any contamination outside of the glove box occurred as a result of this incident (Incident Report A0013).[131,132]

[130] Robinson, G.C., Internal Letter, *Re: Radiological Safety Incident Report, March 29, 1982.*
[131] Moore, J.D., Internal Letter. *Re: Quarterly Review of NMDF (T055) for Radiation Safety - First Calendar Quarter, 1983,* July 7, 1983.
[132] Badger, F.H., Internal Letter *Re: Radiological Safety Incident Report, February 8, 1983.*

VOLUME VI

FINAL
TECHNICAL MEMORANDUM
SUBAREA HSA-6
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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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.
Northway 10 Executive Park
313 Ushers Road
Ballston Lake, New York 12019

October 2012

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HGL

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LIST OF ACRONYMS, ABBREVIATIONS AND SYMBOLS

AEC	U.S. Atomic Energy Commission
ACP	activation products
AETR	Advanced Epithermal Thorium Reactor
AI	Atomics International Division of North American Aviation, Inc.
ANL	Argonne National Laboratory
ANSI	American National Standards Institute
ARRA	American Recovery and Reinvestment Act
Boeing	The Boeing Company
°C	degrees Celsius
CDPHE	California Department of Public Health and Environment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERF	Component Equipment Repair Facility
Ci	curie
COC	contaminants of concern
D&D	decontamination and decommissioning
DHS	Department of Health Services
DOE	Department of Energy
DOT	Department of Transportation
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
ESG	Energy Systems Group
ETB	Engineering Test Building
ETEC	Energy Technology Engineering Center
°F	degrees Fahrenheit
gpm	gallons per minute
HSA	Historical Site Assessment
HGL	HydroGeoLogic, Inc.
HR	House Resolution
kW	kilowatt
µCi/cm^3	microcurie per cubic centimeter
µR/h	microroentgen per hour
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MFP	mixed fission products
mrad/h	millirad per hour
MWd	megawatt days
NASA	National Aeronautics and Space Administration

NBZ	Northern Buffer Zone
NRC	Nuclear Regulatory Commission
ORISE	Oak Ridge Institute for Science and Education
pCi/cm^3	picocuries per cubic centimeter
pCi/g	picocuries per gram
rad/h	rad per hour
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
Rockwell	Rockwell International
SBZ	Southern Buffer Zone
SCE	Southern California Edison
SHEA	Safety Health and Environmental Affairs
SNAP	Systems for Nuclear Auxiliary Power
SRE	Sodium Reactor Experiment
SSFL	Santa Susana Field Laboratory
TM	technical memorandum
TO	task order

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TEXT

FINAL
TECHNICAL MEMORANDUM
SUBAREA HSA-6
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, and 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 gamma scanning or 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-6. 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 were 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-6 and the drainage channels that lead to and from this area. The location of subarea HSA-6 is shown on Figure 1.3. Plate 1 presents a summary of the features related to potential radiological sources identified within the HSA-6 subarea. Detailed information pertaining to the use of radioactive materials and the potential release of radionuclides at sites and buildings within HSA-6 are provided in Sections 2 and 3 of this TM. Preliminary findings specific to HSA-6 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 HSA-6. 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.

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.

[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.

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.

Table 1.2
Research Reactors Located at the Santa Susana Field Laboratory[4]

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 (SRE)	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

[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
[4] 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[1]

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	610	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 have been 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]

Table 1.3
Criticality Test Facilities at the Santa Susana Field Laboratory[4]

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] 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, pp. 23, 25.
[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
[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.

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.[1] 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 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-6

Subarea HSA-6 is approximately 57 acres of predominantly flat land and land that had been flattened prior to construction. Over the years, 22 buildings have been located within HSA-6 together with open-air fenced areas, concrete pads, storage yards, oil storage tanks, and parking lots. Subarea HSA-6 includes E Street, the eastern part of G Street, 3rd, 10th, and 11th Streets. The drainage direction varies with the location within the subarea. The majority of operations in Subarea HSA-6 related to activities conducted in the SRE. The SRE was termed an "experiment" because it was the first nuclear reactor designed and constructed to use a sodium solution as reactor coolant. The SRE served as both a nuclear power plant and a reactor systems experiment. There was one retention pond in this subarea that received effluent from the SRE.

1.5 Sites in HSA-6

During the peak of operations, Subarea HSA-6 comprised 38 sites, most of which were buildings. This TM addresses each of these 38 sites within Subarea HSA-6. Of the 38 sites, 22 contained buildings, one of which was a reactor (Building 4143), while others housed operations involving radioactive materials. Of the 22 buildings in Subarea HSA-6, none remains 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;

[1] Agency for Toxic Substances and Disease Registry, *Draft Preliminary Site Evaluation, Santa Susana Field Laboratory*, Atlanta, GA, December 3, 1999, pp. 2-5.

- 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 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 off-site 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, 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 Adminsitration (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 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 provided information that was 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 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-6 TM, 760 individual documents and photographs were reviewed. The review process was conducted by first screening over 80,000 documents amassed for the project. In addition, the documents requested from the document databases comprising approximately 1.4 million documents were reviewed. This screening effort produced 760 documents relevant to past operations at facilities within HSA-6 and was therefore determined to warrant in-depth evaluation. Each of these 760 relevant documents was thoroughly evaluated for information considered useful for carrying out the goals listed in Section 1.2 of this TM. 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; and
- 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;
- 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 have been completed 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-6 according to five groups based on operational characteristics and geographic locations. Plate 1 depicts the entire HSA-6 subarea and should be referenced while reading Section 2. Each HSA-6 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-6 Group 1 are presented. HSA-6 Group 1 includes 22 sites containing the Building 4143 Sodium Reactor Experiment reactor and associated buildings.

2.1.1 Building 4003 Area

Site Description: The Building 4003 area comprises Building 4003, substation Building 4693, support Building 4825, and the land surrounding these three buildings located near the end of E Street. Building 4003 was constructed in 1957.[1, 2] Figures 2.1.1a through 2.1.1i provide a current photograph, historical photographs, and building-specific drawings.

Building Features: Building 4003 was a rectangular steel building with a high bay on the southern end and a low bay on the northern end. It was approximately 10,775 square feet in area. This includes a 2,400-square-foot addition that was added in 1958. The floor plan for Building 4003 is presented in Figure 2.1.1b. A 1974 aerial photograph of Building 4003 is presented in Figure 2.1.1c. Building 4003 contained offices, a change room, several laboratories, a Freon compressor, a concrete pit, a tank pit, a sump, an expansion tank, a boiler, and a cooling tower.[3, 4] Building 4003 also contained an exhaust system that included nine fume hoods, valves, ducts, blowers, filters, filter plenum chambers, and a stack. In addition, Building 4003 contained two radioactive waste sinks connected to 5-gallon bottles, and a highly shielded area designed for remote manipulation of radioactive materials. This area was known as the "Hot Cave" and contained identical east and west "hot cells," a pair of mechanical manipulators for each of the two cells, a transfer tunnel, liquid waste lines, east and west cell "small" radioactive liquid waste holdup tanks located below the Hot Cave, and a hot cell exhaust system with HEPA filters and two blowers located on the roof of Building. Each cell contained a stainless-steel pan about 3-feet by 3-feet by 8-inches deep. These pans served as a junction and distribution system for the exhaust air, electrical power, instrumentation, and radioactive waste. Reinforced concrete 18-inches thick was poured around the pans and the connecting ducts and conduits when constructed. Two 12-ton shield doors, located at the entrance to the Hot Cave structure, rolled

[1] ETEC website at: www.etec.energy.gov/History/Major-Operations/SRE.html
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[3] Montgomery Watson Harza, Table 1, *List of Historical Document Map Features at SRE*, August 1, 2003.
[4] Rockwell internal letter from C. D. Bingham to W. F. Heine, Re: *Application to Perform Radiochemical Operations in Building 003A (ETB Annex)*, December 10, 1970.

open and closed on a supporting steel structure.[1, 2] The documents reviewed do not state how the radioactive liquid waste was removed from holdup tanks and bottles or where it was sent. Each hot cell was 5.5 feet long, 6 feet high, and 4 feet deep. Each cell was connected to the transfer tunnel through a port (opening) that was 1 foot wide and 1.5 feet high. The port to each cell was opened and closed by a remotely operated lead door 4-inches thick.[3] A cut-away view of the Hot Cave is presented in Figure 2.1.1d. The hot cell (Hot Cave) floor plan is presented in Figure 2.1.1e.[4]

Building 4003, in conjunction with Buildings 4143 and 4163, also had a 2,700-gallon septic tank connected to a 600-linear-foot leach field. The leach field was down the hill on the flat area approximately 150 feet north of Building 4003.[5] The site plot plan is presented in Figure 2.1.1f.[6] The sewage system is presented in Figure 2.1.1g, and the contaminated waste lines are presented in Figure 2.1.1h.[7, 8]

Former Use(s): Building 4003 was known as the Engineering Test Building (ETB). It was used to assemble fuel elements for the SRE from 1957 through 1964. In this operation, uranium and thorium metal slugs were loaded into metal tubes, the remaining tube space was filled with sodium and the tubes were sealed. Fuel elements for three SRE cores were prepared in Building 4003, but only two cores were used. The third core was shipped off-site.[9] The Hot Cave was designed and constructed to investigate the chemistry of molten uranium, and to study the separation of fission products and plutonium from uranium systems. The west hot cell was used primarily for kilogram-scale processing experiments involving chemical reactions of irradiated reactor fuels at temperatures up to 1,800 degrees Celsius (°C). The east hot cell was used primarily for mechanical operations, such as decladding, component disassembly, and inspection. The transfer tunnel was used for sample handling, waste removal, inter-cave transfer, and the storage of kilocurie sources.[10] Figure 2.1.1h shows that on the first and second floors of the high bay, there was a radioactive waste sink with a fume hood connected to a 5-gallon bottle. There was also a holding tank located on the southeast side of Building 4003, at the end of the contaminated waste lines. Decontamination reports mention that two "small" liquid waste holdup tanks were located below the Hot Cave. According to the Department of Energy, later

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[1] Majors, W. K., *Procedures for Decontamination of Building T003*, Atomics International Report No. DWP-704-990-001, January 20, 1975, pp. 6-16.

[2] Ureda, B. F., *Building 003 Decontamination and Disposition Final Report*, AI-ERDA-13158, February 25, 1976, pp. 7-21.

[3] Strausberg, S., Gardner, W. J., Guon, J., Luebben, T. E., and Mills, T. H., *Modified Hot Cave Facility for Reprocessing Experiments*, Atomics International Report No. NAA-SR-2687, June 30, 1958, p.14.

[4] Atomics International As-Built Drawing, *Separations Chemistry – ETB Hot Cell Installation Floor Plan*, Drawing No. 303-003-57, July 27, 1959.

[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, pp. 4-82, 4-87.

[6] Atomics International As-Built Drawing, *Santa Susana Facility Plot Plan*, Drawing No. 303-GEN.-C-37, June 5, 1967.

[7] Atomics International As-Built Drawing, *Central Sewage System Plan & Topography*, Drawing No. 303-GEN.-C-17, February 26, 1960.

[8] Atomics International As-Built Drawing, *ETB High Bay Modifications – Contaminated Waste 1st & 2nd Floor*, Drawing No. 303-003-P21, October 19, 1964.

[9] Rocketdyne Environmental Affairs, *Engineering Test Building - Building 4003*, February 10, 2000.

[10] Strausberg, S., Gardner, W. J., Guon, J., Luebben, T. E., and Mills, T. H., *Modified Hot Cave Facility for Reprocessing Experiments*, Atomics International Report No. NAA-SR-2687, June 30, 1958, p.3.

activities involved bench-scale research into reprocessing of used (or irradiated) fuel assemblies. The research involved the removal of fission products from used fuel.[1]

Building 4003 was also used for the analysis of Systems for Nuclear Auxiliary Power (SNAP) fuel burn-up samples and the evaluation of irradiation experiments. Use of the Hot Cave facility ended when the SNAP program was terminated in 1973. At this time, AI found the inner surfaces of the Hot Cave to be "grossly" contaminated with mixed fission products. Containment of this high-level contamination required continuous operation of the radioactive exhaust system as well as filtering and sampling activities. Radioactive contamination was found to be on the internal surfaces of the hot cells, in the liquid waste lines, the liquid waste holdup tanks, the radioactive exhaust system ducting and on filter plenums. In 1974, the Building 4003 facilities were declared "excess" and a facilities dismantling plan was prepared.[2]

AI informed the U. S. Atomic Energy Commission (AEC) that the alpha-emitting radionuclides present were from enriched uranium; some transuranics may also have been present. The beta-gamma emitting radionuclides resulted from fission products and stainless steel activation products.[3] AI commenced decontamination and decommissioning in January 1975 and ended in June 1975. Dismantling of the Hot Cave was completed in April 1975. Because the exhaust system was needed during decontamination activities, it was the last system to be removed.[4] Between 1975 and 1992, Building 4003 was used as an excess equipment storage building.

Information from Interviewees: In 2010, a number of former workers were interviewed about their experiences at the SSFL. Four remembered Building 4003. Excerpts from their comments are presented below.

- "The remaining SRE staff offices were in 4003. That building also provided space for nonradioactive test work."[5] This former employee worked at the SSFL between 1958 and 1968.

- "The Building 3A hot cave was a shielded facility, holding up to 1,000 curies of radiological material."[6] This former employee worked at the SSFL from 1957.

- "Building 3A was decontaminated by people who worked in Building 20."[7] This former employee worked at the SSFL from 1957.

- "There was a building next to the SRE where the fuel rods were chopped up and cleaned, as they were transported there from the SRE. New cladding was put on the fuel rods there."[1] This former employee worked at the SSFL between 1959 and 1960.

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[1] ETEC website at: www.etec.energy.gov/History/Major-Operations/SRE.html.
[2] Graves, A. W., *Facilities Dismantling Plan for Building (D+D) T003 Hot Cave*, Atomics International Report No. FDP-704-990-001, October 10, 1974, p. 2.
[3] Atomics International letter from W. F. Heine to R. L. Westby, U.S. Atomic Energy Commission, re: *Contamination Limits for Release of KEWB and Building 003 for Unrestricted Use*, November 21, 1974.
[4] Ureda, B. F., *Building 003Decontamination and Disposition Final Report*, AI-ERDA-13158, February 25, 1976, p. 11.
[5] Interview No. 300 of former worker conducted by the DOE and EPA on July 16, 2010, p. 2.
[6] Interview No. 117 of former worker conducted by the DOE, September 2010.
[7] Interview No. 270 of former worker conducted by the DOE, September 2010.

Radiological Incident Reports: There have been several incidents associated with Building 4003 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 4003 Incident Report Summary

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A0530	10/7/1959	ETB MAYBE		EMPLOYEE CONTAMINATED HIS HANDS WHEN HE FAILED TO WEAR PRESCRIBED PROTECTIVE CLOTHING.
A0423	12/22/1959	ETB	MFP	CONTRACTOR REMOVED R/A EXHAUST STACK WITHOUT HEALTH PHYSICS COGNIZANCE.
A0549	7/22/1960	ETB RM 160		EMPLOYEE CUT HAND IN CONTROLLED AREA.
A0295	2/1/1965	ETB & D004		VARIED WORK LOCATION & LATE RETURN OF FILM BADGE RESULTED IN EXCEEDING GUIDELINES.
A0438	9/15/1969	ETB HOT CELL	MFP	MULTIPLE PROJECTS RESULTED IN EMPLOYEE EXPOSURE ABOVE GUIDELINES.
A0048	9/2/1969	ETB CHEM LABS		ETB LAB EQUIPMENT AND FLOOR FOUND CONTAMINATED.

*Isotopes are written as they are presented in the incident database. The research team believes that MFP is an acronym for mixed fission products.

- On October 7, 1959, an employee performed maintenance on a radioactive contaminated sodium line with his bare hands. The employee was aware the line was contaminated. Both of his hands became contaminated to a level of 1.5 mrad/h. After 35 minutes of cleaning, the employee's hands were successfully decontaminated (Incident Report A0530).[2]

- On December 22, 1959, contract personnel were working on the exhaust stack of the radioactive vent systems at the ETB without the knowledge of the health physics department, without the proper permit, and without film badges. The contract crew was unaware the exhaust system was radioactive. No personnel contamination was discovered. Work was immediately stopped until the proper permit was filled out and film badges assigned (Incident Report A0423).[3]
- On July 22, 1960, an employee cut his hand during a drilling operation. No activity was found above background on his hand (Incident Report A0549).[4]

[1] Interview No. 207 of former employee conducted by the EPA only, September 2010.
[2] Bell, C. E., Internal Letter, re: *Violation of Health Phys. Practices*, October 8, 1959.
[3] Lang, J. C., Atomics International Internal Letter, re: *Notice of Rule Infraction*, December 31, 1959.
[4] Illegible Author, Atomics International Internal Letter, re: *Radiological Safety Incident Report, Room 160 ETB Annex, July 22, 1960*, July 27, 1960.

- In October 1965, a missing film badge belonging to a chemist was found. The badge had been missing since January 1965 and when processed indicated an exposure of 2,000 mrem gamma and 640 mrem beta. When added to the chemist's February and March exposures, the quarterly total exposure was 2,600 mrem gamma and 1,870 mrem beta. Review of the chemist's duties in January suggested that he did in fact receive the exposure indicated on the film badge, despite the possibility of other factors affecting the reading. The chemist's lifetime accumulated exposure through September 1965 was 28.4 rem, below the permissible exposure of 65 rem at that time (Incident Report A0295).[1]

- On September 15, 1969, film badges worn by an employee over the course of a calendar quarter were evaluated and the combined exposure from the badges was 6,065 mrem. This overexposure was found to be the result of multiple different operations at the ETB (Incident Report A0438).[2]

- On September 2, 1969, a smear survey was requested for the upstairs laboratory at the ETB because contamination had been found on the floor. The contamination was first noted on an employee's shoe (200 cpm). The employee smeared the stairs and found up areas of contamination up to 1,000 dpm/100 cm^2. This prompted him to smear the floor where he was setting up equipment. Repetitive smears of the floor brought forth "hotter" and "hotter" results. The employee eventually roped off the area and requested further surveying of the lab. Additional smear surveys found gross contamination on the bench top and covered sink. A couple of spots read up to 1.5 rad/h. This material was easily removable. Parts of two ring stands on the work bench indicated 0.5 rad/h and were bagged up. Another "hot" area of the lab was located on an adjacent bench top where a survey detected 30,000 cpm. Smear surveys taken on September 4 and 5, 1969 found contamination greater than 150,000 dpm/100 cm^2 (the counter detectibility limit) on the outside of a furnace, a balance, and a hot plate in the hood. The hot plate was measured to be 330 mrad/h. Also found in the hood, behind two lead bricks, was a bottle of liquid waste from earlier equipment, which read 5 rad/h. According to the incident report, the "episode was somewhat mysterious." It appears that there may have been two sources of contamination because gamma activity was missing from one set of smears. It was unknown whether a chemical or physical process had removed gamma emitters, such as cesium, from this area. As of September 8, 1969, the lab had been fairly well decontaminated and most items outside the hood were less than 100 dpm/100 cm^2 beta-gamma (Incident Report A0048).[3]

Current Use: Building 4003 was demolished in 1999. The extent of the Building 4003 excavation is shown in Figure 2.1.1i.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): A chronology of radiological investigations at this building is as follows:

[1] Correspondence from Remley, M. E., Atomics International, to Levy, J., U.S. Atomic Energy Commission, *Re: Apparent Type B Radiation Exposure*, November 5, 1965.
[2] Bresson, J. F., North American Aviation Internal Letter, re: *Film Badge Exposure - Contamination at the ETC, SS003, Bresson to Heine, 9/13/69*, October 15, 1969.
[3] Bresson, J. F., North American Rockwell Corporation Internal Letter, re: *Contamination at the ETC, S003*, September 15, 1969.

- Between January and June 1975, AI dismantled and removed the Hot Cave contents and structure. To provide access to the Hot Cave, the high bay in Building 4003 was cleared of unnecessary equipment, including the remains of a sodium experiment. The east cell of the Hot Cave was entered and decontaminated first. Restricted Access Entry Permit No. 17602 was issued by the Health, Safety, and Radiation Services Department. The manipulator, other equipment, materials, and structures were wrapped in plastic sheeting to contain removable contamination and placed in a U.S. Department of Transportation (DOT) shipping container for shipment to Beatty, Nevada for burial. AI decontaminated the east cell using a "foamer" to loosen the contamination, and a vacuum cleaner to remove the contamination. Following foaming, the cell was cleaned by wiping with "Big K,"[1] a caustic solvent. The vacuum cleaner was later decontaminated at the Radioactive Material Disposal Facility (RMDF), Building 4075. All other residue and wiping cloths were placed in a plastic bag and shipping container, and shipped to the RMDF.[2]

  As part of dismantling operations, AI opened the west cell and conducted a radioactivity survey; the cell was found to contain significantly higher levels of radioactivity than the east cell. The west cell contained test analysis equipment and experimental residue. Miscellaneous waste was removed including three trays (7 rad/hour [rad/h]) and two 1-gallon paint cans (approximately 25 rad/h). AI bagged this waste and placed it in a conduit with 6-inch concrete shielding, and sent it to the RMDF for disposal. The cell interior was wiped using the cell manipulators and vacuum cleaned. Five prefilters (250 mrad/h) from the lower section of the cell and a 30-gallon bag of solid waste (2 rad/h) were then removed, and the cell was vacuum cleaned again to remove most loose contamination. The roof shield blocks associated and the manipulators were removed while the openings in the roof were covered with plastic sheeting to contain loose contamination. The remaining items in the cell were then removed. These included a Lucite enclosure, a shelf, a table, and 90 gallons of solid radioactive waste. Dry uranyl salt solution (25 rad/h at 10 centimeters) was removed from the floor. A container of SNAP burnup samples was located in the transfer tunnel between the two cells. Using tongs, this container was transferred to a 5-gallon can and then into a lead cask. The cask was transferred to the RMDF.[3]

  AI removed contaminated materials (cask dolly, rails, push-pull rods) from the tunnel and packaged them for shipment to Nuclear Engineering Company for burial in Beatty, Nevada. AI also removed the shield blocks surrounding the tunnel together with the cell roof, wall shield, and floor blocks. These were disposed of as radioactive waste. AI's demolition contractor removed the square stainless-steel pans from the floor of each cell using explosives. He drilled several holes beneath the pans and set off charges. The force of the explosive charges was contained by sand bags over the pans and concrete. The two 12-ton shield doors and supporting steel structure were sold to a salvage

[1] Big K is a "safety solvent" manufactured by NCH Corporation, Irving, Texas. According to its material safety data sheet, its main ingredients are silicic acid and sodium metasilicate.
[2] Ureda, B. F., *Building 003Decontamination and Disposition Final Report*, AI-ERDA-13158, February 25, 1976, pp. 12-13.
[3] Ureda, B. F., *Building 003Decontamination and Disposition Final Report*, AI-ERDA-13158, February 25, 1976, pp. 13-15.

contractor who dismantled and removed them free of charge. Prior to removal, the doors were decontaminated by wiping them with "Big K"[1] solvent.[2]

AI removed the Hot Cave radioactive exhaust filters, exhaust ducts, liquid waste lines, and two liquid waste holdup tanks, wrapped them in plastic, and shipped them to Beatty, Nevada for burial. Nine fume hoods were removed from the Building 4003 laboratories. Two were contaminated and were sent to the RMDF for decontamination and later sent to salvage for unrestricted use. The exhaust ducting associated with the fume hoods was also removed. About 30 feet from the high bay were found to be contaminated and were sent to the RMDF for packaging and subsequent off-site burial. One radioactive waste sink in the high bay and one in the upstairs laboratory were removed and packaged for shipment to Beatty, Nevada, for burial. The drain lines were removed by breaking through the concrete floor for a distance of about 60 feet and excavating. In the removal process, the soil became contaminated when pieces of pipe came into contact with the soil. In the areas where radioactivity was found, the soil was removed, packaged in 55-gallon drums, and shipped to Beatty, Nevada, for burial. The holdup tank at the end of the drain line (located on the southeast side of Building 4003) was removed and the trenches were then backfilled and paved with concrete and sent to Beatty, Nevada, for burial.[3]

After the Hot Cave contents and structure were dismantled and removed, AI excavated the floor beneath the Hot Cave to a depth of 35 feet for a mockup construction of the SRE. AI planned to simulate water shielding anticipated for SRE dismantling by using a 15-foot diameter by 31-foot-deep tank to represent the core cavity liner depth and diameter.[4] Soil samples from the excavation contained alpha and beta activity concentrations of 0.75 picocurie per gram (pCi/g) and 24.8 pCi/g, respectively. Rockwell considered alpha and beta background concentrations to be 0.60 pCi/g and 25.0 pCi/g, respectively. During the excavation, groundwater seeped into the hole. Analysis of a water sample indicated alpha and beta activity concentrations of 7.9×10^{-10} microcurie per cubic centimeter ($\mu Ci/cm^3$) and 1.2×10^{-8} $\mu Ci/cm^3$, respectively. Rockwell considered these values to be lower than the 1975 site background activity concentrations in groundwater. Removal of the drain lines from the radioactive sinks involved excavating about 60 feet of concrete floor and soil cover. Rockwell collected 15 soil samples from the excavated trench. Rockwell reported that radioactivity concentrations ranged from 0.38 to 56.3 pCi/g for alpha activity, and 20.3 to 408.2 pCi/g for beta activity. Additional soil was excavated from the trench in the regions where four soil samples exhibited concentrations significantly above average background levels according to Rockwell. A total of 4,235 cubic feet of radioactive waste was shipped to the Nuclear Engineering Company for burial in Beatty, Nevada.[5] After completion of the

[1] Big K is a "safety solvent" manufactured by NCH Corporation, Irving, Texas. According to its material safety data sheet, its main ingredients are silicic acid and sodium metasilicate.
[2] Ureda, B. F., *Building 003Decontamination and Disposition Final Report*, AI-ERDA-13158, February 25, 1976, pp. 15-19.
[3] Ureda, B. F., *Building 003Decontamination and Disposition Final Report*, AI-ERDA-13158, February 25, 1976, pp. 19-21.
[4] Brengle, R. G. and Phillips, D. A., *SRE Mockup Operations Test Plan*, Atomics International Report No. N704-TP-990-005, October 9, 1975, p. 6.
[5] Ureda, B. F., *Building 003Decontamination and Disposition Final Report*, AI-ERDA-13158, February 25, 1976, pp. 27-28.

removal and excavation, the U.S. Energy Research and Development Administration recommended that Building 4003 be released for unrestricted use in March 1976.[1]

- During September and October 1981, the DOE directed Argonne National Laboratory (ANL) to survey Building 4003 using new instruments that were sensitive to lower count rates. ANL found several areas contaminated above then-acceptable limits. Rockwell decontaminated the majority of the hot spots as they were located. When the duct system leading to the blowers on the roof was determined to be contaminated, cleaning was halted to develop a work plan and cost estimate. On February 11, 1982, work commenced on removing the exhaust system in Room 180. The blowers and access structure on the roof showed beta activity readings of between 250 and 1,000 counts per minute (cpm) above local background. Rockwell regarded local background measured using Eberline PAC-4G-3 survey instruments to be between 75 and 125 cpm. The blowers and access structure were removed and packaged as low-level waste. The metal roof under the blower exhaust showed beta activity readings of between 250 and 1,250 cpm above background. The metal roof area was cleaned and resurveyed to verify removal. The ducting in Room 101 was removed to the absolute filter plenum and packaged as low-level waste. The high bay and low bay in Room 180 were cleaned and resurveyed to verify removal. A total of 248 cubic feet of contaminated material and equipment were packaged into containers and sent to the SRE to await shipment for burial. The Eberline survey instruments were adjusted to have an efficiency factor of 2, and the area of the probe was 50 square centimeters. Net cpm were multiplied by 4 to get disintegrations per minute (dpm) per 100 square centimeters (cm^2). Removable contamination levels were reduced to below 50 dpm per 100 cm^2 for beta-gamma contamination.[2, 3]

- In April 1982, ANL conducted a final post-remedial action survey. Those areas of Building 4003 that had been found contaminated in 1981 were found to be free of detectable radioactive contamination. A sludge sample collected from the sewer sump showed elevated levels of enriched uranium (314 µg). Mass spectrometric analysis of this uranium indicated that the material was slightly enriched in U-235. Subsequently, Rockwell removed all sewer lines within Building 4003 in September 1982. This involved the removal of the cold sink line in Room 180 through Rooms 160 and 165 to the sewage sump tank. The restrooms were located at the northwest corner of Building 4003. Rooms 160, 165 and 180 were located on the west side of the high bay. See Figures 2.1.1b and 2.1.1h. The sewer line was packaged as radioactive waste for shipment to offsite land burial.[4] In May 1983, ANL recommended that Building 4003 be released for unrestricted use. However, the sewer lines exterior to Building 4003, which remained in place, were considered to be potentially contaminated and subject to

[1] Letter from S. R. Stamp, U.S. Energy Research and Development Administration, to W.F. Heine, Atomics International, March 3, 1976.
[2] Rockwell International Internal Letter from J. F. Lang to B. F. Ureda, *Decontamination of Building 003*, March 9, 1982.
[3] Rockwell International Internal Letter from F. E. Begley to Mailing List, *Radiation Survey of Building T003 - Santa Susana*, March 15, 1982.
[4] Wallace, J. H., *Radiological Survey Results – Release to Unrestricted Use, Building 003*, Rockwell International Report No. N704TI990063, November 9, 1982, pp. 3-7.

restricted use. See Figure 2.1.1g. ANL recommended that effluent from the outfall of this sewer system be periodically monitored for radionuclides.[1, 2]

Use of the sewage treatment plant began in the 1950s to collect sanitary waste from Areas II, III, and IV. In addition to sanitary waste, the plant also received cooling tower discharges from non-chromated cooling tower systems and treated groundwater from various site groundwater recovery systems. The treatment plant had a capacity of 35,000 gallons per day and consisted of a source aeration unit, clarifier, anthracite coal filter, and chlorine contact chamber. The treated plant discharge was allowed to flow into the R-2A Discharge Pond. Use of the treatment plant was discontinued in 2001 and domestic waste was treated off site.

- In June 1982, Rockwell reported that the cleanup of Building 4003 was complete because ANL had indicated that its "overcheck" found no contamination above its acceptable limits. Consequently, Rockwell's Energy Systems Group renewed a previous offer to take title to the DOE portion of Building 4003.[3]

- In July 1982, Rockwell reported that enriched uranium was identified in the sewer sump outside of Building 4003 in the range of 23 to 32 µg/g. Rockwell concluded that ANL would object to the unrestricted use of Building 4003, but cleanup was impractical and almost impossible.[4]

- In November 1983, the DOE reported that the levels of contamination in the sanitary and/or storm sewer systems exterior to Building 4003 were below the proposed Formerly Utilized Sites Remedial Action Program (FUSRAP)/Remote Surplus Site Criteria and the criteria tacitly agreed to between the State of California and the DOE.[5] Furthermore, the DOE stated that the sewer was completely buried and, as used at that time, posed no radiological hazard to personnel or the environment. Therefore, the proposed American National Standards Institute (ANSI) 13.12 standard or the NRC Regulatory Guide 1.86 notwithstanding, the DOE believed that there was no need to place a restriction on the sewer lines as noted in the ANL interim report on this facility, based on the cleanup criteria noted above. However, the DOE recommended to periodically check the sewer lines where appropriate for radiological contamination further downstream.[5]

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[1] Wynveen, R. A., Smith, W. H., Sholeen, C. M., Justus, A. L., and Flynn, K. F., *Interim Radiological Survey Report for Building 003, Santa Susana Field Laboratory, Rockwell International*, Argonne National Laboratory Report, May 1983, pp. 1-6.

[2] Wynveen, R. A., Smith, W. H., Sholeen, C. M., Justus, A. L., and Flynn, K. F., *Post Remedial Action Survey Report for Building 003, Santa Susana Field Laboratories, Rockwell International, Ventura County, California*, Argonne National Laboratory Report, DOE/EV-0005/44, ANL-OHS/HP-83-109, October 1983, pp. 1-6.

[3] Rockwell International Letter from R. W. Hartzler to L. Lanni, DOE, re: *Santa Susana Laboratory, Building 003*, June 4 1982.

[4] Rockwell International Telephone Conversation Record from W. Smith to B. F. Ureda, Re: *Building 003 Contamination*, July 2, 1982.

[5] U.S. Department of Energy Memorandum from A. J. Whitman to E. Keheley, Re: *Remedial Action Certification on the Sodium Reactor Experiment (SRE) and the Hot Cave (Bldg. 003, Santa Susana Field Laboratory*, November 15, 1983.

- Based on a review of the 1983 remedial action project report, the DOE, San Francisco Operations Office, released Building 4003 for unrestricted use on July 23, 1985, and removed it from the DOE's radiologically contaminated Surplus Facilities Program.[1]

- In 1996, Rockwell located the septic tank previously connected to Buildings 4003, 4143 and 4163 by a vent pipe, which extended above ground level. Using a backhoe, Rockwell dug a transverse trench about 15 feet from the tube in the direction of the expected location of the leach field. See Figure 2.1.1g. An unperforated clay pipe was uncovered. Rockwell considered this to be the supply pipe to the leach field. A second transverse trench dug about 15 feet further downstream, uncovered perforated clay pipe resting on a gravel bed at a depth of about 4 feet. This was a continuation of the pipe in the first trench and apparently extended from the center of the septic tank. No evidence of branch lines was found. Rockwell collected a soil sample from the gravel and wet soil mixture under the clay pipe in the second trench. Rockwell dug a third transverse trench about 6 feet further downstream and again found the perforated pipe and gravel. Rockwell collected a second leach field sample from this location. Rockwell also collected two soil samples from the area surrounding Building 4003. Analytical results from one of these samples showed an elevated soil activity level for cesium-137 (Cs-137) of 0.44 pCi/g.[2] The septic tank, leach field, and contaminated soil were not removed at this time.

  As stated above, use of the sewage treatment plant began in the 1950s to collect sanitary waste from Areas II, III, and IV. In addition to sanitary waste, the plant also received cooling tower discharges from non-chromated cooling tower systems and treated groundwater from various site groundwater recovery systems. The treatment plant had a capacity of 35,000 gallons per day and consisted of a source aeration unit, clarifier, anthracite coal filter, and chlorine contact chamber. The treated plant discharge was allowed to flow into the R-2A Discharge Pond. Use of the treatment plant was discontinued in 2001 and domestic waste was treated off site.

- In July 2000, Boeing excavated, removed, and surveyed for radiological contamination the drainage lines, septic tank and leach field. Instrument measurements and wipe samples were collected from the septic tank and associated piping. Boeing found no man-made gamma emitting radionuclides from gamma spectroscopy of concrete debris from the septic tank. The septic tank was full of a mixture of debris and soil. Boeing collected seven samples from the debris within the septic tank, its inlet pipes, and its outlet pipes. Using gamma spectroscopy, Boeing detected Cs-137 in the inlet pipes and inlet chamber in concentrations up to 2.5 pCi/g. These materials were packaged as radioactive waste per Boeing's policy. Boeing also collected four soil samples from beneath the septic tank, but no man-made radionuclides were identified in these samples. Boeing collected seven soil/gravel samples along the length of the leach field lines. The highest concentration detected was Cs-137 at 0.65 pCi/g, which Boeing considered to be

[1] Voigt, W. R., Jr., *Certification for Unrestricted Use of the Sodium Reactor Experiment (SRE) Complex and the Hot Cave Facility (Building 003)*, U.S. Department of Energy, July 23, 1985.
[2] Rutherford, P., *Area IV Radiological Characterization Survey Final Report*, Energy Technology Engineering Center Report No. A4CM-ZR-0011, August 15, 1996, pp. 35, 39-40, 61-62, 65.

consistent with its local background level in 2001. Other than the soil samples, no soil was removed from the area.[1]

- In October, November, and December 2000, Pacific Materials Laboratory, Inc. provided compaction tests during the backfill of two 20-foot deep cavity structures that remained at the conclusion of the demolition and removal of Buildings 4003 and 4143. Rough grading activities were conducted by engineering contractors Standard Industries of Ventura. Prior to fill placement using heavy grading equipment, minor isolated depressions and irregularities within the bedrock surface were backfilled with ¾-inch gravel to less than 1 foot in thickness to create a nearly flat surface in the bottom of each excavation. Fill soils placed in the excavation consisted of imported soils exported from an off-site borrow site as well as on-site native soils local to the building sites. The limits of the excavation for Building 4003 are shown in Figure 2.1.1i.[2]

- In March 2001, CDM Engineers & Constructors, Inc. (CDM) excavated and removed an inactive 1,500-gallon steel underground diesel tank located at the northwest corner of the footprint of former Building 4003. The tank was found to be in good condition without holes, but filled with saturated clay material, which was vacuumed into a truck. No odor was detected in the excavation and no groundwater was encountered. Three soil samples were collected and analyzed for total petroleum hydrocarbons (TPH) and volatile organic compounds (VOCs), but none were detected. No radioactive monitoring or sampling for radioactive contaminants was conducted.[3]

Radiological Use Authorizations: At various times, the following radiological use authorizations were assigned to Building 4003.

- Use Authorization No. 2 for water corrosion tests of SNAP fuels (authorization missing).

- Use Authorization No. 31 for radiochemical use (authorization missing).

- Use Authorization No. 85, issued January 16, 1975, for the Decontamination and Disposition of Facilities Program, applied to the Hot Cave. Authorized materials were uranium and transuranic elements of various isotopic compositions, activation products, and mixed and separated fission products distributed through the Hot Cave in unknown quantities.[4]

Former Radiological Burial or Disposal Locations: Until 1961, Building 4003 was connected to a leach field system, which was located downhill on a flat area approximately 150 feet north of Building 4003. Building 4003 was connected to a site-wide sewage treatment system after that time. In 1982, the sewer lines were found to be radioactively contaminated.[1]

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[1] Letter from B. D. Sujata, The Boeing Company, to J. Evans, County of Ventura, re: *Information Regarding Permit – Septic Tank and Leach Field*, October 23, 2001.
[2] Pacific Materials Laboratory, Inc., *Final Compaction Test Report – Structural Backfill of Former Buildings 4143 and 4003 Test Cells, Area IV Rocketdyne, Santa Susana Field Laboratory, Ventura County, CA*, January 2, 2001.
[3] Sierra Geoscience, Inc., *Report on UST Closure, Tank UT-74, The Boeing Company Building 4003, Rocketdyne Propulsion and Power, Santa Susana Field Laboratory, Ventura County, California*, April 6, 2001, pp. 1-5.
[4] Atomics International Use Authorization No. 85, issued January 16, 1975, in effect until January 16, 1976.

Aerial Photographs: Aerial photographs show undeveloped land until a 1957 photograph in which a large rectangular building is observed that is identified as Building 4003. In the 1959 photograph, Building 4003 appears about 40 percent larger in area. The building does not change in size in photographs from approximately 1960, 1965, 1967, 1972, 1978, 1980, 1983, 1988, and 1995. A possible pipeline is identified extending southwest from Building 4003. In the 2005 photograph, a ground scar appears where Building 4003 was located. In the 2009 photograph, a parking lot appears where Building 4003 was formerly located.[1]

Radionuclides of Concern: This facility was used to examine spent fuel, research reprocessing of such, and to study molten uranium fuel. Radioactive materials managed at Building 4003 included uranium, thorium, transuranic elements, mixed fission products, and activation products. Possible radionuclides include natural and enriched uranium (U-238, U-234, U-235, U-236), isotopes of plutonium (Pu-239, Pu-240, Pu-241, Pu-242), americium-241 (Am-241), thorium-228 (Th-228), Th-232, Th-234, activation products (tritium (H-3), carbon -14 (C-14), sodium-22 (Na-22), Na-24, chromium-51 (Cr-51), manganese-54 (Mn-54), nickel-59 (Ni-59), Ni-63, iron-59 (Fe-59), cobalt-60 (Co-60)) and fission products (krypton-85 (Kr-85), strontium-89 (Sr-89), Sr-90, antimony-125 (Sb-125), iodine-129 (I-129), I-131, cesium-134 (Cs-134), Cs-137, cerium-144 (Ce-144), barium (lanthanum)-140 (Ba (La)-140), niobium-95 (Nb-95), ruthenium-103 (Ru-103), Ru-106, xenon-133 (Xn-133), Xe-135, promethium-147 (Pm-147), samarium-151 (Sm-151), curopium-152 (Eu-152), radium-226 (Ra-226), actinium-228 (Ac-228).[2, 3, 4] All radionuclides of concern listed with the exception of Na-24, Cr-51, Mn-54, Fe-59, Kr-85, Sr-89, I-131, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xe-133, Xe-135, Pm-147 and Sm-151 are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives except for Sm-151 for which no analytical method is available. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Based on general site topography, surface water from Building 4003 flows northeast into the SRE retention pond. From 1957 to 1959, outflow from the retention pond was onto the NBZ and Brandeis-Bardin Institute land. In 1959, a 6-foot diameter overflow pipe and a pumped sump were installed at the confluence of the two main drainage channels upstream of the pond. Water was then pumped through a 4-inch diameter overland pipe to a channel connecting to the Area II ponds. The overflow from these ponds is into Bell Canyon and thence to the Los Angeles River.[5]

Radiological Contamination Potential: The preliminary MARSSIM classification for the Building 4003 area is Class 1, due to its former use as an SRE support building, and its proximity to SRE Building 4143.

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[1] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[2] Hart, R. S., *Distribution of Fission Product Contamination in the SRE*, Atomics International Report No. NAA-SR-6890, March 1, 1962, pp. 8-27.
[3] Kinzer, J. and Crawford, A. C., *SRE First Core Fuel*, Atomics International Technical Data Record No. 5301, May 16, 1960, pp. 1-7.
[4] Letter from Heine, W. F., Atomics International, to Proctor, J. F., E. I. du Pont de Nemours & Company, re: *Fission Product and Fissile Content of SRE Fuel*, July 2, 1975.
[5] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.

Recommended Locations for Soil/Sediment Sampling:

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

Previous characterization studies for the Building 4003 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 4003 area. This includes the following Building 4003 areas and appurtenances:

- The flat and low-lying areas surrounding the footprint of Building 4003. Radionuclides originating from the Hot Cave may have migrated to these areas via surface water flow or airborne releases.

- The general area of the former Hot Cave, particularly on the western side, within the footprint of Building 4003. Two radioactive liquid waste holdup tanks were located below the Hot Cave. It is not clear that this area was thoroughly investigated and decontaminated.

- The middle of the southern end of Building 4003 where a 5-gallon bottle collected contaminated liquid from a radioactive waste sink.

- The septic tank and leach field areas located 150 feet north of Building 4003. Boeing excavated, removed, and surveyed these features in 2000, but it is not clear that these areas were thoroughly investigated and decontaminated.

- The contaminated liquid waste lines in the highbay near the Hot Cave and the contaminated waste sump (tank pit) located outside the east side of the high bay near the former Hot Cave. See Figure 2.1.1h.

- The sanitary sewer lines located northeast of the site. If radionuclides were released into the sanitary sewer system, residual contamination may exist in the materials surrounding the sewer lines.

- It should be noted that testing in the Northern Buffer Zone subarea, where subarea HSA-6 drains, will be addressed in the TM pertaining to the Northern Buffer Zone.

2.1.2 Building 4041 Area

Site Description: The Building 4041 area comprises Building 4041, its loading dock designated Building 4687, concrete pad 4896, and the land surrounding these located immediately west of Building 4143. Building 4041 was constructed in 1958 as a steel prefabricated Butler building.[1, 2] Figures 2.1.2a and 2.1.2b provide a current photograph and a floor plan. The location of Building 4041 in the SRE complex is presented in Figures 2.1.1f and 2.1.1g.

[1] Wallace, J. H., *Radiological Survey Results-Release to Unrestricted use, SRE, Building 041*, Rockwell International Report No. N704TI990037, November 9, 1982, pp. 3, 5, 8.
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.

Building Features: Building 4041 was a long narrow building located at the west end of the SRE complex. Building 4041 was constructed with a steel frame, corrugated sheet metal siding and roofing, anchored to a concrete slab and measured approximately 132 feet long by 27 feet wide and 15 feet high.[1] Building 4687, a rectangular concrete pad also constructed in 1958, was used as a pad for helium bottle storage. Figure 2.1.2b presents a floor plan of Building 4041 in 1982.[1]

Former Use(s): Building 4041 was the SRE Component Storage Facility. From 1959 until 1964, the north portion of Building 4041 was used for interim storage of radioactive waste prior to shipment for disposal. The south portion was used for storage of controlled items. The HSA team assumes that these were SRE components and spare parts. In May 1962, AI reported that approximately 2/3 of Building 4041 was filled with spare parts and radioactively contaminated components from the SRE that required cleaning before reuse.[2] No additional information was found about the use of Building 4041. In the early 1980s, during decommissioning of the SRE, Building 4041 was initially decontaminated.[3] Building 4041 was released for unrestricted use on July 23, 1985. After this time, Building 4041 was used for non-radioactive Energy Technology Engineering Center (ETEC) equipment storage.

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: Building 4041 was demolished in 1998.[3] The dimensions of the Building 4041 excavation are unknown because no building demolition documents have been located.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): A chronology of radiological investigations at this building is as follows:

- In August 1982, Rockwell began decontamination and disposition of Building 4041. Rockwell collected 200 smear samples on surfaces throughout the interior of the building. Results were documented at less than 5 dpm/100 cm^2 alpha contamination and less than 30 dpm/100 cm^2 beta-gamma contamination. The only major operation performed was scabbling of the floor area to remove surface radioactive contamination. At the conclusion of this decontamination effort, Rockwell recorded an average background reading of 0.03 mrad/h inside the middle of Building 4041. All radioactive material was packaged for shipment to offsite land burial; the location of the burial site was not identified in the report reviewed. Rockwell designated Building 4041 to be available for unrestricted use on September 17, 1982.[1]

- In July 1982, ANL conducted a post-remedial-action survey. Four areas of Building 4041 were found to exceed ANL's acceptable limits of 20 dpm/100 cm^2 for removable alpha contamination, and 200 dpm/100 cm^2 for removable beta-gamma contamination.

[1] Boeing letter from P. B. Ramirez to R. Laughlin, Resource Management Agency, Ventura County, re: *Buildings 4041, 4687 and 4662 Demolition Project, Area IV, ETEC, Santa Susana Field Laboratory*, January 26, 1998.
[2] Atomics International letter from J. F. Trevillyan to J. V. Levy, U.S. AEC, re: *Sodium Components Cleaning Facility*, May 28, 1962.
[3] Rockwell International, *Sodium Reactor Experiment Decommissioning Final Report*, ESG-DOE-13403, August 15, 1983, pp. 166, 175, 195.

Two areas of Pad 4687 behind Building 4041 were found to have activity above these limits. Rockwell subsequently decontaminated these areas before termination of ANL's post-remedial-action survey. In September 1982, ANL conducted an independent verification survey and found Building 4041 and its surrounding area to be below the limits specified in the draft American National Standards Institute (ANSI) Standard N13.12 and NRC guidelines dated 1982.[1]

- In 1983, Rockwell conducted a radiological survey in the area of Building 4041. The survey areas were designated as SRE Regions VIII and IX. Survey results indicated an average reading of 0.04 mrad/h for surface gamma radiation, and 108 soil samples were found to have an average of 33 pCi/g of gross detectable beta activity, with a maximum of 98 pCi/g. Rockwell's acceptable limit for soil was 100 pCi/g of gross detectable beta activity. All survey results were below Rockwell's applicable limits for release for unrestricted use.[2, 3]

Radiological Use Authorizations: On July 23, 1985, the DOE released the SRE complex, including Building 4041, for unrestricted use and removed it from the DOE's radiologically contaminated Surplus Facilities Program.[4]

Former Radiological Burial or Disposal Locations: Building 4041 was an interim disposal location.

Aerial Photographs: Aerial photographs show undeveloped land until a 1959 photograph when a rectangular building observed that is identified as Building 4041. Building 4041 appears to have expanded by about 100 percent in the 1965 photograph. Building 4041 remains unchanged in the 1967, 1972, 1978, 1980, 1983, 1988, and 1995 photographs. A possible container is identified on the northeast side of Building 4041 in the 1980 photograph. Vegetation and an unpaved road are seen in the location of Building 4041 in the 2005 and 2009 photographs.[5]

Radionuclides of Concern: Building 4041 was used for the interim storage of radioactive waste from the SRE reactor in Building 4143. Possible radionuclides include U-238, U-234, U-235, U-236, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Th-228, Th-232, H-3, Na-22, Na-24, Cr-51, Mn-54, Fe-59, Co-60, Kr-85, Sr-89, Sr-90, Sb-125, I-129, I-131, Cs-134, Cs-137, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xn-133, Xe-135, Pm-147, Sm-151.[6, 7, 8] All radionuclides of concern listed with the exception of Na-24, Cr-51, Mn-54, Fe-59, Kr-85, Sr-89, I-131, Ce-141,

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[1] Argonne National Laboratory, *Post Remedial Action Survey Report for the Sodium Reactor Experiment (SRE) Facility*, DOE-EV-0005-46, February 1984, pp. 10-15.
[2] Wallace, J. H., *Radiological Survey Results Release to Unrestricted Use, SRE Region VIII*, Rockwell International Report No. N704TI990034, May 13, 1983, pp. 3-8.
[3] Wallace, J. H., *Radiological Survey Results Release to Unrestricted Use, SRE Region IX*, Rockwell International Report No. N704TI990035, May 31, 1983, pp. 3-8.
[4] Voigt, W. R., Jr., *Certification for Unrestricted Use of the Sodium Reactor Experiment (SRE) Complex and the Hot Cave Facility (Building 003)*, U.S. Department of Energy, July 23, 1985.
[5] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[6] Hart, R. S., *Distribution of Fission Product Contamination in the SRE*, Atomics International Report No. NAA-SR-6890, March 1, 1962, pp. 8-27.
[7] Kinzer, J. and Crawford, A. C., *SRE First Core Fuel*, Atomics International Technical Data Record No. 5301, May 16, 1960, pp. 1-7.
[8] Letter from Heine, W. F., Atomics International, to Proctor, J. F., E. I. du Pont de Nemours & Company, re; *Fission Product and Fissile Content of SRE Fuel*, July 2, 1975.

Ba (La)-140, Nb-95, Ru-103, Ru-106, Xe-133, Xe-135, Pm-147 and Sm-151 are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives except for Sm-151 for which no analytical method is available. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Based on general site topography, surface water from Building 4041 likely flows northeast into the SRE retention pond. Outflow from the retention pond was initially onto the NBZ and Brandeis-Bardin Institute land. In 1959, a 6-foot diameter overflow pipe and a pumped sump were installed at the confluence of the two main drainage channels upstream of the pond. Water was then pumped through a 4-inch diameter overland pipe to a channel connecting to the Area II ponds. The overflow from these ponds is into Bell Canyon and thence to the Los Angeles River.[1]

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4041 area is Class 1, primarily due to the proximity with SRE reactor Building 4143 and because radioactive waste from this reactor was stored in Building 4041.

Recommended Locations for Soil/Sediment Sampling:

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

Previous characterization studies for the Building 4041 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 4041 area. This includes the following Building 4041 areas and appurtenances:

- The flat and low-lying areas surrounding Building 4041. Radionuclides originating from the Building 4041 and/or Building 4143 may have migrated to these areas via surface water flow or airborne releases.
- The site of the possible container identified from aerial photographs on the northeast side of Building 4041. It is unclear whether radioactive components, pending shipment, were stored outside Building 4041.

- The storm drain located on the west, north, and south sides of the site that connects to the SRE retention pond.

- The loading dock 4687 and concrete pad 4896 adjacent to Building 4041. It is unclear whether radioactive components, pending shipment were stored in these areas.

2.1.3 Building 4143 Area

Site Description: The Building 4143 area comprises Building 4143, concrete pads Nos. 4413, 4894, 4895, 4896, 4897, and 4898, electrical substation Building 4683, and the land surrounding these facilities located at the end of E Street. Building 4143 was constructed between April 1955

[1] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.

and February 1957 and was operated as a nuclear reactor until February 1964.[1, 2] Figures 2.1.3a through 2.1.3m provide a current photograph and historical photographs and drawings.

Building Features: Building 4143 was approximately 20,000 feet in area and included below-grade vaults and galleries for radioactive materials, a high bay, ground floor and mezzanine offices, rooms housing support equipment, a paved area surrounding the building, several out-buildings, and drainage channels.

The Building 4143 superstructure was a low-air-leakage building with ventilation and exhaust systems designed to control leakage and air flow paths. The interior of the building was maintained at a lower pressure than the exterior, so that air would flow into the building. This was designed to prevent radioactive particulates from escaping. The SRE was equipped with three independent radioactive exhaust systems. Two identical units were mounted on the roof and exhausted air from the high-bay area. A separate single exhaust system for the hot cells was located west of the high bay. Exhaust filters were installed to trap particulates (including radioactive particulates) generated during reactor operations. No information was found about their effectiveness or filter changeout frequency. The reactor and components containing radioactive materials were enclosed in below-grade vaults and galleries sealed from the outside atmosphere.[1] A floor plan is presented in Figure 2.1.3b. A 1962 photograph is presented in Figure 2.1.3c.

The reactor core was enclosed in a stainless steel cylindrical core tank, which was contained within two steel enclosures forming the outer tank and the core cavity liner. A helium cover gas blanket filled the space between the sodium and the top shield. The primary radioactive sodium system piping and equipment external to the reactor were contained within two galleries, one for the main loop and one for the auxiliary loop, and within three vaults for the primary drain pump, primary sodium service system, and primary storage tank, respectively. These were located at the northeast corner of Building 4143. Large shield blocks made from a minimum of 4.25-foot thick dense concrete were placed over the vaults and galleries.[1]

A total of 99 storage cells were constructed for the storage of irradiated core elements. These cells were arranged in a 6 by 16 array and were imbedded in concrete on 1-foot centers. Each cell comprised a carbon steel tube about 25 feet in length with a 4-inch minimum internal diameter and a wall thickness of 0.25 inch. The tube was closed except at the upper end where a gas seal and biological shielding were provided. A total of 79 tubes were attached to kerosene cooling lines. A helium atmosphere was supplied to the storage cells. Three moderator storage cells were constructed for the handling or storage of moderator or reflector cans. These were approximately 22 feet long and 20 inches in diameter, with a 0.5-inch wall thickness.[1]
Two hot cells were used to inspect or modify irradiated core elements remotely and to can fuel clusters for transfer to shielded transport casks. Access to each cell interior was through heavily shielded doors. All operations in the cellswere performed with manipulators and remotely operated equipment. The cell interiors were designed to; be maintained at negative pressure of -0.5-inch water pressure.[1]

[1] Rockwell International, *Sodium Reactor Experiment Decommissioning Final Report*, ESG-DOE-13403, August 15, 1983, pp. 1-3, 7-15, 162.
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.

The building ventilation system was designed and operated to move air toward potentially contaminated rooms and areas. Makeup air was brought in from the outside and combined with recirculated air within the administration areas with the purpose of maintaining positive pressure relative to the contaminated areas. Fresh air at the rate of five air changes per hour was supplied to the reactor room by independent supply fans. Exhaust fans and high-efficiency filters on the reactor room roof were designed to control the reactor room pressure below all contiguous regions, which included the administration areas, the hot cell, and the outdoors. The pipe and equipment vaults were maintained in an atmosphere of dry nitrogen from the recirculating nitrogen cooling system. They were designed to exclude air from the vaults and thereby avoid sodium-oxygen reactions in the event of a sodium leak. Blowers with exhausts to the dilution stack were also designed to maintain a negative pressure in the SRE hot cells. Per AI's design, the hot cell personnel area was designed to maintain a positive pressure relative to both the hot cell chambers and the reactor room. According to AI, air from the hot cell chambers was filtered before it left the cell and was filtered for a second time by the radioactive vent system filter banks, prior to dilution in the stack.[1] No information was found about air monitoring results at the stack.

The SRE reactor core was a matrix of moderator elements containing the fuel elements, control rods, neutron source, and instruments for measuring temperature and sodium level. Because the SRE was an experimental reactor, the core geometry changed as test elements changed. Of the 119 moderator elements in the core, 86 were hexagonal shaped and clad with Zircaloy-2. Stainless-steel clad graphite logs were inserted in spaces at the core reflector periphery. There were 57 process channels, 33 of which contained 6-foot-long fuel elements, 15 contained instrument devices, and 1 contained a neutron source. The main and auxiliary sodium coolant inlet lines and the moderator coolant inlet line were brought through the core tank wall and the core tank liner at an elevation slightly above the top of the moderator elements. The coolant inlet lines were routed down to their respective inlet plenums through holes in the outer ring of moderator elements.[1]

The thermal shield was located between the core tank wall and the outer tank. A structure of concentric rings above the bottom of the cavity liner supported the outer tank. The volume between the outer tank and the cavity liner was filled with block thermal insulation. Outside the cavity liner was a high-density concrete biological shield. Overheating of the shield was controlled by cooling coils attached to the exterior of the cavity liner through which kerosene from the kerosene cooling system was pumped. The cavity liner extended upward to the reactor floor.[1]

There were two complete circuits in the reactor coolant system. The main circuit consisted of a primary and secondary loop. Included in the primary loop were an intermediate heat exchanger, a free-surface mechanical pump, an electromagnetic brake, a valve flow controller, instrumentation, controls, and sodium service connections. In the secondary loop, the main secondary pump and expansion tank were integrated into a single unit and were located in the cold area of the system. The expansion tank provided space for sodium volume changes and a free surface for the release of entrained gas. Sodium was pumped through the main intermediate heat exchanger where it was heated and then passed to the Edison Plant steam generator, where thermal energy was used to produce steam. The sodium exited from the steam generator and

[1] Rockwell International, *Sodium Reactor Experiment Decommissioning Final Report*, ESG-DOE-13403, August 15, 1983, pp. 1-3, 7-15.

passed through an electromagnetic brake prior to returning to the main secondary pump and expansion tank.[1]

The major portion of the radioactive liquid and gas system was located on the hillside north of Building 4143. This area was designated as Building 4653 (discussed later in this section).[2] In March 1964, in preparation for a power expansion program (PEP) at the SRE, a new radioactive liquid waste storage system was installed outside the north end of the SRE building. The system comprised one used tank (T-1) and two new storage tanks (T-2 and T-3). T-1 was a 150-gallon tank. T-2 was a 350-gallon tank installed alongside T-1 in the sump pit 40 feet below ground level. T-3 was a 3,200-gallon tank installed at ground level. The radioactive liquid waste and vent system are presented in Figure 2.1.3d, the Hot Cells in Figure 2.1.3e, and a photograph of rod removal is presented in Figure 2.1.3f.

Former Use(s): Building 4143 housed a high-temperature reactor with a slightly enriched uranium metal fuel (Core I) and sodium-cooled, hexagonal zirconium clad graphite moderator elements. After an accident in 1959, the enriched uranium fuel was replaced with a 93 percent uranium-thorium metal alloy fuel (Core II). The SRE was developed to demonstrate a sodium-cooled, graphite–moderated reactor for civilian use. The reactor reached full power in May 1958 and provided 37 gigawatt hours of power to the Southern California Edison Company (SCE) grid before it was shut down. The SRE did not operate as a nuclear plant after February 15, 1964. Between May 1965 and September 1967, Building 4143 was used for the SRE PEP program. AI operated the main primary sodium system for 4,386 hours at 700 °F and 13,196 hours at 350 °F. The objective of this program was to raise the sodium operating temperatures to 1,200 °F and thermal power levels to 30 MW with a stainless-steel-clad uranium carbide fuel loading. In September 1967, the primary sodium system was shut down and the sodium was drained into the primary fill tank while the secondary sodium was drained into drums. AI's deactivation plan involved a "stored-in-place" configuration, but nonessential equipment was removed and the steam generator and uncontaminated support facilities were not maintained. AI completed deactivation activities in 1968. Decommissioning began in 1974 with the objective of removing all significant radioactivity from the site and releasing the facility for unrestricted use. Rockwell decided to retain the SRE building superstructure, primarily to provide containment for airborne contamination released by the decontamination operations. Rockwell made arrangements for the collection, packaging, and burial of radioactive waste, first at Beatty, Nevada, and later at Hanford, Washington.[3, 4] After decontamination activities were completed, Building 4143 was used for ETEC component storage. Figure 2.1.3g is a photograph of reactor core removal taken in 1977.

Information from Interviewees: In 2010 and 2011, a number of former workers were interviewed about their experiences at the SSFL. Several remembered the SRE. Excerpts from their comments are presented below.

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[1] Ureda, B. and Heine, W., *Facilities Dismantling Plan for SRE*, Atomics International Report No. FDP-704-990-003, June 26, 1975, pp. 15-18.
[2] Gallegos, A. N., *Disposal of Radioactive Waste Systems at Building 653 and Building 143*, Rockwell International Report No. N704-DWP-990-054, April 7, 1977, p. 3.
[3] Ureda, B. and Heine, W., *Facilities Dismantling Plan for SRE*, Atomics International Report No. FDP-704-990-003, June 26, 1975, pp. 9, 13, 17-18.
[4] Rockwell International, *Sodium Reactor Experiment Decommissioning Final Report*, ESG-DOE-13403, August 15, 1983, pp. I-15.

- "The SRE was a 20 megawatt thermal sodium cooled, graphite moderated thermal nuclear facility. The plant was built as a "proof of principle" experiment and as a fuel test bed. Various fuel combinations and configurations were tested. The experimental fuel elements were loaded, the reactor started up and operated to expose the fuel to a pre-determined neutron exposure. The reactor was then shut down, the experimental fuel elements were extracted, transported to the fuel wash cell, sprayed with water to remove residual sodium, transported to the hot cell, disassembled, and examined. The original plant design provided for the heat to be removed by an air cooled heat exchanger. SCE installed a steam/electric generating plant, about 6.7 megawatt electric, to utilize our waste heat. As you can imagine, the SCE operators were not pleased with our intermittent operation. Their objective was to generate electricity; our primary objective was to evaluate fuel technology."[1] This former employee worked at the SSFL from 1955.

- "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. 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...SRE personnel were not evacuated from Building 4143 during the melting accident or at any other time except for one practice drill. The cost recovery was $1.25 million 1959 dollars and required 15 months for repairs and modifications. At one point during cleanup after the accident, the Group Leader required all SRE personnel including supervisors and him 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."[2] This former employee worked at the SSFL between 1958 and 1968.

- "I have read accounts of what happened at the 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

[1] Interview No. 206 of former worker conducted by the DOE, September 2010.
[2] Interview No. 300 of former worker conducted by the DOE and EPA on July 16, 2010, p. 3.

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. 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."[1] This former employee worked at the SSFL between 1955 and 1966.

- "I am aware of the incident at the SRE that occurred in about 1959, which has been mischaracterized in the community. It was a fuel element failure, not a meltdown."[2] This former employee worked at the SSFL between 1952 and 1957.

- "We did have a partial meltdown in the reactor when I was working there. It wasn't a full meltdown, but some of the fuel elements melted. We spent a lot of time looking at the core. We corrected the problems and put the reactor back into service."[3] This former employee worked at the SSFL from 1957 until 1999.

- "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."[4] This former employee worked at other nuclear facilities and visited the SSFL, but did not work there.

- "I don't think there was a cover-up at the 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...It was an annual meeting of East Coast utilities. There were 1,500 to 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

[1] Interview No. 2 of former employee conducted by the EPA only, September 2010.
[2] Interview No. 45 of former employee conducted by the DOE and EPA, September 2010.
[3] Interview No. 63 of former worker conducted by the DOE, September 2010.
[4] Interview No. 8 of former employee conducted by the DOE and EPA, September 2010.

trying to hide anything, especially not AI or DOE."[1] This former employee worked at the SSFL from 1957.

- "In 1959 I was hired as a trainee operator and mechanic at the SRE, as referred by a family friend, who also was my supervisor. I worked there approximately one year, and it was during that time there that the fuel element failure occurred. I was on site 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.

  All my training was on the job. I don't recall any specific training courses or training meetings, but I was working towards becoming a certified operator on the reactor, which was not accomplished due to the layoff. I was quite fortunate in that the person who hired me took care to make certain I was involved in safe activities. I don't remember any safety meetings, but my coworkers were aware of safety issues and passed along those concerns to me.

  I wore cotton coveralls and cotton gloves to work in, and on several occasions had to wear a respirator. I wore a film badge, but shortly into the clean up, AI took the film badges back. The levels of radiation were high enough that the badges would have shown high exposure, resulting in people having to cool off and not get any work done. The employees were willing to accept the risk in working in those risky conditions to maintain their job, and to hopefully get the SRE back running so that everyone could continue working. Safety was a concern, but it was overlooked in this instance. Some areas were so hot that it was off the Geiger counter, and those areas were roped off.

  My cleanup activities went from approximately July to November, and I was involved with cleaning up various levels of contamination. I remember lying on the floor on plastic working on some of the reactor repairs. We used buffing machines on the floor as well as sponges and mops, also on the walls, but determined those efforts moved the contamination around more than clean it up, so we went to use Kotexes. Those were used to wipe and then discard. All items that were used in the clean up, as well as contaminated items, were stored outside in back of the SRE. It was there when I was laid off, so I am unaware of how it was eventually disposed. All the office equipment and supplies ended up there as well.

  We used chemicals in the cleanup process, such as various cleaning agents purchased at the store, acetone, paint thinner, etc. We experimented with TCE to see if that would be effective in the radiation cleanup. There was a lot of TCE on site as it was used to flush out the rocket motors after Rocketdyne did testing."[2]

  This interviewee also provided additional details about specific events that occurred during his tenure at the site and, specifically, during the sequence of events that took place during the SRE incident. These details are as follows:

  "On July 13th, the SRE Reactor had a power esscursion about 6:30 pm. The reactor started escalating in temperature so fast, it was with in seconds of going critical and blowing up. To stop the reactor from going critical they had too release all the cover gas from the reactor core very quickly to stop it. The cover gas from the reactor core was

[1] Interview No. 296 of former worker conducted by the DOE, September 2010.
[2] Interview No. 207 of former worker conducted by the EPA, only, September 2010.

highly radio active. At the time of the release of the cover gas, the wind was blowing toward the San Fernando Valley, and Los Angles, California.

I came to work on July, 14th on the graveyard shift 12:00am just a few hours after the power esscursion (meltdown) had happened. When I arrived at work I found my shift supervisor talking with the shift supervisor of the previous shift and his workers. What made it different this time was other men standing around in their suits and ties of the higher level of supervision, I knew something was wrong; these men were never there at this time of the night, or morning. Seeing the looks on the men's faces and hearing what they were talking about and the fear and emotion in their talk, it was not good.

After standing there listening; they noticed me standing there and put me to work masking, or taping up the cracks around the doors and windows that led to the High bay area where the reactor was housed to help keep out the radioactive contamination from the reactor control room where everyone was standing. While I was taping, I over heard them talk about which way the wind was blowing and how the wind had blown the Radiation over their own personal homes and family. They lived in the San Fernando Valley. I thought to my self how lucky I was, because I lived in Moorpark, the opposite direction.

Over the next few weeks after the accident they started up and shut down the reactor trying to see what had caused the reactor to over heat and the cause of the nuclear accident. They would run the reactor for a short time at a low level watching gauges and charts then shut it down and release more cover gas each time they shut it down. This cover gas would be released on the graveyard shift when the wind was blowing toward the Ocean and Ventura County; this was direction they preferred to release the cover gas because of the smaller population.

In the mean time the High Bay area where the reactor was housed was getting more contaminated. At times the contamination got so high it was off the scale of measurement. Finally after almost 2 weeks of starting and stopping the reactor, they settled on the idea that tetraline had leaked into the Sodium line through the seals on the Sodium pump. On the last run of the reactor on July 26th they almost did not get the reactor shut down because of the damage to the fuel rods and had to release the cover gas once again most likely toward Ventura County, the direction they preferred. The reason I know this; one of my duties on my work shift was to check the weather station to see which way the wind was blowing before they made a release. I am sure all the other 3 shifts followed the same rule.

Onee the reactor was shut down, plans were made to inspect the reactor to see what damage occurred to the reactor; and see if it could be repaired. At this time everyone wondered how long our job would last with the reactor broken. Remember this was all new to everyone; no one had experienced a reactor power excursion. This was a reactor operator's worst night mare; to have a power excursion (nuclear accident); No one knew where to start. No one had ever cleaned a large contaminated building. Everything we did from this time forward was a new experience. We were willing to try what we need to do to save our jobs.

It was decided to clean up as much radioactive contamination that we could in the High Bay area that housed the reactor. We started at a door leading into theHigh Bay area trying to clean up the contamination with out much success. The normal ways of cleaning did not work for cleaning up radio active contamination. Soap & water and

mops, sponges did not work; all, it did was spread it around and make it worse, and contaminated all the cleaning equipment, and had to be thrown away out in the trash pile out behind the building. They even tried floor scrubbers and all it did was contaminate them where they had to be thrown out in the trash pile. They finally came up with the idea of using feminine sanitary napkins (Kotex) and chemicals. We used chemicals and Kotex to dab and absorb up the contamination small areas at a time. This was a hands and knee job, and took time. To keep from re-contaminating the area that we cleaned we put a number of layers of clear plastic sheeting over those areas. So if the plastic got contaminated we could remove it and replace it to save time.

After a few days and 3 shifts working on the cleanup we finally reached the reactor so we could start working on removing the fuel rods to see what damage had occurred. We started on the outside or far side of the reactor where we felt that no damage fuel rods would be found. The first fuel rods came out quickly. The closer we got to the fuel rods we felt were damaged they become harder to remove. We had to pull and wiggle them to break them free. We used the fuel transporter (we called it the coffin) to remove the fuel rods. The last 13 fuel rods took a number of days to remove with using 3 shifts (worked 24-7). We finally got down to the last two fuel rods in the reactor; they were the ones that got the hottest. They were stuck solid and would not move. So this took a number of shifts working on them to try to get them free. When they finally got one of the fuel rods to free up a little on another shift than mine; while pulling on it, it broke off in the reactor core. The upper half of the broken fuel rod came up inside the fuel rod transporter; as it came up the operator saw that it was broken and panicked; wanting to stop it; he pushed the wrong button and lifted the lead safety protection shield up off the reactor face and exposed the High Bay area, and the complete building with radioactive contamination from the reactor core. When he seen what he had done, he panicked again, and ran and sounded the alarm for every one to get out of the building. Luckily it was on a night shift and not many people in the building. Once they were all outside and knowing the lead safety shield was still up and releasing radiation out of the reactor one of them volunteered and went back inside to push the button to put the shield down. By that time enough radiation had been released from out of the reactor core that it contaminated the whole building and they had to block off roads leading to the SRE building in about a mile radius. One road was blocked at the Fire station. I was called by my shift supervisor not to come into work. I was off work for about 2 weeks before I could go back.

When I returned to work I found all the office furniture, filing cabinets full of records and desk draws full of files and personal things in a pile out back of the building in a large pile about 15 feet high on top of all the other contaminated trash that had been thrown there from previous other clean ups.

They had brought people in to clean up the office area while I was gone. Also in the pile of trash there were about 50 floor scrubbers that were contaminated from cleaning the office and control room areas. The office area was never cleaned to a point that it was safe to be used again. No one used the office area because of all the contamination that was continually in the building; they were still vacant when I left in November 1959. Many records were lost during that time, and records were not keep that well from that time forward because of the reactor no longer running. All thought was placed on how do we save the reactor and get it up and running.

All the men that were running experimental tests at the SRE reactor prior to July 26th were now in the repair mode, and records were not kept like they had before the nuclear accident on July 13th.

Note: About this time they decided to start draining the reactor core and the sodium lines (the main hot loop of Sodium) to make it safer and easier to work on the reactor. They pumped the sodium into 55 gal drums. Once they were full they would haul them out to the "Pond" and dump them in the Pond. Then they took a 22 rifle and shot holes in the drums so they would catch fire and burn up the radioactive sodium to dispose of it; this was done on the graveyard shift. I did take part in it; I was always left behind at the SRE reactor building to keep an eye on things there until they returned. I was never out to the Pond I did not know where it was at. I would see them leave in a pick-up truck with two 55 galdrums sodium in the back. They went up the road in front of the building that went up hill. I thought to my self it would be terrible if on of those drums fell off going up the hill. On my shift they all stayed on, with no accidents.

After we got the Sodium level down in the reactor we were able to see better, had a better view of the last fuel rod. They used the TV camera from the newer fuel rod transporter; it was on the end of a long cord/cable. The TV camera was small enough to fit down into the reactor core in the hole /channel of the first broken off fuel rod Also a drop light was placed down the same hole. (the one that contaminated the whole building) This channel/hole did not have a plug in it. They put two lead blocks over the hole and some sand bags. So all they had to do was move them off the hole and place the small drop light and the TV camera down the hole. With the Sodium level down they were able to get the TV camera just above the level of the sodium. Note they had to leave some sodium in the core until they removed the last fuel rod. They had to keep the sodium hot so it would help in removing the last fuel rod.

Note: before using the TV camera we used a mirror to look into to look down into the reactor core with a droplight. Then we got the idea of using the TV camera. The bad idea of using the TV camera it got it highly contaminated. This is why we used a mirror at first. This was dangerous looking down into the reactor viewing off the mirror, with an open hole in the reactor. That is where the lead blocks came in handy again; where we were able to move them off the hole and put them back on again. After the inspection with the mirror, we had to clean up more contamination. This is why we laid a number of layers of clear plastic down on the floor so it could be removed quickly and take the contaminated plastic outside and dump it in dump pile behind the building. And lay new plastic down. It saved a lot of scrubbing. This was my job; and I would get contaminated from removing all this plastic. .

So with the ability to have an open hole / channel in the reactor core; things got contaminated once again. With the TV camera and drop light in the hole they were not able to seal it up that well. They used the lead blocks the best they could and the sandbags on top of them. The sand bags did not keep the radiation in the core as well as what they had hoped for. So, all of us men were exposed to radiation directly out of the reactor core while we worked around the reactor. It came time to start removing the last fuel rod. The TV camera and drop light were removed and the lead blocks were place over the hole, with no sandbags; they sit to high for the fuel transporter to go over the top of them. Once we got over the top of the reactor and lined up with the last fuel rod to be removed and let the lead safety shield down we were ready to remove the last fuel rod.

We started pulling the last fuel rod out of the reactor. It was the hardest of all the fuel rods to pull out. We spent many shifts trying to remove this fuel rod and about to give up when it broke off in the reactor like the previous one. This time when it broke off, the upper part got wedged in the reactor core and they were not able to get it to go up, or down. There they were stuck on top of the reactor not able to remove this fuel rod. I was there at the time; it happened on my shift. They worked on it for most of the shift to try to un-stick the broken fuel rod. It was such a problem they decided to lift the lead shield a little bit to try to see under the lead shield to see if they could see why it was stuck. There were three men working on it while I was in the control room watching. With the lead shield up about two inches one man laid on the floor with flashlight looking under neath while another man at the controls tried lifting up and down and wiggling the fuel rod transporter back and forth. It looked very dangerous so I got the Polaroid camera that was in the control room, and took a picture through the control room window of all three of them working on trying to free this fuel rod. Two of them were wearing a gas mask, and the one laying on the floor was not because it got in his way to see. So he was exposed the radioactive contamination coming out of the reactor core with out a gas mask. I also took another picture from in the High Bay area where I should not have been because of the contamination. I felt I needed to record what was going on and did it anyway very quickly. I have those pictures this day, after 50 years.

They did finally get the fuel rod out of the reactor after some time and a lot of exposure of radiation to them selves. It also re-contaminated the High Bay area once again and it had to be cleaned up. This was my job cleaning up radioactive contamination, and was exposed to a lot of it; and exposed to a lot of chemicals in cleaning it up.

Now they had the last broken upper part of the fuel rod out of the reactor, leaving the bottom half in the reactor core. There we were with the bottom half of two broken fuel rods left in the reactor core. These two broken fuel rod ends still needed to be removed. At this time we were in a predicament; we had both fuel rod transporters, with broken fuel rods stuck in them and they could no longer be used. They tried to remove the broken fuel rods from the fuel rod transporters without success, and were exposed to more radiation trying to dislodge them.

Note: the reason we were able to be exposed to so much radiation is that our film badges were taken away from us and put into the safe. This is why our dose count on all of us employees was very low; for this reason I am speaking up for me, and all the other employees I worked with. The dose count that Atomics International has for all of us is incorrect; because we were not wearing film badges (after July 26th) through the dangerous times I have described.

They now had to come up with an idea how to remove the two broken and stuck fuel rod ends that was left in the reactor core. These two fuel rod holes / channels had two lead blocks laid over them to keep the radiation from coming out of the reactor core. They were not able to plug them properly because of the broken fuel rods stuck in the fuel rod transporter. This came in handy once they decided to try removing the broken fuel rod ends still in the reactor. With removing the lead blocks they could look down into the reactor with a TV camera that was taken off the newer fuel rod transporter. It had a long cord on it and the camera was small enough to fit down in the fuel rod hole /channel. They were able to put a small drop light down the other hole/channel by removing the

lead blocks too. So there we were two open holes in the reactor looking down into the reactor core.

Note: before the TV camera was used they took a mirror off the bathroom wall and use it to look down into the reactor core and found that it did not work that well; and got the idea of using the TV camera.

After inspecting the two broken fuel rods; they came up with the idea of making a tool from a pair of vice grips to reach down into the reactor core to grab a hold of the broken fuel rod. Once they got a hold of it they used a cherry picker, (small crane) to pull it out. It took some time to do this; between getting a hold of the broken fuel rod with the tool they made, and working the stuck fuel rod loose. This exposed the workers again with radioactive contamination from out of the core of the reactor, plus re-contaminating The High Bay area again. It took a number of shifts and days, to be able to free and remove both of the stuck fuel rod ends in the reactor core. This was one of the most dangerous jobs we did repairing the reactor. There was a lot exposure to radiation coming out of the reactor core while the two broken fuel rods were being removed.

Once the broken fuel rods were free they left them loose in the reactor core until they could figure out what they were going to do with them, when they pulled them out. They came up with the idea to bring in a lead lined cask with a fork lift to put them in. So the men practiced for a number of days on how they would go about getting them out of the reactor core and into the lead lined cask.

Note: I watch them practice with large metal tongs that they would use to pick up the radiated fuel rod end once they got it out of the reactor core onto the floor. They practiced with a piece of pipe about the size of the fuel rod. It was my job to time them as they practiced.

I was there when they pulled the first broken fuel rod end out. I watched them from the control room. They took the Cherry picker as planed and lifted it out onto the floor and grabbed the large metal tongs, one at each end and tossed it into the cask and shut the lid in record time. This is one more time where the men were exposed to a large amounts of radiation handling this hot fuel rod end. It also contaminated the High Bay area one more time and needed to be cleaned up.

Note: While the men were using this cherry picker to pull the stuck fuel rod ends the company started building the large equipment you can see in the 1959 SRE Training film that was used to remove all the small pieces of fuel rod out of the bottom the reactor core. While this equipment was being built; we had to use improper tools in removing these stuck fuel rods and getting exposed to a lot of radiation in doing it.

Now it comes time to remove the second broken fuel rod end out of the reactor core; this was done by another crew; I was not there at the time. I was there on the next shift. These men did the same thing as we did in removing the broken fuel rod end, but they accidentally dropped theirs on the floor and it broke into pieces and made it difficult to pick up; to put it in the lead lined cask. So it took them longer with more exposure time of radiation; they never did get it all cleaned up. I was on the next shift to come in and I helped in finish cleaning up the small pieces and put them in the cask. So I and another man were exposed to the contamination that was left behind. We also had to remove the plastic sheeting on the floor that was contaminated and put down new plastic sheeting. The plastic sheeting was thrown out into the trash pile.

Note: We had plastic sheeting on the floor in the High Bay area so we could clean up contamination easier than all the scrubbing. We had a number of layers down and we would put more layers down when they were removed. All this plastic sheeting was thrown out in the back of the build in the contaminated trash pile that was about 15 feet high and about 75 to 100 feet long and 25 feetdeep. This is the same trash pile all the office furniture and filing cabinets were in. It was a big mess.

After all the removal of all the fuel rods in the reactor, and a lot of radiation exposure. It was now decided that all the small broken pieces of fuel rod now needed to be removed from the bottom of the reactor core. The new equipment that they had been building would be used to help remove those broken pieces.

Now they had to finish draining the rest of the sodium out of the reactor core and the main loop so they could see all the small fuel rod pieces in the bottom of the reactor. They brought in a pump truck to finish draining the last of the sodium out of the reactor core and main loop to speed things up. It took to long to pump it into 55 gal drums and hauling it out to the Pond. While the sodium was being drained. We cleaned up the High Bay area and tools were made to look down inside the reactor. They made a scope that would attach to the top of the reactor and go down inside of the reactor for inspection. (These scopes are seen in the Training film being used)

While they were finishing up this new equipment, we still had to use crude equipment to gather up the small pieces of fuel rod into piles in the bottom of the reactor core. They made grappling hooks, and other types of tools out of vice grip's, to reach down into the reactor core through the two open holes in the reactor to reach the small pieces and place them into piles in the bottom of the reactor core. This was done by making a scope to see down into the reactor core, and also using a TV camera. They had to put a drop light also down into the reactor core to light it up to see what they were doing. With a drop light down into the reactor through a fuel rod hole/channel and installing the grappling hooks and scope to see with; this give the men more exposure to radio active contamination from out of the reactor core. The men were on top of the reactor for long periods of time while gathering up all the small pieces, and being exposed to radio active contamination.

Note: you can learn about this by watching the 1959 SRE Reactor Training Film, that was made showing the tools they used and scope to gather up the broken pieces in the bottom of the reactor core. When they first came up with the Idea before making the film; experimentation was used to figure out how to make the tools and try them out. While doing this the men were exposed to more radiation from the reactor core while they worked through the two open holes in the reactor. This period of time is not shown the training film, and not recorded.

Finally the reactor core was fully drained of sodium and small pieces of fuel rod parts were gathered up in piles in the reactor core. They decided to see if they could remove the broken sodium pump that had caused the reactor to have a power excursion, or meltdown. It was not an easy job to do. With it pumping sodium any residue of sodium left in the pump, or piping could catch fire, or could have an explosion. Then you have the radiation that would come from the reactor core, piping and the broken pump.

The pump was down in the floor, under a grading that could be removed. They devised a tent over the area where the pump was by using scaffolding and wrapping it with clear plastic sheeting to make the tent. Then they put a cover gas in the tent to remove all the air so the sodium would not catch fire, or explode. They had one of the men go down in

the hole to unbolt and remove the sodium pump. With the gas in the hole the man wore an oxygen mask so he could breath. This hole was a very contaminated area with radiation and asbestoses, because it had not been cleaned. It would have been very difficult area to clean because of the piping in the hole. So the man was exposed to more radioactive contamination and asbestoses. The pump was only about 3 feet from the reactor core.

Note: When the sodium pump was removed this was on my work shift. I was there helping and was exposed the radioactive contamination along with the other men.

When the man got the pump unbolted and came out of the tented area it allowed air to get into the tented area and caused an explosion and fire. The man just got out of the tented area about a foot or two and it exploded; we other men were about 6 to 10 feet away. We thought we were dead when it happened, but we were lucky and did not get hurt some how. The man that stepped out of the tent his cover-alls were singed but was ok. We had a big fire for a short time and it settled down. This fire was about 3 feet from the reactor core. About the time it had settled down a fireman came running through the door into the high bay area with a fire extinguisher in his hand to help put out the fire. We yelled at him to get out because the high levels of radioactive contamination. He also had the wrong fire extinguisher; it was water filled. If he would have used it on the fire he could have blown up the building. Water and Sodium you do not mix, the two together it will cause an explosion. Luckily the fire did burn out.

Note: we all had to take a shower that night before we went home to remove the radioactive contamination that had gotten all over us from the explosion. Luckily I had some extra cloths to wear home I keep in a locker.

Note: we were not wearing any type of breathing mask, and our lungs were exposed to all that radioactive contamination. Plus all the asbestoses that blew out of that hole.

The next day or two we worked on installing the new pump. They brought in a film crew to start taking pictures of us. They could only stay for a short time and would have to leave because of the radiation. They took a picture of me working on the new pump putting a coat of sealer over the asbestoses that had been placed over the new pump and piping that went into the reactor core. The sealer was to help the asbestos from flaking off.

Now comes the time they start bringing in the big new equipment that they had been working on to remove the small pieces in the bottom of the reactor core. They first brought in a large spoke wheel looking thing that would attach to the top cover of the reactor, so they could lift it enough to rotate the top cover of the reactor. To do this they had to cut, break the seal all around the top cover that prevented the radiation from coming out of the reactor core. They had to cut this seal while lifting up on the top cover face of the reactor, with a large overhead crane. It was difficult to do with the top cover weighing over 60 tons. Once the seal was cut and broken, we started rotating the top cover. It took about 12 men to rotate the top cover with two come-a-longs and the other men pushing. In the mean time while these men along with me were getting exposed again with radiation on of the reactor core with the broken seal allowing it to escape. The top cover had to be raised about a two inch`s so we could turn it. A 60 ton top cover was not easy to turn; it took a while to break the seal and get it to turn.

Note: you can see all this in the 1959 SRE Reactor Training Film; a group of men all around a large spooked wheel pushing. I am there with them. I was helping on the come-a long with another man helping. This was dangerous with the exposure of radioactive contamination coming out of the broken seal around the reactor top cover. This is where everyone helping had their feet right over this broken seal.

The reason for rotating the top cover was to align the large plug in the top cover with the pile of small broken pieces in the bottom of the reactor core. Once it was aligned where they wanted it, they removed the large spoke wheel and brought in the other large equipment they had built to remove the small broken pieces in the bottom of the reactor core; this equipment was very large. Once they got the new equipment attached to the top of the reactor cover they started removing the small pieces from the reactor core.

Note: this can be seen in the 1959 SRE Reactor training film. I was there in the film helping on removing the small pieces. The equipment worked quite well and safe to use.

Once all the small pieces were removed from the reactor core; this was about the last week of October, or the first week of November 1959. Now it was the matter of putting the reactor back together and cleaning up all the radioactive contamination. Fill the reactor core with new sodium and install new fuel rods back into the reactor. To do this they would have to remove the broken fuel rods in the fuel transporters or have to bring in new ones. At this time they were not sure what they would do next. They had been through a lot in dismantling the reactor over the past 4 months, with large expenses in building new equipment and manpower; and the reactor was still not up and running. They had done the impossible, with more to go to get it up and running.

My last day working for Atomics International was November 9th 1959." This former employee worked at the SSFL between 1959 and 1960.

- "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…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…Once this was done we could heat the vessel to 230 degrees Fahrenheit (°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. I worked on the dismantling the SRE from 1975 to 1980...Originally, we were supposed to save the SRE building. It was going to be used as a building for the Saturn rocket. 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 when the pond got too full."[1] This former employee worked at the SSFL between 1957and 1989.

- "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 boxes, 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."[2] This former employee worked at the SSFL between 1976 and 1982.

- "Back to the SRE building. The testing verified to our complete satisfaction and to those overseeing the project that we had met all requirements for unrestricted use of the building. We began to refurbish the building for the test program. One day while driving from the DeSoto facility, the Program Manager and I noticed road construction at the northwest corner of Topanga Canyon Boulevard and Plummer Street, where the hill that used to be there was being carved up. We talked with the construction supervisor there and asked where they were transporting the dirt to, and lo and behold it was a long way away. It was mutually beneficial for them to bring that dirt up to the SRE to use as fill in the basement that had already been excavated. We wouldn't let them dump any rocks larger than 10 inches in diameter, so they broke them up rather than take the dirt back down the hill. The quality engineer rejected 3 or 4 of the loads because they had rocks in them that were too big. Then the Fast Flux Test Facility program was cancelled and funding for the steam generator program was terminated."[3] This former employee did not state when he worked at the SSFL.

Radiological Incident Reports: There have been several incidents associated with Building 4143 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 4143 Incident Report Summary

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A0374	6/13/1958	SRE HIGH BAY		EMPLOYEE DID NOT WEAR PRESCRIBED RESPIRATORY PROTECTION.
A0478	2/6/1959	SRE HIGH BAY	MFP	TWO EMPLOYEES HANDLED CONTAMINATED EQUIPMENT WITH OUT PROPER USE OF PROTECTIVE GLOVES.
A0315	6/4/1959 - 6/5/1959	WASH CELL	MFP	EXPLOSION BLEW FUEL ELEMENT UNDERGOING SODIUM CLEANING OUT OF THE WASH CELL.

[1] Interview No. 254 of former employee conducted by the DOE and EPA, September 2010.
[2] Interview No. 78 for former employee conducted by the DOE and EPA, September 2010.
[3] Interview No. 30 of former employee conducted by the DOE and EPA, September 2010.

Building 4143 Incident Report Summary (continued)

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A0274 **(MAJOR INCIDENT)**	7/12/1959 - 5/21/1960	REACTOR CORE	MFP	SRE FUEL ELEMENT DAMAGE
A0351	9/10/1959	R/A STORAGE	MFP	EMPLOYEES ENTERED CONTROLLED AREA WITHOUT APPROPRIATE AUTHORITY.
A0390	11/21/1959	SRE HIGH BAY	MFP	EMPLOYEE CONTAMINTATED DURING MODIFICATION OF SRE CORE RECOVERY TOOL.
A0548	12/7/1959	SRE HIGH BAY		EMPLOYEE ENTERED CONTROLLED AREA WITH OUT PRESCRIBED PROTECTIVE CLOTHING.
A0391	12/18/1959	SRE HOT CELL	MFP	EMPLOYEE ENTERED CONTROLLED AREA W/O REQUIRED HOOD AND EXITED W/O A SURVEY.
A0510	4/11/1960	SRE HIGH BAY	MFP	LEAKAGE AROUND VIEWING GLASS CAUSED CONTAMINATION OF EMPLOYEE.
A0394	5/15/1960	SRE HIGH BAY	MFP	SRE SODIUM FIRE IN THE HIGHBAY.
A0393	5/25/1960	SRE HIGH BAY	MFP	EMPLOYEE CONTAMINATED BY CORE COVER GAS EXCAPING DURING CORESCOPE REMOVAL.
A0460 Incident report missing	6/2/1960	SRE HIGH BAY	MFP	MAN SLIGHTLY INJURED AND CONTAMINATED WHILE WORKING ON SRE FUEL COFFIN.
A0005	6/9/1960	SRE HIGH BAY	MFP	CORE COVER GAS LEAK CONTAMINATED EMPLOYEES.
A0442	7/7/1960	SRE HIGH BAY	MFP	REACTOR COVER GAS ESCAPED CONTAMINATING EMPLOYEE.
A0305	12/15/1960	TENT	Cs/Sr	IMPROPERLY SEALED RESPIRATOR CAUSED HIGH INTERNAL AND EXTERNAL CONTAMINATION.
A0435	5/17/1961	SRE HIGH BAY	MFP	PROTECTIVE BOOT LEAKED CONTAMINATING SHOES.
A0515	11/4/1961	SRE HIGH BAY	MFP	EMPLOYEE EXPOSED TO AIRBORNE ACTIVITY WHILE REMOVING SAMPLES IN HIGH BAY.

Building 4143 Incident Report Summary (continued)

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A0472	12/23/1961	SRE HIGH BAY	MFP	CONTROLLED AREA ENTERED W/O PROPER AUTHORITY, PROTECTION AND PROCEDURE.
A0534	2/6/1962	SRE HP OFFICE	MFP	UNAUTHORIZED EMPLOYEE USED HEALTH PHYSICS EQUIPMENT WITH FAULTY RESULTS.
A0015	4/4/1962	SRE HIGH BAY	MFP	AIRBORNE ACTIVITY IN SRE HIGH BAY.
A0373 Incident report missing	6/13/1962	SRE HIGH BAY	MFP	OPERATOR ENGULFED IN FIRE DURING TRANSFER OF CORE HEATERS.
A0404	7/30/1962	SRE WEST PAD	Sb124	SRE SOURCE TRANSFER OPERATION CAUSED EMPLOYEE EXPOSURE ABOVE GUIDELINES.
A0379	10/20/1962	SRE WEST PAD		THREE EMPLOYEES SIZE REDUCING SRE CORE HEATERS BECAME CONTAMINATED.
A0030	3/19/1964	SRE & SURFACE DRAINAGE	MFP	R/A LIQUID PUMPED ONTO GROUND AS CLEAN.
A0409	6/13/1964	SRE FHM PIT	MFP	AIRBORNE ACTIVITY IN FUEL HANDLING MACHINE PIT CONTAMINATED EMPLOYEES.
A0493	6/17/1964	SRE FHM PIT	MFP	HIGH AIRBORNE ACTIVITY IN FUEL HANDLING MACHINE SERVICE PIT CONTAMINATED TWO EMPLOYEES.
A0380	6/21/1964	SRE HIGH BAY	MFP	EMPLOYEES AND AREA CONTAMINATED FROM IMPROPER DOFFING.
A0382	9/18/1964	POOR MAN'S CELL		WORK IN THE POOR MAN'S HOT CELL CAUSED AIRBORNE EXPOSURE TO EMPLOYEES.
A0545	12/1/1964	SRE HIGH BAY	MFP	GAMMA SURVEY OF CONTROL ROD THIMBLE CONTAMINATED PROBE AND SURVEYOR.
A0371	12/18/1964	SRE HIGH BAY		SIZE REDUCTION OF REACTOR COMPONETS CAUSED EXPOSURE AND CONTAMINATION OF EMPLOYEES.

Building 4143 Incident Report Summary (continued)

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A0296	1/14/1965	SRE HIGH BAY		MOVEMENT OF TEMPERATURE PROBE CAUSED EXPOSURE IN EXCESS OF GUIDELINES.
A0386	2/20/1965	SRE HIGH BAY		CORE LIGHT REPLACEMENT CONTAMINATED EMPLOYEES WHEN R/A GAS WAS RELEASED.
A0416	2/27/1965	SRE HIGH BAY	MFP	SERVICING MODERATOR CASK RESULTED IN EMPLOYEE CONTAMINATION.
A0444	4/24/1965	SRE HIGH BAY	MFP	EMPLOYEE DRILLED THROUGH FINGER DURING OPERATION IN SRE HIGHBAY.
A0445	5/22/1965	NA PIPE GALLERY	MFP	EMPLOYEE LACERATED THUMB DURING OPERATION IN SRE HIGHBAY.
A0041	8/19/1966	TAB EXPOSURE FACILITY	MFP	PERSONNEL EXPOSED TO PRIMARY SODIUM IN TAB EXPOSURE FACILITY.
A0321	12/8/1967	MAINTENANCE CELL	MFP	R/A WATER DISCOVERED IN 8" PIPES THAT PENETRATED MAINTENANCE CELL FLOOR.
A0289	10/23/1976	SRE HIGH BAY	MFP	CORE GAS ESCAPED DURING REMOVAL OF INSTRUMENT THIMBLE.
A0059	8/1/1977	SRE HIGH BAY		THE BOTTOM OF A COLD TRAP FELL OFF DURING MOVEMENT CONTAMINATING FLOOR.
A0414	8/10/1977	SRE – WATER PIT	MFP&CP	REACTOR VESSEL SEGMENTS STORAGE PIT LEAKED WATER TO THE SOIL.
A0458 A0683	9/23/1977	SRE HIGH BAY	MFP	EMPLOYEE EXPOSED TO AIRBORNE ACTIVITY DURING D&D OPERATION.
A0578	6/24/1978	SRE		EMPLOYEE INJURED WHEN HE TRIPPED ON CULVERT.

*Isotopes are written as they are presented in the incident database. The research team believes that MFP is an acronym for mixed fission products and ACP stand for activation products.

- On June 13, 1958, three employees failed to wear the respirators recommended and supplied by the health physicist while working beneath the fuel handling coffin. The incident report notes that compliance with health physics recommendations is expected. No other information about the incident is provided (Incident Report A0374).[1]

- On February 6, 1959, two AI personnel handled contaminated equipment without the proper use of protective gloves. The men were replacing a television camera that had been used on the reactor loading face with a movie camera. After handling the television

[1] Fisher, W.L., Internal Letter, re: *Non-Compliance with Health Physics Recommendation*, June 16, 1958.

camera and its component parts, the television camera was removed. One man asked for the SRE Polaroid camera to take a picture of the camera setup. He received the Polaroid camera with contaminated gloves and when he was not able to make the camera adjustments he wanted, he removed the gloves by placing the fingers of the gloves between his teeth and withdrawing his hands. After continuing to have difficulty, both men handled the camera, one with gloves on and one without gloves. The picture was taken and the camera was returned to the SRE operations department. Both men then handled the movie camera and mounted it on the old television camera brackets. Again, one man had gloved hands and the other did not. The men then walked off the potentially contaminated plastic sheeting on the floor before removing their shoe covers. Smears of the plastic sheeting showed less than 30 dpm beta-gamma and smears of the television camera ranged from 1 to 200 dpm beta-gamma. The Polaroid camera and movie camera were not significantly contaminated. When questioned, the men stated they had used the hand and foot counter before leaving the building. No personnel contamination was found. One of the men was found to be new and had little knowledge of the hazards of radiation contamination (Incident Report A0478).[1]

- On June 4, 1959, a fuel element (R-56) was removed from the SRE reactor core for transport to Wash Cell B for sodium cleaning. The operator noted that the fuel element appeared "quite dirty." After cooling, the operator felt the fuel rod "appeared better, however, a dark material was noted near the upper part of the hanger rod, near the lower end of the hanger rod, at [the] top of [the] fuel cluster and at the lower extremity of the fuel cluster." The dark material was not definitively identified in the incident report; however, it is implied to be the hydrocarbon coolant and lubricant tetralin or one of its decomposition products.

  The fuel element was lowered into Wash Cell B by the transfer cask. A vacuum was started on the cell and wash water was pumped into the cell. When the vacuum was decreased to about 2 inches of mercury, the vent valve was opened. Some "pops" were heard, but that was typical of the sodium-water reaction that occurred in the cleaning process. At approximately 6:55 a.m., an abnormal rise in pressure occurred leading to an explosion, which blew the fuel element shield plug and hanger rod out of the wash cell and onto the reactor room floor. The fuel element cluster itself remained in the wash cell. Flames and smoke erupted from the wash cell, the radiation air monitor sounded, and the building was evacuated.

  A survey reading taken through a buckled door measured 125 mrad/h approximately 10 feet from the hanger rod. Absolute filter banks on the SRE building roof were surveyed. Results were 250 mrad/h for the west filter bank and 150 mrad/h for the east filter bank. Personnel entered the high bay to collect samples. Liquid material, presumed to be sodium hydroxide, found on the floor measured 2.5 rad/h at 6 inches. The hanger rod measured 5 rad/h at 6 inches and the core plug measured 2.5 rad/h at 6 inches. The SRE control room, mezzanine area, and health physics office were surveyed, but only minor contamination was detected and these areas were quickly decontaminated. A high volume air sample was taken in the high bay near the wash cells at 2:00 p.m. and airborne activity was found to be 3×10^{-9} $\mu Ci/cm^3$ beta-gamma.

[1] Young, C. L., Atomics International Internal Letter, re: *Potential Contamination of Personnel*, February 19, 1959.

On June 5, 1959, the core plug and hanger rod were placed into a moderator can storage well. Measurements taken at that time found the core plug to be 1 rad/h at 6 inches, the hanger rod to be 2.5 rad/h at 6 inches, and the lid of the moderator can to be 30 mrem/h at the surface. A high volume air sample was taken at 11:25 a.m. and results showed airborne activity to be 2 x 10^{-9} µCi/cm^3 beta-gamma. Decontamination and re-surveying of the high bay began.

An investigation board noted the most probable cause of the incident was a hydrogen-oxygen reaction. Oxygen from the wash cell vent pipe combined with hydrogen resulting from the sodium-water reaction that occurs in the cleaning process to create the pressure build-up and explosion. Additionally, a new wash cell procedure had just been put into place, and the "hold down" clips used to keep the fuel element components in place in the event of a pressure surge were not installed. Other areas for improvement were also noted in the incident report.

A smear survey of the high bay area found results ranging from 1,700 dpm beta-gamma near the center of the high bay to 214,000 dpm beta-gamma at the north end of the building near the wash cells. A smear survey of equipment in the high bay found contamination ranging from 719 dpm beta-gamma on an equipment panel to 469,836 dpm beta-gamma on the transfer cask vent hose. A 1961 AI report titled *SRE Fuel Element Damage: Final Report, NAA-SR-4488*, states that the maximum contamination level detected as a result of the incident was 700,000 dpm/100 cm^2 taken 24 hours after the incident and found on the fuel handling cask located 25 feet from Wash Cell B. An environmental survey of the area surrounding the SRE showed results ranging from 0.03 mrad/h northwest of the building to 0.20 mrad/h at the southwest corner of the SRE perimeter. Normal background for the survey meter was between 0.03 and 0.05 mrad/h. Soil samples collected on June 5 ranged from 9.36 x 10^{-6} µCi/g outside the Santa Susana Field Lab boundary line to 1.65 x 10^{-5} µCi/g inside the SRE perimeter fence. The June 5 soils samples were comparable to samples taken two months earlier.[1, 2, 3]

July 12, 1959 Major Incident

- On July 12, 1959, power run 14 of the SRE began, which resulted in the melting of 13 fuel elements. However, circumstances involved in the July 12, 1959 incident extended over the entire period of time from November 29, 1958 to July 26, 1959. AI reports describe the following sequence of events related to power runs 8 through 14 at the SRE (Incident Report A0274):

    - Run 8 began on November 29, 1958 after a shutdown of two months in which considerable repairs and modifications were made to the primary sodium system. During this work, the primary sodium was pumped back and forth several times between the primary loop and the primary fill tank, which was known to contain a large amount of sodium oxide. A substantial amount of oxide was thus

[1] Investigating Board, Atomics International Internal Letter, re: *SRE Wash Cell Incident of June 4, 1959*, June 19, 1959.
[2] Borg, G., *Wash Cell Incident at the Sodium Reactor Experiment, AI Memo 5155*, Atomics International, April 6, 1960.
[3] Ashley, R. L., Beeley, R. J., Fillmore, F. L., Hallett, W. J., Hayward, Jr., B. R., and Jarrett, A. A., *SRE Fuel Element Damage, Final Report, NAA-SR-4488 (suppl.)*, Atomics International, 1961.

introduced into the primary sodium. At the beginning of run 8, an unusually large spread in the fuel channel exit temperature was detected and attributed to the high oxide content of the sodium. The reactor was shut down to reduce the oxide in the sodium by cold trapping. On December 12, 1958, two fuel elements that were excessively hot and had black foreign material on them were removed and washed. Washing the fuel elements proved to be the most successful to reduce the temperature spread. Reactor operations continued intermittently. Some improvement in fuel channel exit temperature spread was found in running the reactor at elevated temperatures as well as by jiggling the fuel element one inch or less. On December 23, 1959 the reactor was shut down to inspect the fuel elements. Fifteen fuel elements were washed and additional cold trapping was done to reduce exit temperature spreads. The reactor was started again and the spread in the fuel channel exit temperatures continued to improve until the end of run 8 on January 29, 1959. During the shutdown, the sodium was cold trapped to less than 5 parts per million of oxygen content. No reactivity anomalies were observed during the run, but a cover gas sample indicated that the hydrocarbon coolant and lubricant tetralin had entered the primary sodium.[1] The presence of tetralin indicates that the system was not functioning properly.

- Run 9 began on February 14, 1959, but continued difficulties with the fuel channel exit temperatures forced a shutdown four days later to wash fuel elements and do further cold trapping. Reactor operations resumed and the temperature spread improved. Reactivity increased ½ percent during this run. Two reactor scrams (automatic dropping of control rods into reactor core to shut down reactor) occurred because of an excessive temperature drop across a moderator can and several other scrams occurred because of power line transients. Run 9 ended February 26, 1959. A fuel element was removed for routine examination in the SRE hot cell and was found to have a thin black deposit. The element was washed and placed back in the reactor.[1]

- Run 10 lasted from March 6 to March 7, 1959. This run was conducted as a temperature test on a uranium oxide fuel element. No unusual circumstances were noted. A thimble was replaced at the end of the run. Later examination showed that a loss in reactivity of ¼ percent occurred at the start of run 11.[1]

- Run 11 began on March 16, 1959. Difficulties with the fuel channel exit temperatures were still being experienced, but the reactor continued to operate up to 20 megawatts (MW). On March 27, 1959, several reactor scrams occurred caused by fluctuations in the main primary sodium flow due to helium leaking into the primary sodium. The reactor returned to power and ran at 19 to 20 MW until the run ended on April 6, 1959. An increase in reactivity of 1 percent occurred during the run. A reduction in fuel channel exit temperatures was noted. Twenty-one fuel elements were examined by television camera in the fuel handling cask and found to be in good condition. Ten days after the run, the radiation level in the main gallery was higher than expected. This was not surprising because it was realized that some fission product contamination had

[1] Ashley, R. L., Beeley, R. J., Fillmore, F. L., Hallett, W. J., Hayward, Jr., B. R., and Jarrett, A. A., *SRE Fuel Element Damage: An Interim Report, NAA-SR-4488*, Atomics International, November 15, 1959.

occurred in the primary sodium. A filter was installed in the primary system, which collected considerable carbon-containing (decomposed hydrocarbon coolant and lubricant tetralin) material.[1]

- Run 12 lasted from May 14 to May 24, 1959. The reactor performed normally during this entire period. A fuel element was examined after shutdown and there was no measureable change in fuel dimensions.[1]

- Run 13 lasted from May 27 to June 3, 1959. Prior to run 13, the core gas radioactivity was found to be 1.7×10^{-3} $\mu Ci/cm^3$. It was assumed to be Xe-133 and considered normal. Xe activity had been observed after reactor operations for many months and was attributed to small pin hole leaks in the cladding of a few elements or to uranium contamination from the outside of new fuel elements. The filters were designed to remove particulates from the air; they did not stop noble gases from being released from the reactor building. With the exception of a scram caused by abnormal sodium flow rate, run 13 proceeded smoothly until May 30, 1959. At this time, several abnormalities in temperature measurements occurred. By June 2, 1959, it was clear that something occurred to impair the heat transfer characteristic of the reactor system. A tetralin leak was detected and the run was terminated on June 3, 1959. On June 4, 1959, an attempt was made to wash a fuel element from the core and that resulted in the incident described above. In order to remove the tetralin from the primary system, a nitrogen gas stripping operation was used. About 3 pints of tetralin and 1,500 cm^3 of naphthalene crystals (assumed to be a breakdown product of tetralin) were removed from the primary sodium system.[1]

- Run 14 lasted from July 12, 1959 to July 26, 1959. The SRE was brought to criticality on July 12, 1959, at 6:50 a.m. with rod positions at 46 inches as expected. At 8:35 a.m., as the reactor was increasing power to 0.5 MW, large temperature fluctuations were noted among the fuel channels. Fluctuations were about 10 °F compared to less than 5 °F fluctuation under normal operating conditions at 20 MW. Fuel channel exit temperatures also started to diverge more than normal.

  Operation continued until 11:42 a.m. when a reactor scram occurred due to loss of auxiliary primary sodium flow. The reactor outlet temperature at the time of the scram was 485 °F. Criticality was re-established at 12:15 p.m. and rod-positions were still at 46 inches, indicating no change in reactivity during the scram. Operation continued at slowly increasing power levels and temperatures.

  At 3:30 p.m. both reactor room air monitors detected a sharp increase in activity. To reduce the activity level, the reactor pressure was lowered from 2 to 1 pounds per square inch gauge (psig). A survey of the reactor loading face shield revealed excessive radiation over the sodium level coil thimble in core channel 7. The initial reading was 500 mrad/h. A high bay air sample showed activity of 3×10^{-7}

[1] Ashley, R. L., Beeley, R. J., Fillmore, F. L., Hallett, W. J., Hayward, Jr., B. R., and Jarrett, A. A., *SRE Fuel Element Damage: An Interim Report, NAA-SR-4488*, Atomics International, November 15, 1959.

$\mu Ci/cm^3$ after 15 minutes of decay and 4.5 x 10^{-8} $\mu Ci/cm^3$ after 90 minutes of decay.

At 4:20 p.m., it was noted that the filter from the air sampler showed an activity level of 160,000 cpm. At 5:00 p.m., a sharp increase in the stack activity to 1.5 x 10^{-4} $\mu Ci/cm^3$ was noted. This returned to normal by 10:00 p.m. Also at 5:00 p.m., the radiation level over core channel 7 reached 25 rad/h and a decision was made to shut the reactor down and replace the thimble in channel 7 with a standard plug. At 8:57 p.m. the reactor was shut down. The sodium level was checked and found to be normal.

The reactor was brought to criticality again at 4:40 p.m., on July 13, 1959. Rod positions were 49.5 inches out. No significant activity was noted in the high bay. At 5:28 p.m., the reactor power was at 1.6 MW and a planned increase was started. The power level persisted in rising faster than expected and at 6:25 p.m., the reactor was manually scrammed. The peak power was about 14 MW.[1] After the scram, rod positions were 52 inches out as compared with 49.5 inches prior to the scram, but it was decided that the power excursion had not affected the reactor adversely. The reactor was brought up to criticality.

At 9:00 a.m. on July 14, radioactivity in the high bay increased to 14,000 cpm on the air monitor. Two hours later, the source of activity had been localized to channels 29 and 50 in the core loading face. Seal rings were placed on the channels and the contamination levels dropped. Another scram occurred at 1:00 p.m. when a short circuit was introduced into the demand circuit for the main primary pump. Rod positions were an average of 51.1 inches prior to the scram at a power level of 3.7 MW. The reactor was quickly brought back to criticality. Rod positions were an average of 51.9 inches at 3.5 MW after recovery from the scram.

On July 15, 1959, the reactor was pressurized and vented to reduce the radioactivity level caused by Xe in the reactor cover gas. This appears to have been released to the atmosphere. The filters were designed to remove particulates from the air; they did not stop noble gases from being released from the reactor building. It was then decided to shut the reactor down because it would not be able to reach the maximum power level necessary to continue getting the Edison turbine generator online while circulating through the steam generator. During the shutdown, the Edison loop was drained, the main airblast heat exchanger was filled, the reactor sodium level coil was reinstalled in core channel 7 and a complete helium leak check was conducted on the core loading face.
On July 16, 1959, the reactor again achieved criticality. The average rod position was 57 inches out, which indicated a substantial loss in reactivity (about 1.2 percent in the four days since the start of run 14). Intermittent operation continued at low power (less than 2 MW) until July 20, 1959. During this time, measurements of primary sodium plugging temperatures were made, the effects of

[1] The 1961 SRE Fuel Element Damage Final Report notes that the 1959 SRE Fuel Element Damage Interim Report stated a peak power of 24 Mw was reached. However, this value was obtained from a linear extrapolation, which was not valid.

core cover gas pressure on reactivity was studied, and the reactor outlet temperature was gradually raised to see if this improved reactor operating conditions (as it did on run 8).

On July 21, 1959 at 2:10 a.m., a scram was caused by a fast period indication. It is worth noting that "the reactor ha[d] a history of spurious scrams due to apparent period transients....Many so-called period scrams have been traced to voltage and frequency instability in the power suppl[y]."[1] The reactor was critical at 2:25 a.m. at an average rod position of 49 inches. Operation continued at 2.5 MW. At 6:45 a.m., radioactivity in the reactor started building up as indicated by continuous air monitoring system installed to protect personnel. At 10:00 a.m., two air monitors were reading 15,000 and 18,000 cpm. By 2:00 p.m., a high bay air sample found activity at 2×10^{-9} $\mu Ci/cm^3$.

On July 21, 1959 at 9:45 a.m., a reactor scram was manually initiated when flow was lost in the main secondary loop. This loss-of-flow-scram was caused by a low sodium level in the secondary expansion tank resulting from a faulty level coil. After the scram, fuel channel exit temperatures dropped. When the main secondary loop was restored to service, temperature swings were noted in the reactor cold leg. At 11:30 a.m., the reactor was again critical at an average rod position of 54 inches. The spread of fuel channel temperatures was still present, but AI's safety limits were not exceeded.

On July 22, 1959, the fuel temperature recorder on the element in core channel 55 showed fluctuating temperatures from 1,100 to 1,200 °F. This channel was composed of various experimental fuels and the point recording instrument found channel temperatures higher than recording instruments in the control room. The point recording instrument was felt by AI staff to be unreliable so no attempt was made to reduce the temperature. An instrument recorded a maximum temperature of 1,465 °F for the experimental fuel element on July 23, 1959. Operation continued at power levels up to 4.5 MW with sodium flow rates up to 1,500 gallons per minute (gpm), and reactor outlet temperatures up to 790 °F.

On July 23, 1959, it was decided to shut the reactor down in view of the high fuel temperature for the element in channel 55 and because the fuel channel exit temperature spread was not improving noticeably. Reactor outlet temperature was kept between 700 and 800 °F, although a few fuel channel exit temperatures reached 900 to 1,000 °F. At 9:50 a.m. on July 23, 1959, a reactor scram occurred due to a fast period indication, but the reactor was critical again at 10:15 a.m. Between midnight and 8:00 a.m. on July 24, fuel elements were jiggled in an attempt to dislodge any foreign material and lower the fuel channel outlet temperature. During this time it was noted that elements in core channels 10, 12, 35, and 76 were stuck in place. Another scram occurred at 12:50 p.m. on July 24, 1959. The reactor was critical again at 1:14 p.m. At 3:40 p.m., another scram was caused by loss of auxiliary primary flow. Criticality was reestablished at 3:56 p.m. Rod positions were an average of 54 inches out.

[1] Ashley, R. L., Beeley, R. J., Fillmore, F. L., Hallett, W. J., Hayward, Jr., B. R., and Jarrett, A. A., *SRE Fuel Element Damage: An Interim Report, NAA-SR-4488*, Atomics International, November 15, 1959, p. III-17.

On July 26, 1959, it was noted that elements in channels 12 and 35 were no longer stuck and the element in channel 76 was somewhat freer. On July 26, 1959, at 11:20 a.m., the reactor was shut down after a total of 16 megawatt-days (MWd) on run 14. The shutdown was made to examine each fuel element that had been running hot and clear away any obstructions in the channels.

The first damaged fuel element was observed at 5:15 p.m. on July 26, 1959. By August 2, 1959, six parted fuel elements had been removed from the reactor and taken to the fuel storage facility before a parted fuel element from core channel 12 became lodged in the fuel handling cask forcing the suspension of operations. After it was determined that "a considerable amount of radiation exposure and contamination in the high bay area was resulting from the attempts to dislodge the jammed fuel element," the plan shifted to modifying a moderator handling cask for fuel removal instead. The removal of the 19 remaining fuel elements began on October 8 and ended on October 19, 1959. The status of the fuel elements are shown in the Table 2.1 below.[1] This is AI's summary of events as of November 15, 1959. AI did not issue a press release regarding the fuel element damage until August 29, 1959.[2]

Table 2.1
Damaged Fuel Elements

Fuel Cluster	Description
R-25	On July 26, 1959 at 5:15 p.m., the element was being viewed by using the portable television camera when it was noted that the cladding appeared to be split open on one of the fuel rods. The element was lowered back into the core, rotated 180 degrees and viewed again showing an additional ruptured fuel rod. The fuel element was stored in storage cell 56.
R-31	On July 27, 1959 at 2:00 a.m., this fuel cluster was found broken in two with approximately one-half of the fuel remaining in the fuel channel. The shield plug and broken section of fuel cluster were stored in storage cell 68.
R-35	On July 27, 1959 at 5:00 p.m., this fuel cluster was found broken in two with approximately one-half of the fuel remaining in the fuel channel. The shield plug and broken section of fuel cluster were stored in storage cell 68.
R-10	On July 27, 1959 at 10:00 p.m., this fuel cluster was found broken in two with approximately two-thirds of the fuel cluster remaining in the fuel channel. The shield plug and broken section of the fuel cluster were stored in storage cell 69.[3]

[1] Ashley, R. L., Beeley, R. J., Fillmore, F. L., Hallett, W. J., Hayward, Jr., B. R., and Jarrett, A. A., *SRE Fuel Element Damage: An Interim Report, NAA-SR-4488*, Atomics International, November 15, 1959.
[2] Atomics International News Release, *During Inspection of Fuel Elements – SRE – Parted Fuel Element...*, August 29, 1959.
[3] According to one stakeholder's recollection of events: "We found only damaged fuel rods, not broken in two."

Table 2.1 (continued)
Damaged Fuel Elements

Fuel Cluster	Description
R-55	On July 28, 1959 at 7:00 p.m., this experimental fuel element was found to be broken in two with approximately one-half of the fuel cluster remaining in the channel. The broken section of the fuel cluster was examined and photographed in the hot cell and then the remains of the cluster were removed from the shield plug section and placed in a container and left in the hot cell. The shield plug was placed in storage cell 73.[1]
R-68	On August 1, 1959 at 11:00 p.m., this fuel cluster was found broken in two with approximately two-thirds of the fuel cluster remaining in the channel. The shield plug and broken section of the fuel cluster were stored in storage cell 72.[2]
R-12	On August 2, 1959 at 5:45 p.m., this cluster was found broken in two with approximately two-thirds of the fuel cluster remaining in the channel. The shield plug and broken section of fuel cluster were contained within the fuel transfer cask awaiting transfer to a storage cell.[3]
R-21	On October 10, 1959 at 10:45 p.m., this cluster was observed in the SRE hot cell. Lower one-third of fuel cluster had broken off and likely remained in the core channel. The portion of the cluster that was removed was canned and stored.[4]
R-23	On October 11, 1959 at 2:13 p.m., this fuel element was removed from the core. It became momentarily stuck in the fuel channel after about 4 feet of upward travel. The element was broken with the lower one-third remaining in the channel. The portion of the cluster removed from the core was canned and in storage.[5]
R-69	On October 14, 1959 at 10:30 p.m., this fuel element was withdrawn from the reactor. The fuel cluster was broken in half and the portion of the cluster that was removed was canned and stored.[6]
R-43	On October 15, 1959 at 7:05 p.m., this fuel cluster was removed from the core. The fuel cluster was broken in half and the portion that was removed was canned and stored.
R-24	Date unknown. Immediate attempts to remove this cluster failed. This cluster and its moderator can was raised and blocked-up after 1 inch in an attempt to free the fuel cluster from the moderator can. No change was noted.[7]
R-76	Date unknown. Immediate attempt to remove this cluster failed. Observations in the core indicate that attempts to remove the fuel element also lifted the moderator can. The fuel cluster and its moderator can were raised and blocked-up after 1 inch in an attempt to free the fuel cluster from the moderator can. No change was noted.[8]

[1] According to one stakeholder's recollection of events: "We found only damaged fuel rods, not broken in two."
[2] According to one stakeholder's recollection of events: "We found only damaged fuel rods, not broken in two."
[3] According to one stakeholder's recollection of events: "Note: broke off when pulling out of the reactor core and contaminated the whole building. The lead safety shield was lifted up by the operator by accident and contaminated the whole SRE building. It was not transferred to the storage cell, because we could not remove it from the fuel transfer cask."
[4] According to one stakeholder's recollection of events: "This is not correct; it was never placed in the hot cell. Not Correct; 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."
[5] According to one stakeholder's recollection of events: "This is not correct; all fuel rods were out of the reactor core by the first part Sep. The last two were pulled out with a Cherry Picker. All incorrect information."
[6] According to one stakeholder's recollection of events: "No fuel rods were withdrawn in October; they were already removed."
[7] According to one stakeholder's recollection of events: "I think this is when we tried to pull 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."
[8] According to one stakeholder's recollection of events: "Notice they have no date. 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."

- Fuel element examination showed that 13 of the 43 fuel elements in the SRE during power run 14 exhibited substantial damage. Figure 2.1.3l shows fuel damage to the bottom and midsection of the fuel element in channel 55. Figure 2.1.3m shows the fuel damage to the top of the fuel element in channel 55.[1] The following sequence of events led to fuel element failure:

    - Tetralin slowly leaked into the primary sodium via a freeze seal on the main primary pump. The tetralin leaked into 1,000 °F sodium for a period of five days and into 350 °F sodium for another nine days when the reactor was shut down to repair the pump.

    - A nitrogen purge was used to remove tetralin and decomposition products from the sodium.

    - Carbon, other tetralin decomposition products, and oxides were still present in the core, despite being undetected. Partial plugging of several fuel channels was evident from the spread in fuel channel outlet temperatures. The plugs were located randomly in the core and in the channels and it is possible some of the elements were plugged before run 14 began.

    - The fluctuation in coolant flow produced severe thermal cycling of the fuel, which caused the fuel to swell until the cladding ruptured.

    - Local heat transfer was disrupted by plugged coolant lines and high temperatures (above 1,400 °F) were reached even at low power. These high temperatures led to the diffusion of uranium into the stainless steel cladding forming a low-melting iron-uranium eutectic alloy.[2]

- Reactivity changes in power run 14 were also attributable to the presence of tetralin decomposition products in the reactor. The reactivity loss of 1.2 percent during the first four days of run 14 was caused by sodium entering the R-10 and R-42 moderator cans likely caused by abnormal temperature conditions in the core. The reactivity increase of 0.3 percent, which produced an excursion to about 70 percent full power, was likely the result of sodium expulsion from several fuel channels in quick succession. The general conclusion of the 1961 *SRE Fuel Element Damage* report is that "no important change in [the SRE's] physical condition [has occurred] as a result of the fuel element damage to the first core.[2]

- Following removal of the fuel elements, inspection of the core began. The radiation level at the bottom of the loading face shield was measured at 43 rad/h. The fuel slugs and cladding fragments remaining in the core were picked up by articulated grapples, canned, and then stored with other damaged fuel. Removal of damaged moderator cans showed that sodium had leaked into cans R-10 and R-42. Later sodium leak checks found cans

[1] Ashley, R. L., Beeley, R. J., Fillmore, F. L., Hallett, W. J., Hayward, Jr., B. R., and Jarrett, A. A., *SRE Fuel Element Damage: An Interim Report, NAA-SR-4488*, Atomics International, November 15, 1959, pp. IV-A-17 – IV-A-18.
[2] Ashley, R. L., Beeley, R. J., Fillmore, F. L., Hallett, W. J., Hayward, Jr., B. R., and Jarrett, A. A., *SRE Fuel Element Damage, Final Report, NAA-SR-4488 (suppl.)*, Atomics International, 1961.

R-32, R-44, and R-45 also contained leaks. A total of 16 cans were replaced. As a result of the fuel cladding failures during power run 14, an estimated 5,000 to 10,000 Ci of fission products were released to the primary coolant system.[1]

Although conducted after the end of the major incident, a gamma spectrometer scan of an air sample identified Xe-133 and Kr-85 as the principle remaining contaminants. AI extrapolated the decay of these two isotopes back to the date of the SRE shutdown on July 26, 1959, and estimated contamination levels of 7.4 $\mu Ci/cm^3$ for Xe-133 and 0.016 $\mu Ci/cm^3$ for Kr-85. Through radioactive decay of the Xe-133 and cover gas purging operations, the fission product contamination level in the reactor cover gas was estimated at 4×10^{-3} $\mu Ci/cm^3$ Kr-85 by September 29, 1959. Fixed contamination of the primary sodium piping was found. Isotopes detected were Sr-89, Sr-90, zirconium-niobium-95 (Zr-Nb-95), Ce-144, and Cs-137. The cold trap (vapor condenser) was also found to collect radioactivity with dose rates ranging from 50 to 80 rad/h at 2 inches from the cold trap surface.[1] There are many caveats to interpreting sample results following the SRE fuel cladding failures. Limited sampling opportunities and reactor recovery efforts imposed restrictions on the quantitative value of data collected.

- Constant monitoring for airborne contamination in the reactor room occurred during recovery efforts. The highest level recorded was 3×10^{-8} $\mu Ci/cm^3$ during core inspection on May 21, 1960 and operations had to be suspended for one hour. General contamination on the walls, floors, tools, etc. in the reactor room ranged from 100 to 1,500 dpm/100 cm^2 of beta-gamma activity. Occasional high counts of 150,000 dpm/100 cm^2 were detected and reportedly cleaned up.

  Several instances of minor contamination of the asphalt blacktop were reported just outside the SRE access door. These areas were reportedly cleaned up. According to the AI 1961 *SRE Fuel Element Damage* report, with the exception of the inert gases Xe-133 and Kr-85, all of the fission fragments remained in the sodium or were absorbed by the metal surfaces of the cladding or the piping. The principle fission products found in SRE primary piping were Sr-90, Ce-144, and Cs-137. During SRE recovery operations, several modifications were made to the reactor system. Tetralin was eliminated as a coolant in favor of NaK, nitrogen gas, and kerosene. The sodium heat transfer system was modified. Instrument monitors were added to the system and the fuel element geometry was altered to provide more clearance between the fuel element and channel.[2]

Incidents after the July 12, 1959 Major Incident

- On September 10, 1959, two AI employees entered a radioactive storage area west of the SRE without permission. The area contained highly radioactive, contaminated equipment and was normally barricaded with yellow and black rope and signs stating: "No Entry Without Tagged Entry Permit," "Contact Health Physics Before Entering," and "Contaminated Equipment." Two AI health physicists discovered the barricade had been removed, a large trailer truck was parked 50 feet inside the barricade, and three outside contractors were loading radioactive waste onto the truck. These contractors were

[1] Hart, R. S., *Distribution of Fission Product Contamination in the SRE, NAA-SR-6890*, Atomics International, March 1, 1962.
[2] Ashley, R. L., Beeley, R. J., Fillmore, F. L., Hallett, W. J., Hayward, Jr., B. R., and Jarrett, A. A., *SRE Fuel Element Damage, Final Report, NAA-SR-4488 (suppl.)*, Atomics International, 1961.

wearing protective clothing. In the southwest section of the area, three people (two AI employees and a contractor) were examining material without wearing any protective clothing. One of the health physicists requested that the men leave the area and one of the AI men responded that they were busy. When the men eventually started to leave, the health physicist requested that they remain for a contamination check and the men refused. One of the AI men stated they were late for a meeting and that the health physicist and his supervisor had better not interfere with the operation. As a result of this violation, the AI men and the contractor, subjected themselves to a high radiation field (Incident Report A0351).[1]

- On November 21, 1959, an employee was modifying an SRE core recovery tool when an exit survey found contamination on his nose, upper chest, and undershorts. The undershorts had to be discarded as contaminated waste. Nose swipes indicated contamination up to 3,600 dpm beta-gamma. Smears of the face and upper chest found contamination at 400 and 5,600 dpm beta-gamma, respectively. The employee's dosimeter worn at the time of the incident gave a reading of 50 mR. After a shower and repeated cleaning of the nostrils, no significant contamination was found. A positive urine specimen did come back and the employee was restricted from tagged areas until additional results were received (Incident Report A0390).[2]

- On December 7, 1959, an employee violated standard operating procedures and did not notify the health physics department that he was entering the high bay area of the SRE, a red tagged area. He also failed to wear the proper clothing required for this high radioactive contamination area. The incident report notes the employee was reminded of proper procedure (Incident Report A0548).[3]

- On December 18, 1959, an employee was found working in the SRE Hot Cell Service Area, a red tagged area highly contaminated with beta-gamma activity, without a protective hood. A health physicist verbally informed the employee that he was in violation of his entry permit and he needed to leave the area. The employee stated that no hoods were available and he continued to work. When the employee finally left the area, he did not check himself for radioactive contamination as required by his entry permit. The employee was informed that it was his responsibility to follow the requirements of his work permit (Incident Report A0391).[4]

- On April 11, 1960, an employee's nose became contaminated up to 190 dpm beta-gamma when the viewing glass of the remote cell he was working in started leaking. He was immediately taken out of the area and decontaminated (Incident Report A0510).[5]

[1] Borg, G., Atomics International Internal Letter, re: *Account of Incident on September 10, 1959 at about 10 a.m. in the Radioactive Waste Storage Area West of the SRE as per G. Borg*, September 11, 1959.
[2] Young, C. L., Atomics International Internal Letter, re: *Radiological Safety Incident Report, Sodium Reactor Experiment, 11/21/59*, December 7, 1959.
[3] Bell, C. E., Atomics International Internal Letter, re: *Violation of Health Physics Practices*, December 11, 1959.
[4] Lang, J. C., Atomics International Internal Letter, re: *Notice of Rule Infraction*, December 31, 1959.
[5] Shannon, J. W., Atomics International Internal Letter, re: *Radiological Safety Incident Report, SRE Hi Bay Area, 4/11/60*, April 11, 1960.

- On May 15, 1960, a leak occurred in the tank used for containing sodium removed from the reactor. The sodium ignited upon contact with the atmosphere causing a large volume of smoke. Approximately 200 g of sodium containing fission products was burned. A 30 minute air sample was taken about 10 minutes after the fire occurred. Beta-gamma activity was 1.3 x 10^{-10} µCi/cm^3 on immediate counting. After 1 hour the activity level decreased to 5.0 x 10^{-11} µCi/cm^3 (Incident Report A0394).[1]

- On May 25, 1960, a corescope from the SRE core was being removed and came out of the gas lock because there were no markings to identify the upper limit of the equipment when it is in the gas lock. When the corescope came out, core gas contaminated with mixed fission products escaped for a short period. Two employees received nasal contamination ranging from 47 to 392 dpm beta-gamma. The employees were decontaminated and a recommendation was made to mark all equipment going through a gas lock with an upper limit (Incident Report A0393).[2]

- On June 2, 1960, an employee was slightly injured and contaminated while working on an SRE fuel coffin. The incident report has not been located (A0460).[3]

- On June 9, 1960, a corescope from the SRE reactor core was being removed through a 6-inch gas lock when it was discovered that the valve on the gas lock had not completely closed. Immediate attempts were made to close the valve, but in the brief time it was open gas containing mixed fission products escaped from the SRE reactor core into the high bay. Nasal smears were done and employees were found to be contaminated between 18,000 and 26,000 dpm beta-gamma. At least one employee had hair and facial contamination of 5 mrad/h. The contaminated employees were immediately removed from the high bay area and decontaminated. At least one employee was restricted from further exposure until bioassay results were obtained (Incident Report A005).[4]

- On July 6, 1960, gas contaminated with mixed fission products escaped into the high bay atmosphere. An employee was measuring a moderator can through a window in the gas lock that had a plastic bag covering it and the employee's arm. As the employee removed his arm from the plastic bag, the gas escaped and set off the continuous air monitor. The plastic bag was quickly sealed and the employee was advised to leave the high bay for nasal smears. Fifteen minutes later, the employee had not reported to health physics and claimed his chief operator did not deem it necessary to leave. Eventually three men were given nasal smears as a precaution. Results ranged from 0 to 3,168 dpm beta-gamma. The employee with the highest reading was decontaminated down to 22 dpm beta-gamma for the right nostril and 10 dpm beta-gamma for the left nostril (Incident Report A0442).[5]

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[1] Galperin, A., Atomics International Internal Letter, re: *Radiological Safety Incident Report, SRE High Bay, 5/15/60*, May 26, 1960.
[2] Galperin, A. and Shannon, J. W., Atomics International Internal Letter, re: *Radiological Safety Incident Report, SRE High Bay, 5/25/60*, August 30, 1960.
[3] Boeing Radiation Incident Database, 2010.
[4] Lane, W. D., Atomics International Internal Letter, re: *Radiological Incident Report, SRE High Bay, 6/9/60*, July 20, 1960.
[5] Galperin, A., Atomics International Internal Letter, re: *Radiological Safety Incident Report, SRE High Bay, 7/7/60*, August 31, 1960.

- On December 15, 1960, two employees became contaminated during a sandblasting operation. A sodium pump was being decontaminated by sandblasting in a plastic tent fabricated for this purpose. The pump was contaminated with mixed fission products and a maximum radiation level was measured at approximately 5 rad/h. One employee was working in full protective clothing and face mask inside the tent, while the other employee was operating the sandblasting compressor outside the tent. After approximately 3 minutes, the employee in the tent realized dust was leaking into his face mask. He motioned to have the compressor shut off and stepped out of the tent where he was helped out of his protective gear. Nasal swipes of both men revealed beta-gamma contamination of 75,000 dpm (employee working in tent) and 420 dpm (employee outside tent). A survey meter check found one employee's clothing contaminated up to 0.2 mrad/h. The clothing was disposed and the men were decontaminated (Incident Report A0305).[1, 2]

- On May 17, 1961, an employee working in the SRE high bay discovered contamination on his shoes upon exiting for lunch. Investigation found that the rubber boots he had been wearing as required health and safety dress had developed leaks. After unsuccessful attempts to decontaminate the shoes, they were disposed as radioactive waste (Incident Report A0435).[3]

- On November 4, 1961, an employee working on samples from "hot trap (heater) A" in the SRE high bay became contaminated while grinding a sample container away to expose the sample. The external surface of the sample container was less than 30 dpm beta-gamma, but the sample itself was 3 rad/h. The employee was wearing a hard hat with a face shield for grinding operations and was told that a full respirator would be required when he got close to exposing the sample. The employee stated that he had done this type of work before and had never been contaminated. Upon further observation from a health physicist, the sample had indeed been exposed by grinding operations. A smear survey was taken and indicated high internal contamination. The employee further stated that the air flow through the high bay door was enough to protect him from exposure. The health physicist went to get a face mask for the employee, but none were available. Nasal smears indicated the employee's right nostril was contaminated to 145 dpm beta-gamma and the left nostril was contaminated to 372 dpm beta-gamma. Contamination had also filtered through the employee's cotton gloves and his hands were contaminated to 2 mrad/h. The employee was decontaminated and released (Incident Report A0515).[4, 5]

- On December 23, 1961, an employee entered a red tagged area without a tagged entry permit and manipulated high contaminated core lights without protective gear or without

[1] Klostermann, J. P., Atomics International Internal Letter, re: *Radiological Safety Incident Report, R/A Material Storage Area – SRE, 12/15/60*, December 19, 1960.
[2] Correspondence from Lang, J. C., Atomics International, to Levy, J. V., U.S. Atomic Energy Commission, re: *Preliminary Report – Inhalation Incident at Santa Susana*, January 24, 1961.
[3] DuBois, P. R., Atomics International Internal Letter, re: *Radiological Safety Incident Report, SRE High Bay, May 17, 1961*, May 31, 1961.
[4] Yarrow, A. R., Atomics International Internal Letter, re: *Radiological Safety Incident Report, Bldg. 143 (High Bay), 11/4/61*, November 7, 1961.
[5] Health and Safety Department, Atomics International Internal Letter, re: *Notice of Health and Safety Rule Infraction*, November 8, 1961.

following proper procedure for working with radioactive materials (Incident Report A0472).[1]

- On February 6, 1962, an employee was observed in the Health and Safety Counting Room using counting equipment to measure radioactivity on a smear because he didn't believe the results of a health physicist's survey of the plastic cover on a storage cell. The employee failed to detect the radioactivity (3×10^5 dpm/100 cm^2) observed before and after by health physics analysts. Not only did the employee delay decontamination of the object, but he violated rules by using radiation detection equipment he was not trained to use (Incident Report A0534).[2]

- On April 4, 1962, two sets of air samples for radioactive particulates were taken on the roof of the SRE near the exhaust fans and filters. At least 90 percent of the high bay particulate activity was rubidium-88 (Rb-88). One sample set was taken with the filters bypassed and the other sample set was taken with air exhausted through the filters. The reactor was at 5 MW and only the east fan was on. Air samples from the high bay were taken at the same time as samples on the roof. These results were compared to sample results on March 1, 1962 with the reactor critical. Additionally, a roof sample had been taken on March 3, but it could not be correlated to high bay activity because it was taken in the stack, which only exhausts the hot cell and vent system effluent. Results were as follows:

    - April 4, 1962, 9:30 a.m. filtered exhaust – 5.5×10^{-11} $\mu Ci/cm^3$ beta-gamma
    - April 4, 1962, 9:30 a.m. high bay activity – 9.4×10^{-9} $\mu Ci/cm^3$ beta-gamma
    - April 4, 1962, 1:30 p.m. nonfiltered exhaust – 5.9×10^{-9} $\mu Ci/cm^3$ beta-gamma
    - April 4, 1962, 1:30 p.m. high bay activity – 9.9×10^{-9} $\mu Ci/cm^3$ beta-gamma
    - March 3, 1962, stack sample – 2.04×10^{-11} $\mu Ci/cm^3$ beta-gamma
    - March 1, 1962, roof – 1.5×10^{-10} $\mu Ci/cm^3$ beta-gamma
    - March 1, 1962, high bay – 1.1×10^{-10} $\mu Ci/cm^3$ beta-gamma (A0015).[3]

- On June 13, 1962, an operator was engulfed in fire during the transfer of core heaters.[4]

- On July 30, 1962, an employee received an exposure exceeding the weekly limit during a source transfer operation. A 200 Ci Sb-124 source was being transferred from one storage cask to another using a bottom loading cask suspended from a crane over the cask containing the source. A cable was then used to pull the source up into the suspended cask. As the source was being drawn up, the suspended cask began to oscillate. The employee approached the cask to steady it so the source could be drawn into it and by so doing exposed himself to the unshielded source. The employee's film badge indicated a dose of 2,150 mrem gamma, but approximately 400 mrem of the film badge exposure

[1] Health and Safety Department, Atomics International Internal Letter, re: *Notice of Health and Safety Rule Infraction*, January 4, 1962.
[2] Health and Safety Department, Atomics International Internal Letter, re: *Notice of Health and Safety Rule Infraction*, February 16, 1962.
[3] Badger, F. H., Atomics International Internal Letter, re: *Air-borne Activity of SRE High Bay*, April 6, 1962.
[4] Boeing Radiological Incident Database, 2010.

was received prior to the incident. The employee was put on restriction to not exceed 100 mrem per week exposure for the remainder of the quarter (Incident Report A0404).[1]

- On October 20, 1962, a three man crew cutting up obsolete core heaters in the northeast corner of the SRE yard became contaminated. The eight heaters were monitored before the operation. All heaters were contaminated less than 150 mrad/h at the surface. The men were dressed in redline coveralls, shoe covers, and gloves for the operation. At lunch time, the men went to the hot change room to change out of their protective gear and contamination was found on their clothing and bodies. Nasal contamination ranged from 70 to 1,200 dpm, hand contamination ranged from 3 to 5 mrad/h, and radiation exposure ranged from 60 to 70 mrad. All men had scattered face and body contamination and two men had contamination on all of their clothes. The men were given continuous showers until contamination levels were brought to background. Further testing was prescribed for internal contamination. The contaminated employees reportedly contaminated most doorknobs in the lower level of the SRE building (up to 300 dpm/100 cm^2) and a large area of the floor (up to 600 dpm/100 cm^2). These areas were decontaminated to 30 dpm/100 cm^2 (Incident Report A0379).[2, 3]

- On March 19, 1964, approximately 3,550 gallons of water were dumped from two new radioactive liquid waste storage tanks located on the north side of the SRE as a part of pre-operation testing for the PEP program. Twenty-four hours later it was discovered that the water was contaminated with an estimated 5.8×10^{-4} µCi of irradiated corrosion products. A new radioactive liquid waste storage system was installed outside the north end of the SRE building. The system included one used tank (T-1) and two new storage tanks (T-2 and T-3). T-1 was a 150-gallon tank. T-2 was a 350-gallon tank installed alongside T-1 in the sump pit 40 feet below ground level. T-3 was a 3,200-gallon tank installed at ground level. Piping was installed to allow gravity flow of radioactive water to either T-1 or T-2. The waste water was then pumped to ground level where it could be sampled. Activity level permitting, the waste water could then be pumped to T-3 for storage and disposal. T-1 and T-2 were vented to the existing radioactive gas compressor vent system serving the fuel wash cells.

  The old liquid lines to T-1 were closed and T-2 and T-3 were filled with clean water from a nearby fire hydrant to check level indicators and pumps. The next day the water was emptied from the tanks so that the system could go through final checkout. When a health and safety representative came to monitor the circulation lines during final testing, he discovered that two lines from T-2 were radioactive, while the lines to T-1 were at what was characterized at the time as "background." Apparently, the radioactive gas vent lines had contaminated condensate. A portion of the vent system had been drained of condensate the day before and valved off, but the remainder of the vent line was left open to T-1 and T-2. Condensation accumulated in the open vent line and entered T-2 by gravity flow contaminating the clean hydrant water in the tank. The water was later

[1] Raper, R. R., Atomics International Internal Letter, re: *Radiological Safety Incident Report, SRE West Pad, 7/30/62*, September 6, 1962.
[2] Unknown Author, Atomics International Internal Letter, re: *Incident Report, Contamination of Personnel Working on Disposal of Outworn Core Heaters*, October 20, 1962.
[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. G-16-17.

analyzed and found to have approximately 18 percent Co-60, 13 percent Co-58, 62 percent Cr-51, and 7 percent Zr-95 – Nb-95.

Once the contamination was discovered the SRE area was secured and a class one emergency was proclaimed. A 150 cubic foot air sample taken in the spill area found airborne activity at 8.3×10^{-11} µCi/cm^3 beta-gamma. Survey of personnel in the area found low-level radioactive contamination on shoes only. The maximum contamination on shoes was 2,000 dpm beta-gamma. Vehicles in the area were surveyed and smeared. The maximum contamination detected inside any vehicle was 1,800 dpm/100cm^2 beta-gamma and the maximum contamination outside any vehicle was 4 mrad/h. Contamination was also noted at the north door of the SRE building, where 800 dpm/100cm^2 beta-gamma was detected.

According to the incident report, the major spread of contamination, however, was to the watercourse with low-level contamination spread to no more than 500 feet from the point of dumping on the asphalt. After people and vehicles were decontaminated to less than 30 dpm/100cm^2 beta-gamma they were released from the area. A water sample was taken from the 750,000-gallon SRE retention pond and the drain pump for the pond was secured to prevent release. The pond had not been dumped since the incident. Pond water measured 7.1×10^{-6} µCi/cm^3. The asphalt area where the water was first released measured 10 mrad/h with about 3 mrad/h gamma contamination. The SRE ditch measured a maximum 60 mrad/h. The asphalt was hosed down with water and contamination levels dropped to 4 mrad/h, but the maximum contamination in the ditch increased to 80 mrad/h.

Operations decided to abandon efforts to flush the asphalt and brought in a crew to clean out the ditch, and use a floor scrubber and vacuum on the asphalt to decontaminate it. The asphalt was decontaminated to a maximum of 0.7 mrad/h. Four 55-gallon drums of mud and debris from the ditch were removed, which reduced contamination from 80 mrad/h to 15 mrad/h. Further decontamination reduced the ditch contamination to less than 2 mrad/h, except for a small area reading 10 mrad/h that was to be removed later. Any areas indicating up to 2 mrad/h were to be fixed with an additional layer of asphalt.

Rain occurred intermittently for two days during cleanup operations and runoff water filled the SRE pond to within 6 inches of the spillway leading to Brandeis Canyon and Simi Valley on March 23, 1964. The SRE pond was drained to Rocketdyne's Area II ponds to prevent overflow. A sample of the SRE pond when this began indicated 1.8×10^{-6} µCi/cm^3. Six hours later a sample indicated 4.1×10^{-7} µCi/cm^3. Samples taken at the inlet of the first Area II pond and the midpoint of the second Area II pond 9 hours into the drainage process found 1.4×10^{-7} µCi/cm^3 and 6.7×10^{-8} µCi/cm^3, respectively. On March 24, 1964, the Area II ponds indicated an average of 6×10^{-8} µCi/cm^3. This compares to an average of 6.8×10^{-8} µCi/cm3 for a three-month period the previous year. Ultimately, 421,000 gallons of water from the SRE pond was drained to the Area II ponds. It was calculated that the maximum release of contamination from the incident was 5.8×10^4 µCi, with 5.2×10^3 µCi released in the SRE pond.

According to the incident report, of the major isotopes involved in contamination, the most restrictive maximum permissible concentration at the time for water was 6×10^{-5}

$\mu Ci/cm^3$. With a total release restriction of 1 Ci per year and a release of approximately 3 mCi, it appeared that the standards established by the AEC for liquid disposal were met. The incident report notes that the possibility of significant contamination offsite "appears remote." Failure to detect the release until 24 hours after it happened was attributed to failure of personnel involved to request monitoring of the water, failure of personnel to check out on the hand and foot counter, failure of routine surveys of the building floors to detect increased contamination levels, and lack of frequency in outside surveys (Incident Report A030).[1]

- On June 15, 1964, an employee vacuuming contamination in the fuel handling machine service pit became contaminated. Nose swipes found 90 and 450 dpm beta-gamma in his nostrils and fingers on his right hand were contaminated to 300 dpm beta-gamma. The employee was fully suited and wearing a full face mask while he was working. A few hours later, another employee wearing the same gear exhibited similar results after being in the service pit for 20 minutes. His nostrils were contaminated to 120 and 4,000 dpm beta-gamma. It was determined that the air filter equipment was not rated high enough for the contamination levels in the service pit and supplied air should have been used. The airborne radioactive contamination was mixed fission products from the MK-1 fuel handling machine (Incident Report A0409).[2]

- On June 17, 1964, two employees working in the fuel handling machine service pit were found to be contaminated. One employee was contaminated to a maximum of 0.3 mrad/h on the front of his neck and had a nasal smear of 1,525 dpm beta-gamma. The other employee was contaminated to a maximum of 0.4 mrad/h on the back of his neck and had a nasal smear of 3,675 dpm beta-gamma. Both men were decontaminated, but internal contamination was still present in sputum, spit, and breath. The men were wearing full face masks with supplied air, double coveralls, hoods, two pair of plastic and one pair of canvas shoe covers, and two pair of surgeon's gloves while working. Smears of one of the masks revealed 13,000 dpm beta-gamma inside and 84,000 dpm beta-gamma outside. The incident report notes that there was extremely high surface and airborne contamination beneath the MK-1 fuel handling machine and the incident occurred during removal of Core 1 fuel. No immediate cause was found for the mechanical means of by which the employees inhaled contamination through their protective gear (Incident Report A0493).[3]

- On June 21, 1964, an SRE shift supervisor having been in the MK-1 fuel handling machine service pit was checked out and found to be contaminated. He had been in the pit for inspection prior to component disassembly. A count rate meter indicated approximately 300 cpm on his left forearm and 500 cpm on his shoes. Another employee then exited and was also found to be contaminated to 300 cpm. Nasal smears for the men were 30 and 280 dpm beta-gamma. Apparently, a component from the fuel handling machine had been dropped and caused a cloud of contamination in the tented area. A check of the area indicated 1,000 to 150,000 dpm/100 cm^2 beta-gamma contamination all

[1] Badger, F. H., North American Aviation Internal Letter, re: *SRE R/A Liquid Release*, April 17, 1964.
[2] Bergstrom, W. H., Atomics International Internal Letter, re: *Incident Report, Fuel Handling Machine Service Pit, June 15, 1964*, June 24, 1964.
[3] Unknown Author, Atomics International Internal Letter, re: *Incident Report, FHM Service Pit, 6-17-64*, June 24, 1964.

over the west end of the high bay. An air monitor on the east side of the plastic screen dividing the east and west high bay revealed a 200 cpm increase in airborne contamination. Spots smears of the area revealed less than 30 dpm beta-gamma. Personnel had reportedly taken off the full face mask in a portable change room booth set up adjacent to the service pit during a time when airborne contamination was still significant. Recommendations included providing filtered exhaust to the tented areas of work and use proper donning and doffing of protective gear, including removing face masks after outer garment (Incident Report A0380).[1]

- On September 18, 1964, a crew began work in the SRE high bay to remove Core I fuel, cladding, and debris from the "Poor Man's Hot Cell." Full protective clothing was worn with the exception of full face respirators, as the plan was to set up equipment first and begin operations later in the shift. Grappling tools and a bucket were lowered into the pit. After tedious manipulation with the grappling tool, one 18-inch piece of cladding, possibly containing NaK and up to three fuel slugs, was precariously placed in the bucket. Full face respirators should have been donned at this point, but difficulty was encountered in removing the rod from the bucket and the immediate action of all three personnel was necessary to prevent the rod from falling back into the pit and starting a fire. Upon securing the rod on a ledge, work ceased and all personnel left the area. An immediate contamination survey of two crew members revealed no contamination; however, nose swipes revealed nasal contamination of 1,380 and 9,000 dpm beta-gamma. A third crew member had a nose swipe of 400 dpm beta-gamma after his shower, but the rest of his body was clean. The men were all decontaminated and placed on restriction pending bioassay analysis. The contamination was thought to result from moving the rod to the ledge and creating airborne contamination (Incident Report A0382).[2]

- On December 1, 1964, a probe was wrapped and lowered into a control rod thimble in storage to obtain a radiation measurement. Plastic sheeting was laid on the floor and the employee conducting the survey wore shoe covers and gloves. After getting the measurement, the probe was carefully unwrapped to avoid contamination spread to the probe or the immediate area. A contamination survey of the probe revealed a significant reading on the count rate meter despite precautions. The employee received 0.3 mrad/h contamination on his hands, between 2,000 and 6,000 dpm of contamination over his face, neck, and the front of his clothing, and 1,300 dpm of contamination on a nasal smear. A smear survey of the west high bay area after operation revealed contamination levels from 1,500 to 1,800 dpm /100 cm^2. Decontamination reduced levels to non-detect (Incident Report A0545).[3]

- On December 18, 1964, size reduction of two control rods led to contamination of the surrounding area, equipment, and personnel. A tagged area entry permit was submitted for the transfer, cutting, and canning of control rods in the SRE high bay. Prior to operations, the west high bay floor was covered with plastic and plastic barriers were set

[1] Badger, F. H., Atomics International Internal Letter, re: *Incident Report, SRE High Bay West, June 21, 1964*, July 1, 1964.
[2] Tworek, D. D., Atomics International Internal Letter, re: *Incident Report, "Poor Man's Hot Cell," 9-18-64*, October 6, 1964.
[3] Unknown Author, Atomics International Internal Letter, re: *Incident Report, SRE High Bay, 12-1-64*, December 2, 1964.

up around the storage cells. The work area was roped off and designated a red tagged area. Two control rod lower thimbles were transferred from the canisters in moderator storage cell 2 to the fuel handling machine. They were transferred to two fuel cans, one in storage cell 25 and the other in storage cell 74. The lower 93 inches of each thimble was cut off and remained in the storage cell. The upper 129 inches of each thimble was transferred from the fuel handling machine to the canister in moderator storage cell 2. The radiation levels encountered during the cutting and transfer operations were measured. At 3 feet from the thimble surface, activity was measured at 30 and 36 r/h (units may be incorrectly presented in the source document) for the two thimbles. At the surface of the cutting point, activity was measured at 11.5 and 12 r/h, respectively.

Personnel exposures for three employees at this time were 45, 225, and 240 mr (units may be incorrectly presented in the source document). Follow up smear samples of the area found 3,000 dpm/100 cm^2 beta-gamma on plastic outside the work area, 800 dpm/100 cm^2 beta-gamma on a new full-face mask located south of the storage cells, 300 dpm/100 cm^2 beta-gamma on an uncovered portion of the floor south of the storage cells, and 100 dpm/100 cm^2 on the floor between the hot change room and the door leading to the high bay. One worker had a nasal smear indicating 600 dpm beta-gamma.

A cleanup of the contaminated areas began and another smear survey was conducted. Contamination remained on the hot change room floor (120 dpm/100 cm^2), floor between the hot cell stairs and high bay door (120 dpm/100 cm^2), and high bay floor just inside the hot change room door (180 dpm/100 cm^2). Other surveys found up to 2,400 dpm/100 cm^2 beta-gamma on items in the welder's work area, which prompted immediate roping off of the area and decontamination efforts. It was not clear at the writing of the incident report what caused the contamination of the one employee and the surrounding area. The procedure had followed established guidelines. It was recommended that the open moderator storage cell be covered with a lid or plastic between transfers and that work periodically cease to allow for health and safety monitoring in the future (Incident Report A0371).[1]

- On January 14, 1965, the movement of a temperature probe caused radiation exposure in excess of guidelines for three personnel. Reevaluation of the personnel exposures suggested they were lower than reported because the film badge supplied used a linear formula to calculate exposures instead of a more accurate calibration curve. The corrected exposures showed that the three personnel involved in the incident received lifetime exposures well below the permissible level (Incident Report A0296).[2, 3]

- On February 20, 1965, an SRE core light was removed and replaced with a short plug. Personnel performed the operation manually with 0.5-inch water pressure in the core. The core light was brought up into a bag, which was tied off and cut. An extension of the core channel was removed and the plug was readied for insertion when particles of ignited sodium and contamination were released. The plug was dropped in place almost

[1] Townsend, R. I., Atomics International Internal Letter, re: *Radiological Safety Incident Report, High Bay Area of SRE, Building 143, Santa Susana*, December 18, 1964.
[2] Boeing Incident Database, Reviewed 2011.
[3] Correspondence from Remley, M. E., Atomics International, to Levy, J., U.S. Atomic Energy Commission, re: *Type B Radiation Exposures*, April 2, 1965.

immediately, stopping the release of contamination. The spread of contamination was negligible, but personnel were contaminated. Two workers had contamination on their necks (180 and 300 dpm beta-gamma) and two workers had positive nasal smears (180 and 2,400 dpm). The health physics department was not given advanced notice of the operations and was not aware that the core would be open. Personnel indicated that this activity had been performed in the past without incident. No masks were worn during the operation (Incident Report A0386).[1]

- On February 27, 1965, an employee was contaminated through two pairs of coveralls as he worked to change a door seal inside a moderator cask. The employee was contaminated to about 500 cpm on his neck. Only his head and shoulders were inside the cask and he was wearing a full face mask. The employee was observed the entire time by the health and safety department and no unusual occurrences happened while performing the operation (Incident Report A0416).[2]

- On April 24, 1965, an employee was injured in a non-radiological operation in the SRE high bay. The employee was drilling an electrical circuit box and the drill passed through the tip of this third finger. He was taken to the West Valley Baptist Hospital for treatment and later returned to work. The incident was not radiological in nature, other than it occurred in the SRE high bay (Incident Report A0444).[3]

- On March 22, 1965, an employee cut the tip of his thumb while attempting to adjust the position of a temporary ring in a sodium line prior to welding. A small area of skin on his right wrist was found to be contaminated to 60 dpm beta-gamma. This contamination was easily removed by flushing with water. All other survey results showed background activity (Incident Report A0445).[4]

- On August 19, 1966, an investigation took place to identify the cause of a recent incident at the SRE Tab Exposure Facility (TEF) resulting in exposure of operating personnel to primary sodium. At the time of the incident, personnel had inserted the tabs into the line and were preparing to expose them to primary sodium at nominal operating temperatures when the primary sodium started filling the piping and gas lock used for tab insertion and removal. A freeze stem temperature alarm went off and an operating crew member found drops of sodium on the floor below the gas lock. The TEF inlet and outlet valves were closed and the heaters were turned off so that the TEF was isolated from the primary sodium line. The incident occurred because the temperature alarm on the TEF was out of calibration and alarmed at a higher temperature, preventing cooling operations from being implemented to keep the freeze stem frozen. The occurrence could have been much worse during reactor operations, so standard operating procedures were changed to include adding a lead shield to access ports when the reactor was operating, helium leak testing the TEF prior to melting sodium in the piping and exposure site, and freezing

[1] Bergstrom, W. H., Atomics International Internal Letter, re: *SRE High Bay, 2-20-65*, February 24, 1965.
[2] Owens, D. E., Atomics International Internal Letter, re: *Incident Report, SRE High Bay, 2-27-65*, March 2, 1965.
[3] Moore, J. D., Atomics International Internal Letter, re: *Incident Report, SRE High Bay, 4-24-65*, May 6, 1965.
[4] Moore, J. D., Atomics International Internal Letter, re: *Incident Report, Building 143 Primary Na Pipe Gallery, Mar. 22, 1965*, May 22, 1965.

adjacent piping while sodium was in the exposure site among other changes (Incident Report A0041).[1]

- On December 8, 1967, radioactive water was discovered in two 8-inch pipes that penetrate the floor of the maintenance cell at the SRE. Samples indicated radioactivity of 6×10^{-4} µCi/cm^3, which was principally Cs-137 with small amounts of Sr-90, Y-90, and Co-60. According to the incident report, the radioactivity found in the water samples were comparable to standards for occupational exposure and were no more than a factor of 10 greater than the 1967 standards for exposures in uncontrolled areas, with the exception of Sr-90 in both cases. However, further analysis of the liquid indicated that only about 10 to 15 percent of the total activity in the water was Sr-90. The total activity in the water together with the loose or removable contamination in the pipes was determined to be something less than 0.5 mCi. The incident report states that there is no potential hazard or safety problem associated with the contaminated water, but does note that the accumulation of water is an engineering concern (Incident Report A0321).[2]

- On October 23, 1976, radioactive gas escaped during the removal and replacement of the R-34 instrumentation probe from the core top at the SRE. A health physicist took an air sample 2 inches from inside the plug hole where the probe was located. On his way back to evaluate the sample, he discovered his shoes were contaminated. Results of the air sample were 2.0×10^{-7} µCi/cm^3 for the immediate count and 2.0×10^{-8} µCi/cm^3 for the delayed count. The health physicist reported the suspected contamination around the core and a possible airborne release to the operating personnel. Operating personnel were almost finished reinserting the probe so a 3-minute air sample was taken as the probe was completely replaced. Results of this air sample were 6.3×10^{-9} µCi/cm^3 for the immediate count and 1.7×10^{-11} µCi/cm^3 for the delayed count. The stationary air monitor 5 feet from the core face indicated no increase in radioactivity above background. Four personnel were contaminated between 400 and 500 counts above background. No contamination was found after showering. Nasal smears were below 20 dpm beta for personnel. A smear survey found maximum removable contamination at 10,000 dpm/100 cm^2 beta. Decontamination began to remove the gross contamination as much as possible before the end of the work shift. The SRE high bay was roped off until additional smears and decontamination were completed. The cause of the release was attributed to the core pressure being zero and not negative. Operations involving the removal of plugs from the core were to have verification of negative pressure. Three days later the SRE high bay returned to routine working status (Incident Report A0289).[3]

- On August 1, 1977, the bottom of a cold trap (vapor condenser) at the SRE fell off during movement and contaminated the floor. The cold trap was lifted to a vertical position when the bottom fell off. The top portion of the cold trap was placed in a 55-gallon plastic bag. The bottom portion of the cold trap was hoisted up and placed in a plastic bag inside a 55-gallon drum. Steel baffle plates inside the cold trap had to be pulled

[1] Southward, B. G., Atomics International Internal Letter, re: *Investigation of Incident at SRE Tab Exposure Facility*, August 19, 1966.
[2] Correspondence from Remley, M. E., Atomics International, to Levy, J., U.S. Atomic Energy Commission, re: *Contaminated Water at the SRE*, December 12, 1967.
[3] Radiation and Nuclear Safety, Rockwell International Internal Letter, re: *Incident Report – Radioactive Airborne Release at SRE*, October 28, 1976.

loose and some sodium spilled on to the plastic. Contamination was noted on one of the workers' shoes. Nose smears were taken and ranged from background to 251 cpm. Surveys of personnel clothing revealed contamination ranging from 1,500 cpm to 20,000. Twenty spot smear samples were taken in the high bay area with a maximum count of 50,000 dpm. Additional smears were taken in the health physics office, change room, hallways, shop area, and office area. Two smears came back over 50 dpm and those areas were cleaned (Incident Report A0059).[1]

- On August 10, 1977, a water-filled storage pit used at the SRE for temporary storage of activated material removed from the reactor vessel during decontamination and disposition activities was found to be leaking. The loss of water was detected the day after explosive cutting was done in the reactor vessel near a vault penetration pit that had been welded closed. The thought was that the weld had cracked, allowing water to leak into the reactor cavity. Steps were taken to discontinue work that could aggravate existing cracks; monitor the storage pit water level frequently; and develop plans for locating the leak, storing radioactive components out of the pit, and pumping contaminated water from the pit. The water in the storage pit was contaminated to 7.2 x 10^{-2} $\mu Ci/cm^3$ gross beta activity with a mixture of Na-22, Co-60, Sr-90, Cs-137, and Pm-147.

  Water samples were collected from existing wells and three additional monitoring wells were drilled. Analysis of the water samples from existing wells indicated that contamination did not spread outside of the immediate site, but could be in the surrounding soil, adjacent vaults, or to the reactor guard vessel annulus. During drilling of one of the new wells outside the east wall of the SRE, soil was found to be contaminated to 1,300 pCi/g. According to Rockwell, normal subsurface soil activity was 10 to 50 pCi/g. The water in the well was much less radioactive than the soil (39 pCi/cm^3). Preliminary water samples taken from nine well sites ranged from 2.1 x 10^{-8} to 4.9 x 10^{-5} $\mu Ci/cm^3$ where activity was found. The highest contamination was found in the well with the highest soil activity. Thus, the leak appeared to be in the east end of the storage pit. An estimated 2,200 gallons of water was leaked from August 9, 1977 when the pit was filled to August 22, 1977. As a result of the loss of water, radiation levels in working areas at the pit were now 20 to 50 mR/h. In October 1977, water samples were collected again and contamination ranged from 2.7 x 10^{-8} to 9.1 x 10^{-6} $\mu Ci/cm^3$, with the highest level of contamination at the wash cell valve pit presumably a result of activities that agitated the sediment in the area. Two steel tanks were installed for containment of water in the storage pit and all water in the pit was pumped to these tanks. These tanks also served as the storage location for radioactive components (Incident Report A0414).[2,3]

- On September 23, 1977, a release of airborne radioactivity occurred in the SRE high bay when a sodium passivation vessel was being unloaded by crane. No unusual occurrences

[1] Health and Safety, Rockwell International Internal Letter, re: *Radiation Incident While Moving the Cold Trap into the Alcohol Passivation Tank at SRE*, August 1, 1977.
[2] Correspondence from Tuttle, R. J., Rockwell International, to Jackson, C., Energy Research and Development Administration, re: *Leakage of Radioactively Contaminated Water at SRE*, August 23, 1977.
[3] Correspondence from Tuttle, R. J., Rockwell International, to Jackson, C., Energy Research and Development Administration, re: *Leakage of Radioactively Contaminated Water at SRE*, October 25, 1977.

or visible releases were noted in the operation, but contamination was discovered when a health physicist checked his shoes. One employee had a nasal swipe with 66.5 cpm measured over 10 minutes (Rockwell's nasal background sample showed 20.5 cpm measured over 10 minutes) indicating an airborne release; however, an air sampler 7 feet away did not detect any rise in activity. The contaminated particles were felt by Rockwell to be so large that they fell to the floor in the immediate area and thus were tracked out of the area on shoes (Incident Report A0458 and A0683).[1]

- On June 24, 1978, an employee was carrying a stainless steel tray and tripped over a piece of culvert piping that protruded 4 inches above ground. The worker suffered an injury to his leg and was taken to West Hills Hospital for treatment. The area of the incident was smear surveyed for radioactive contamination. An area of the protruding piping was found to have 50.7 dpm of contamination. No other detectable contamination was found in the area (Incident Report A0578).[2]

Current Use: Building 4143 was demolished in 1999. The extent of the excavation made during building demolition is shown in Figure 2.1.3h.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): A chronology of radiological investigations at this building is as follows:

- In early 1967, the AEC approved a plan for the deactivation of the SRE. The implementation of this plan resulted in a "stored-in-place" configuration.[3]

- In 1967 and 1968, Rockwell shut down the primary sodium system and drained the sodium into the primary fill tank, and drained the secondary sodium into drums. The fuel cores were removed to the RMDF. Rockwell flushed and drained the liquid waste system and purged the gaseous waste system. Rockwell decontaminated the sump pit and wash cell pit, and decontaminated the external surfaces of the fuel and moderator handling machines as well as the main and portable hot cells.[1]

- In October 1969, Rockwell pumped groundwater seepage from the SRE wash cell valve pit and spread "Drizite," a commercial drying compound over the pit floor to soak up the remaining moisture to allow for a smear survey of the floor and wall surfaces. Rockwell collected a 500-cm^3 sample of groundwater for radiometric analysis. Results showed a beta concentration of 7.4×10^{-6} $\mu Ci/cm^3$. Groundwater seeped into the pit overnight and a second sample collected the next day indicated a beta concentration of 2.5×10^{-6} $\mu Ci/cm^3$. In November 1969, Rockwell conducted a smear survey and found removable contamination of between 21 and 1,326 dpm/100 cm^2. Rockwell concluded that the soil surrounding the wash cells was contaminated, probably as a result of an explosion that occurred in Wash Cell B in 1959. The wash cell liner was replaced after the explosion, but the outer sleeve was not replaced. This may have ruptured and released fission

[1] Owens, D. E., Rockwell International Internal Letter, re: *Incident Report, SRE – September 23, 1977*, Undated.
[2] Owen, R. K., Rockwell International Internal Letter, re: *Personal Injury Incident of June 24, 1978 at SRE*, July 7, 1978.
[3] Ureda, B. and Heine, W., *Facilities Dismantling Plan for SRE*, Atomics International Report No. FDP-704-990-003, June 24, 1975, pp. 9, 13, 17-18.

products into the surrounding soil.[1] The wash cells were located in the northwest corner of Building 4143.

- In October 1972, Rockwell reported that several areas of the SRE, accessible to personnel, had radiation levels in excess of 100 milliroentgens per hour (mR/h). These areas constituted "high radiation areas" and were required to be equipped with alarms that would be automatically actuated in the event of personnel entry, or were required to be locked with positive control on entry. Rockwell reported that extensive internal contamination was present in the fuel handling machines and moderator handling machines. Also, there was a "significant" amount of combustible material in wooden and cardboard boxes, which posed a fire hazard.[2]

- In July 1973, Rockwell prepared an environmental assessment for the decommissioning of the SRE. Specific items of work included the removal and disposal of primary sodium, sodium piping and tanks; the removal of the remaining secondary sodium system piping, pumps, tanks and components; the removal of systems for the cover gas, heaters, and instrumentation; the removal of the core components; the dissection and disposal of the reactor vessel, liner, and the activated concrete encasing the liner; the cleaning of piping galleries and floor trenches; the decontamination and reinstallation of shield plugs and cover plates; the removal of the fuel element wash cells and below-grade earth as required to eliminate contamination; and the backfilling, compacting, and patching of the floor with concrete to match the existing floor.[3]

- In December 1974, Rockwell made plans to ship SRE fuel to Savannah River.[4]

- In 1975, Rockwell further dismantled and decontaminated the partially dismantled SRE. Rockwell removed reactor vessels and sodium systems, chemically passivated residual sodium, stored bulk primary sodium, and scrapped or buried components. The remaining facilities were decontaminated. [5, 6]

- In December 1976, Rockwell discussed its plan to excavate and repair the high bay. Rockwell's plan called for the excavation of all concrete surrounding the reactor vessel, excavation of all concrete structures enclosing the fuel storage cells, excavation of the wash cells structure including the valve pit, and excavation of the hot cell structure. Rockwell would backfill the excavations with clean concrete rubble and sand and would then pour a new high bay floor.[7]

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[1] North American Rockwell Corporation Internal Letter from R. K. Owen to W. F. Heine, re: *Water Seepage Hole in the SRE Wash Cell Valve Pit*, January 15, 1970.
[2] North American Rockwell Internal Letter from W. F.eine to R. W. Hartzler, re: *Use of SRE Facility for Storage*, October 30, 1972.
[3] North American Rockwell Corporation, Environmental Assessment, *Decommissioning of the SRE*, July 27, 1973.
[4] Rockwell International, Telephone Conversation Record from W. F. Heine to B. Chandler, re: *Shipment of SRE Fuel to Savannah River*, December 11, 1974.
[5] Ureda, B. and Heine, W., *Facilities Dismantling Plan for SRE*, Atomics International Report No. FDP-704-990-003, June 24, 1975, pp. 9, 13, 17-18.
[6] Sontag, S., *Passivation of Remaining Sodium in SRE Core Vessel, Bldg. 143, Detailed Working Procedure*, North American Rockwell Report No. N704-DWP-990-009, October 10, 1975.
[7] Rockwell International Internal Letter from B. F. Ureda to W. F. Heine, re: *SRE Hot Cells D & D*, December 1, 1976.

- In June 1977, Rockwell informed the Energy Research and Development Administration (ERDA) that the plutonium content in 55,000 pounds of SRE primary sodium (in 158 drums) that it planned to ship to Hanford for storage, was below the detection limit of 2 x 10^{-7} µCi/g.[1]

- In February 1979, Rockwell excavated, removed, and shipped to Beatty, Nevada, for disposal, the SRE's 4-foot-thick concrete biological shield. Figure 2.1.3i shows the excavation of reactor shielding, Figure 2.1.3j shows the excavation of concrete surrounding the fuel storage cells, and Figure 2.1.3k shows below-ground excavation. According to Rockwell, tritium (H-3) produced in the reactor would have diffused into the concrete and the soil with which the concrete was in contact. The tritium would also have diffused into groundwater in the region of the SRE. Rockwell considered the releases to be below regulatory limits in effect at the time.[2]

- Between November 1979 and September 1982, ANL conducted a series of radiological measurements and analyses at the SRE. Activities included conducting instrument and smear surveys for radioactive contamination and collecting and analyzing material samples. During the survey in the summer of 1982, 46 locations with elevated radioactivity were detected. Of these areas, 27 indicated contamination in excess of ANL's acceptable limits. However, all the areas were subsequently cleaned to below detectable limits before the survey was completed. ANL collected sludge samples from five access points in the sanitary sewer and storm sewer systems. Elevated concentrations of Cs-137 were detected in three samples from the storm sewer, and Sr-90, Cs-137, and U were detected in the samples from the sanitary sewer as it exited Building 4143. ANL concluded that the effluent from the outfall of the storm and sanitary sewer lines was potentially contaminated.[3]
- In 1983, Rockwell conducted a final release survey of Building 143 that included the below-grade hot cell, the high bay, the overhead bridge cranes, the radioactive exhaust systems, the mezzanine offices, main floor offices, and main floor support areas. Rockwell found all below-grade surface radiation readings to be less than 0.1 mrad/h. All below-grade soil samples registered less than 100 pCi/g. Rockwell's average background reading in the high bay was 0.04 mrad/h. Smear survey results from the high bay were less than 10 dpm/100 cm^2 alpha activity, and less than 70 dpm/100 cm^2 beta-gamma activity. All results were below Rockwell's applicable limits for release for unrestricted use.[4]

- In 1983, Rockwell surveyed Region IX of the SRE facility. This area comprised the paved area surrounding the northern portion of Building 4143 including the drainage channel along the north side of the fence. Rockwell found all surface radiation readings

[1] Rockwell International Letter from W. D. Kittinger to C. D. Jackson, ERDA, re: *Shipment of SRE Sodium to Hanford*, June 7, 1977.
[2] Tuttle, R. J., *Tritium Production and Release to Groundwater at SSFL*, Rockwell International Report No. N001SRR140120, December 6, 1991, pp. 9-17, 46-48, 54.
[3] Argonne National Laboratory, *Post Remedial Action Survey Report for the Sodium Reactor Experiment (SRE) Facility, Santa Susana Field Laboratories, Rockwell International, Ventura County, California*, DOE-EV-0005-46, ANL-OHS/HP-84-101, February 1984, pp. iii-iv, 15.
[4] Wallace, J. H., *Radiological Survey Results – Release to Unrestricted Use, SRE Building 143*, Rockwell International Report No. N704TI990038, May 31, 1983, pp. 3, 8-9.

to be less than 0.1 mrad/h. All soil samples registered less than 100 pCi/g. All results were below Rockwell's applicable limits for release for unrestricted use.[1]

- In 1983, Rockwell surveyed Region VIII of the SRE facility. This area comprised the paving to the south and west of Building 4143 to approximately the enclosure for the standing tanks T1, T2 and T3, including the drainage channel along the southwest to south edge of the paved area. Rockwell found all surface radiation readings to be less than 0.1 mrad/h. All results were below Rockwell's applicable limits for release for unrestricted use.[2]

- In 1983, Rockwell surveyed Region III of the SRE facility. This area adjoined Building 4163, the Component Equipment Repair Facility (CERF), and comprised the entrance approach to the SRE complex. Rockwell found all surface radiation readings to be less than 0.1 mrad/h. All results were below Rockwell's applicable limits for release for unrestricted use.[3]

- On July 23, 1985, the DOE released the SRE complex for unrestricted use and removed it from the DOE's radiologically contaminated Surplus Facilities Program.[4]

- In July 2000, Boeing excavated, removed, and surveyed for radiological contamination the drainage lines, septic tank and leach field that served Buildings 4003, 4143, and 4163. Instrument measurements and wipe samples were collected from the septic tank and associated piping. Boeing found no man-made gamma emitting radionuclides from gamma spectroscopy of concrete debris from the septic tank. The septic tank was full of a mixture of debris and soil. Boeing collected seven soil/gravel samples from the debris within the septic tank, its inlet pipes, and its outlet pipes. Using gamma spectroscopy, Boeing detected Cs-137 in the inlet pipes and inlet chamber in concentrations up to 2.5 pCi/g. These materials were packaged as radioactive waste per Boeing's policy. Boeing also collected four soil samples from beneath the septic tank, but no man-made radionuclides were identified in these samples. Boeing collected seven soil/gravel samples along the length of the leach field lines. The highest concentration detected was Cs-137 at 0.65 pCi/g, which Boeing considered to be consistent with its local background level in 2001.[5]

- In October, November, and December 2000, Pacific Materials Laboratory, Inc. provided compaction tests during the structural backfill of two 20-foot deep excavations that remained at the conclusion of the demolition and removal of Buildings 4003 and 4143. Rough grading activities were conducted by engineering contractors Standard Industries of Ventura. Prior to fill placement using heavy grading equipment, minor isolated

[1] Wallace, J. H., *Radiological Survey Results Release to Unrestricted Use, SRE Region IX*, Rockwell International Report No. N704TI990035, May 31, 1983, pp. 3, 7-8.
[2] Wallace, J. H., *Radiological Survey Results Release to Unrestricted Use, SRE Region VIII*, Rockwell International Report No. N704TI990034, May 13, 1983, pp. 3, 7-8.
[3] Wallace, J. H., *Radiological Survey results – Release to Unrestricted Use, SRE Region III*, Rockwell International Report No. N704TI990029, May 13, 1983, pp. 3, 7-8.
[4] Voigt, W. R., Jr., *Certification for Unrestricted Use of the Sodium Reactor Experiment (SRE) Complex and the Hot Cave Facility (Building 003)*, U.S. Department of Energy, July 23, 1985.
[5] Letter from B. D. Sujata, The Boeing Company, to J. Evans, County of Ventura, re: *Information Regarding Permit – Septic Tank and Leach Field*, October 23, 2001.

depressions and irregularities within the bedrock surface were backfilled with ¾-inch gravel to less than 1 foot in thickness to create a nearly flat surface in the bottom of each excavation. Fill soils placed in the excavation consisted of imported soils exported from an off-site borrow site as well as on-site native soils local to the building sites. The limits of the excavation for Building 4003 are shown in Figure 2.1.3h.[1]

- In 2001, Boeing conducted soil sampling at the former SRE site in areas planned for excavation due to high mercury levels. Boeing found no elevated radiation levels in these areas, but found elevated radiation levels in two locations in a drainage ditch northeast of the former Building 4143 site. Following excavation, confirmation sampling determined that Cs-137 levels were below Boeing's cleanup level of 9.2 pCi/g.[2]

- In 2001, the California Department of Health Services (DHS) conducted soil sampling at the location of elevated soil mercury concentrations, east of the former location of the SRE. The agency found gamma spectral results and isotopic analysis for uranium and thorium to be consistent with DHS background levels.[3]

Radiological Use Authorizations: The following radiological use authorizations were assigned to Building 4143.

- Use Authorization No. 94, issued July 8, 1975, to expire on July 8, 1976, for the decontamination and disposition of the facilities program for the SRE. Authorized materials were unknown quantities of uranium, thorium, and "minor" amounts of transuranic elements, activation products, and mixed fission products.[4]
- Use Authorization No. 94A, issued July 8, 1976, to expire July 8, 1977, for the decontamination and disposition of the facilities program for the SRE. Authorized materials were unknown quantities of uranium, thorium, and "minor" amounts of transuranic elements, activation products, and mixed fission products.[5]

- Use Authorization No. 94C, issued July 8, 1978, to expire July 8, 1979, for the decontamination and disposition of the facilities program for the SRE. Authorized materials were unknown quantities of uranium, thorium, and "minor" amounts of transuranic elements, activation products, and mixed fission products.[6]

Former Radiological Burial or Disposal Locations: A sanitary septic tank was installed for Buildings 4003, 4143, and 4163 as part of the original construction in 1956-57. The system, tank, and leach field were abandoned in 1964 when the complex was connected to the site-wide

[1] Pacific Materials Laboratory, Inc., *Final Compaction Test Report Structural Backfill of Former Buildings 4143 and 4003 Test Cells, Area IV Rocketdyne, Santa Susana Field Laboratory, Ventura County, CA*, January 2, 2001.
[2] Letter from P. Rutherford, The Boeing Company, to S. Hsu, Department of Health Services, re: *Request for Approval to Ship Soil from SRE to a Landfill*, September 25, 2001.
[3] California, Department of Health Services, Radiologic Health Branch, *Preliminary Radiological Survey of Mercury Contaminated Soils East of the Former SRE Building – Survey Date: July 26, 2001*, November 19, 2002.
[4] Use Authorization No. 94 for the Decontamination and Disposition of the Facilities Program for the SRE, issued July 8, 1975.
[5] Use Authorization No. 94A for the Decontamination and Disposition of the Facilities Program for the SRE, issued July 8, 1976.
[6] Use Authorization No. 94C for the Decontamination and Disposition of the Facilities Program for the SRE, issued July 8, 1978.

sewage treatment plant. In 2000, the septic tank, leach field, and associated piping were excavated and removed.[1]

Aerial Photographs: Aerial photographs show undeveloped land until a 1957 photograph when an irregularly shaped building is identified as Building 4143. A possible crane and overhead piping are identified in the 1957 photograph. In the 1959, approximately 1960, 1965, 1967, 1972, and 1978, photographs, storage tanks, overhead piping, an open storage area, possible debris, and a stain are identified. Surface water flow from the north and south sides of the building are shown to flow to a small pond located northeast of Building 4143. In the 1980 photograph, excavation around the northeast corner of Building 4143 is observed. In the 1983 photograph, open storage is observed at the northeast corner of Building 4143. Building 4143 is present in the 1988 and 1995 photographs, but a vegetated area is seen in place of Building 4143 in the 2005 and 2009 photographs.[2]

Radionuclides of Concern: Building 4143 housed the SRE reactor that initially included a slightly enriched uranium reactor core and later included a uranium-thorium metal alloy core. Possible radionuclides include U-238, U-234, U-235, U-236, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, neptunium-237 (Np-237), Th-232, H-3, Na-22, Na-24, Cr-51, Mn-54, Fe-59, Co-60, Kr-85, Sr-89, Sr-90, Sb-125, I-129, I-131, Cs-134, Cs-137, Ce-141, Ba (La)-140, technetium-99 (Tc-99), Nb-95, Ru-103, Ru-106, Xn-133, Xe-135, Pm-147, Sm-151).[3, 4, 5] All radionuclides of concern listed with the exception of Na-24, Cr-51, Mn-54, Fe-59, Kr-85, Sr-89, I-131, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xe-133, Xe-135, Pm-147 and Sm-151 are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives except for Sm-151 for which no analytical method is available. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Building 4143 was located south of a drainage divide. Based on general site topography, surface water flows into the storm drain system located south of the site and into the drainage channel located north of the site, which both connect to the SRE retention pond located northeast of the site. Outflow from the retention pond was initially onto the NBZ and Brandeis-Bardin Institute land. In 1959, a 6-foot diameter overflow pipe and a pumped sump were installed at the confluence of the two main drainage channels upstream of the pond. Water was then pumped through a 4-inch diameter overland pipe to a channel connecting to the Area II ponds. The overflow from these ponds is into Bell Canyon and thence to the Los Angeles River.[6]

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[1] Letter from B. D. Sujata, The Boeing Company, to J. Evans, County of Ventura, re; *Information Regarding Permit – Septic Tank and Leach Field*, October 23, 2001.
[2] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[3] Hart, R. S., *Distribution of Fission Product Contamination in the SRE*, Atomics International Report No. NAA-SR-6890, March 1, 1962, pp. 8-27.
[4] Kinzer, J. and Crawford, A. C., *SRE First Core Fuel*, Atomics International Technical Data Record No. 5301, May 16, 1960, pp. 1-7.
[5] Letter from Heine, W. F., Atomics International, to Proctor, J. F., E. I. du Pont de Nemours & Company, re: *Fission Product and Fissile Content of SRE Fuel*, July 2, 1975.
[6] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.

Radiological Contamination Potential: The preliminary MARSSIM classification for the Building 4143 area is Class 1 due to its documented releases and its former use as the SRE reactor building.

Recommended Locations for Soil/Sediment Sampling:

Plate 1 and Figure 2.1 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.

2.1.4 Building 4153 Area

Site Description: The Building 4153 area comprises Building 4153, and the land surrounding this building located in the SRE complex at the northeast corner of Building 4143 at the end of E Street. Building 4153 was constructed in approximately 1957, as a service building for the SRE.[1, 2] Figure 2.1.4a provides a current photograph. Figure 2.1.4b provides a site layout, and Figures 2.1.4c, 2.1.4d, and 2.1.4e show Building 4153 undergoing demolition. The location of Building 4153 in the SRE complex is presented in Figures 2.1.1f and 2.1.1g.

Building Features: Building 4153 was a small sheet-metal building located at the northeast corner of Building 4143. This is shown on the Building 4143 Floor Plan presented in Figure 2.1.3b. The site layout is presented in Figure 2.1.4b. Building 4153 contained an underground vault, a 2,620-gallon secondary fill tank, a diffusion cold trap (vapor condenser) attached to the bottom of the secondary fill tank, an 80-gallon transfer tank, a sodium melt station, piping, valves, a freeze trap, a vapor trap, electrical controls, and switch gear.[1]

Former Use(s): Building 4153 was the SRE sodium service building.[2]

Information from Interviewees: In 2010, a number of former workers were interviewed about their experiences at the SSFL. One had knowledge of Building 4153. Excerpts from his comments are presented below.

- "Building 4153, the Sodium Service Building, contained the secondary sodium storage tank and the sodium melt station."[3] This interviewee worked at the SSFL between 1958 and 1968.

Radiological Incident Reports: There have been several incidents associated with Building 4153 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 4153 Incident Report Summary

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A0340	3/12/1960	NA SERVICE VAULT		SODIUM SERVICE VAULT SPILL CLEAN-UP RESULTED IN FIRE IN SODIUM CONTAINER.
A0426	4/4/1960	NA SERVICE VAULT	ACP	SRE SODIUM SERVICE VAULT MODIFICATION IGNITED TETRALIN DURING WELDING.
A0010	4/10/1961	NA SERVICE VAULT	MFP	SODIUM FIRE IN SODIUM SERVICE VAULT.

[1] Ureda, B. and Heine, W, *Facilities Dismantling Plan for SRE*, Atomics International Report No. FDP-704-990-003, June 26, 1975, pp. 76-77.
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[3] Interview No. 300 of former worker conducted by the DOE and EPA on July 16, 2010, p. 2.

Building 4153 Incident Report Summary (continued)

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A0532	1/29/1962	SRE NA VAULT		EMPLOYEE REPORTED INJURED AND CONTAMINATED LEG ON THE NEXT DAY.
A0013	1/30/1962	SRE NA VAULT	MFP	EMPLOYEE MOVED CONTAMINATED ITEM INTO CLEAN AREA WITH OUT HP APPROVAL.
A0533	3/6/1962	NA SERVICE VAULT	MFP	WORKER IN SODIUM SERVICE VAULT W/O REQUIRED PERMIT OR CONTROLS.

*Isotopes are written as they are presented in the incident database. The research team believes that MFP is an acronym for mixed fission products and ACP is an acronym for activation products.

- On March 12, 1960, a crew of men was going to work on a filter and cold trap (vapor condenser) in the Sodium Service Vault when one of the men noticed sodium leaking from a valve. The sodium had leaked over some of the piping and onto the floor of the vault. The fire department was notified and the sodium was removed from the vault by putting it in a 55-gallon drum filled with calcium carbonate. The sodium was measured at 1,300 dpm/g and the radiation field the men were working in was 400 mrad/h. At approximately 10:45 a.m., a fire started in one of the 55-gallon drums, but it was quickly put out with an argon purge. A few minutes later, a fire was noticed in the sodium service vault. The vault workers donned contained breathing apparatus and some assisted the firemen in trying to put out the fire. Eventually, the vault had to be sealed and purged with argon to put the fire out. During the fire, a high volume air sample was taken and measured 1.64×10^{-10} $\mu Ci/cm^3$. All personnel and equipment in the immediate area were smeared and found free of contamination (Incident Report A0340).[1]

- On April 4, 1960, a fire started in the Sodium Service Vault when welding sparks ignited tetralin on the floor of the vault. Approximately 2 quarts of residual tetralin was on the floor when tetralin lines had been removed for modification. The area and personnel involved were monitored and no contamination was found. A high volume air sample was also taken and revealed no radioactive airborne contamination (Incident Report A0426).[2]

- On April 10, 1961, a contaminated sodium fire erupted in the Sodium Service Vault area. Sodium that had leaked onto the floor of the vault was being removed by being placed in 35-gallon drums with calcium carbonate. Once all the sodium from the floor was drummed, sodium-covered insulation from the cold trap flange was placed in the drum. An explosion occurred and an employee nearby started pouring calcium carbonate on the contents of the drum. Another explosion occurred, accompanied by flames, and the drum was capped with a lid. At this time, an employee in full face mask carried the drum out

[1] Hetzler, D.K., Atomics International Internal Letter, re: *Radiological Safety Incident Report, SRE Sodium Service Vault, 3/12/60*, March 30, 1960.
[2] Marcotte, E.J., Atomics International Internal Letter, re: *Radiological Safety Incident Report, Sodium Service Vault SRE, 4/4/60*, April 19, 1960.

of the area so fire fighting could be effectively employed. After the smoking drum was removed another bag of calcium carbonate was emptied into the drum and an argon purge was started under the lid of the drum. Calcium carbonate was banked along the bottom of the drum to prevent any sodium from leaking out. The drum started to cool off and it was placed in a 55-gallon drum as secondary containment with additional calcium carbonate. Personnel involved received nose smears, but all were negative. A high volume air sample taken in the Sodium Service Vault showed airborne activity at 6.3 x 10^{-10} $\mu Ci/cm^3$. Smears taken in the surrounding area were all less than 30 dpm. The cause of the fire appeared to be use of damp calcium carbonate (Incident Report A0010).[1]

- On January 29, 1962, an employee scratched his leg while working in the Sodium Service Vault. He did not report the injury or have it checked out at the time. The following day he became contaminated again. The front portion of the employee's leg was contaminated to 1.3 mrad/h. The wound itself was free from detectable contamination. The Sodium Service Vault was noted as a red tagged area. The employee had been handling waste from this area with a radiation field of 250 mrad/h before the contamination was detected (Incident Report A0532).[2]

- On January 30, 1962, a tagged area entry permit for work in the Sodium Service Vault was approved for the first shift of workers. The permit was specified to expire at 4:00 p.m. A tour of the SRE facility at 6:30 p.m. revealed that four men were working in the area. Two men were in the vault welding the hot trap (heater) and two men were packaging waste. All four men had initialed the entry permit after it expired. One of the employees requested the health physicist to monitor some radioactive waste. The waste was found to be 230 mrad/h, an abnormally high reading for waste from the Sodium Service Vault. A check of personnel was immediately conducted. One employee was found to have contamination on his hands (1.2 mrad/h), leg (1.3 mrad/h), shoe (1.2 mrad/h), socks (0.7 mrad/h), and nose (nasal smear 374 dpm). Another employee had 0.5 mrad/h contamination on his hand because he did not have rubber gloves on under his canvas work gloves. Both men were successfully decontaminated. In an effort to pinpoint the cause of the contamination, an employee brought a flashlight into the Health and Safety Office, an untagged area, for a smear survey. The flashlight was found to be contaminated to 120 dpm beta-gamma. Eventually, a new tagged area entry permit was requested to complete the work in the Sodium Service Vault. Numerous radiological safety rules and practices were violated in this incident and rule infraction notices were issued (Incident Report A0013).[3, 4]

- On March 6, 1962, an employee removed tape over a weld in the SETF high bay and NaK ran out onto his hand and leg. He "flipped" the NaK off his hands, but his coveralls started to burn. He took the coveralls off and headed for the shower. The Fire

[1] Lane, W.D., Atomics International Internal Letter, re: *Radiological Safety Incident Report, SRE Sodium Service Vault, 4/10/61*, April 28, 1961.
[2] Health and Safety Department, Atomics International Letter, re: *Notice of Health and Safety Rule Infraction*, February 7, 1962.
[3] Denham, R.S., Atomics International Internal Letter, re: *Unusual Incident – SRE – January 30, 1962*, February 5, 1962.
[4] Health and Safety Department, Atomics International Internal Letter, re: *Notice of Health and Safety Rule Infraction*, February 7, 1962.

Department cleaned up the NaK. Health and Safety monitored the area and found no detectable beta-gamma contamination. The employee was found free of contamination. He did not realize there was NaK in the system and was not dressed in proper protective gear (Incident Report A0533).[1]

Current Use: Building 4153 was demolished in 1978. Figures 2.1.4c through 2.1.4e show stages in the demolition process.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): A chronology of radiological investigations at this building is as follows:

- By 1975, Rockwell had drained the secondary fill tank. At this time, Rockwell found that the diffusion cold trap, welded to the underside of the secondary fill tank, contained between 5 and 15 cubic feet of solid sodium. Rockwell planned to passivate the sodium in Building 4163 and cut the cold trap loose. After removing the sodium systems and deactivating the electrical and gas services, Rockwell planned to have Building 4153 razed by a salvage contractor.[1]

- In May 1977, Rockwell requested that Building 4153 be "razed" by a demolition contractor who would accept the resulting salvage materials in exchange for the labor required. This demolition contractor was also required to remove the water tank support structure, the vent system blower support structure, both located above the inert gas system on the north SRE wall, and the shed-like structure located between the SRE and vault.[2]

- In 1978, Rockwell undertook the demolition of Building 4153, part of which was underground. The concrete surfaces of the sodium service vault had become contaminated during reactor operations. Rockwell excavated an access ramp at the northeast corner of Building 4143 and found radiological contamination as high as 13,000 pCi/g in the soil and in cracks in the bedrock surrounding the footing of Building 4143. Rockwell packaged contaminated rubble, soil, and bedrock in tri-wall cardboard containers of 2000-pound capacity, mounted on plywood skids. Rockwell shipped this contaminated waste to two unnamed burial sites. Uncontaminated concrete was used as backfill material. The area was backfilled to provide machine access for further decontamination activity within the high bay of Building 4143.[3] Figures 2.1.4c through 2.1.4e show stages in the demolition process.

- In September 1982, ANL conducted an independent verification survey in the region of former Building 4153. This included instrument and smear surveys and analysis of

[1] Sessions, S.D., Atomics International Internal Letter, re: *Radiological Safety Incident Report, SETF High Bay, Bldg 24, 3/6/62*, March 21, 1962.
[2] Rockwell International Internal Letter from B. F. Ureda to S. Cunha, re: *Disposition of Building 153 – Sodium Service Building*, May 25, 1977.
[3] Rockwell International, *Sodium Reactor Experiment Decommissioning Final Report*, ESG-DOE-13403, August 15, 1983, pp. 115-120, 166-171.

material samples. ANL found that radiological contamination was below the limits specified in the Draft ANSI standard No. N13.2 and the 1982 NRC guidelines.[1]

- In 1983, Rockwell conducted a radiological survey of the paved area surrounding the northern portion of Building 4143 including the drainage path along the north side of the fence. Survey results indicated an average reading of 0.04 mrad/h for surface gamma radiation, and 108 soil samples were found to have an average of 33 pCi/g of gross detectable beta activity, with a maximum of 98 pCi/g. Rockwell's acceptable limit for soil was 100 pCi/g of gross detectable beta activity. All survey results were below Rockwell's applicable limits for release for unrestricted use.[2]

Radiological Use Authorizations: The DOE released the area for unrestricted use as part of the SRE release dated July 23, 1985.[3]

Former Radiological Burial or Disposal Locations: Building 4143, adjacent to Building 4153, had a sanitary septic tank installed as part of the original construction for Buildings 4003, 4143, and 4163 in 1956-57. The system, tank, and leach field were abandoned in 1964 when the complex was connected to the site-wide sewage treatment plant. In 2000, the septic tank, leach field, and associated piping were excavated and removed.[4]

Aerial Photographs: Aerial photographs show undeveloped land until the 1957 aerial photograph when a small rectangular building is identified as Building 4153. Building 4153 is seen in the 1959, approximately 1960, 1965, 1967, and 1972 photographs. In the 1978 photograph, Building 4153 appears to have been demolished. In the 1980 photograph, an excavation is observed in the location of Building 4153. In the 1983 photograph, open storage is observed in the location of former Building 4153. Bare ground is observed in the 1988 and 1995 photographs, and a vegetated area is seen in the 2005 and 2009 photographs.[5]

Radionuclides of Concern: Building 4153 was part of the SRE reactor complex and was located on the north side of Building 4143. Possible radionuclides include U-238, U-234, U-235, U-236, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Th-232, H-3, Na-22, Na-24, Cr-51, Mn-54, Fe-59, Co-60, Kr-85, Sr-89, Sr-90, Sb-125, I-129, I-131, Cs-134, Cs-137, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xn-133, Xe-135, Pm-147, Sm-151.[6, 7, 8] All radionuclides of concern listed with the exception of Na-24, Cr-51, Mn-54, Fe-59, Kr-85, Sr-89, I-131, Ce-141, Ba (La)-

[1] Argonne National Laboratory, *Post Remedial Action Survey Report for the Sodium Reactor Experiment (SRE) Facility, Santa Susana Field Laboratories, Rockwell International, Ventura County, California*, DOE-EV-0005-46, ANL-OHS/HP-84-101, February 1984, pp. 1-3, 15.
[2] Wallace, J. H., *Radiological Survey Results Release to Unrestricted Use, SRE Region IX*, Rockwell International Report No. N704TI990035, May 31, 1983, pp. 3-8.
[3] U.S. Department of Energy, *Certification for Unrestricted Use of the Sodium Reactor Experiment (SRE) Complex and the Hot Cave Facility (Bldg. 003)*, July 23, 1985.
[4] Letter from B. D. Sujata, The Boeing Company, to J. Evans, County of Ventura, r: *Information Regarding Permit Septic Tank and Leach Field*, October 23, 2001.
[5] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[6] Hart, R. S., *Distribution of Fission Product Contamination in the SRE*, Atomics International Report No. NAA-SR-6890, March 1, 1962, pp. 8-27.
[7] Kinzer, J. and Crawford, A. C., *SRE First Core Fuel*, Atomics International Technical Data Record No. 5301, May 16, 1960, pp. 1-7.
[8] Letter from Heine, W. F., Atomics International, to Proctor, J. F., E. I. du Pont de Nemours & Company, re: *Fission Product and Fissile Content of SRE Fuel*, July 2, 1975.

140, Nb-95, Ru-103, Ru-106, Xe-133, Xe-135, Pm-147 and Sm-151 are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives except for Sm-151 for which no analytical method is available. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Building 4153 was located south of a drainage divide. Based on general site topography, surface water flows into the drainage channel located north of the site, which connects to the SRE retention pond located northeast of the site. Outflow from the retention pond was initially onto the NBZ and Brandeis-Bardin Institute land. In 1959, a 6-foot diameter overflow pipe and a pumped sump were installed at the confluence of the two main drainage channels upstream of the pond. Water was then pumped through a 4-inch diameter overland pipe to a channel connecting to the Area II ponds. The overflow from these ponds is into Bell Canyon and thence to the Los Angeles River.[1]

Radiological Contamination Potential: The preliminary MARSSIM classification for the Building 4153 area is Class 1 due to its former use as a service building for the SRE reactor.

Recommended Locations for Soil/Sediment Sampling:

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

Previous characterization studies for the Building 4153 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 4153 area. This includes the following Building 4153 areas and appurtenances:

- The flat and low-lying areas surrounding and in the location of Building 4153 where open storage was identified from aerial photographs. Radionuclides originating from Buildings 4143 and/or 4153 may have migrated to these areas via surface water flow or airborne releases.

- The drainage channel located north of the site that connects to the SRE retention pond. Spills occurred in Building 4153 that contained an underground vault, a 2,620-gallon secondary fill tank, a diffusion cold trap attached to the bottom of the secondary fill tank, an 80-gallon transfer tank, a sodium melt station, piping, valves, a freeze trap, and a vapor trap.

2.1.5 Building 4163 Area

Site Description: The Building 4163 area comprised Building 4163 and the land surrounding it, located in the SRE complex approximately 50 feet east of Building 4143, at the end of E Street. Building 4163 was constructed in 1958 as a site service building.[2, 1] Figures 2.1.5a through

[1] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.
[2] Wallace, J. H., *Radiological Survey Results – Release to Unrestricted Use, SRE Building 163*, Rockwell International Report No. N704TI990039, April 8, 1982, pp. 3-7.

2.1.5c provide a current photograph, a floor plan, and a 1977 aerial photograph. The location of Building 4163 in the SRE complex is presented in Figures 2.1.1f and 2.1.1g.

Building Features: Building 4163 was a rectangular building located about 50-feet east of Building 4143. Building 4163 was built in two sections; the west side comprised a steel prefabricated Butler building structure approximately 40 feet by 40 feet, separated from the east side by a floor-to-ceiling sheetrock wall. The west side contained a change room, a 1-ton crane, sprinklers, and an exhaust system.[2, 3] The east side was a 3,200 square feet box shop, which contained a 5.5-foot deep SRE operations mockup pit with concrete walls and a soil bottom.[1] Figure 2.1.5b presents a floor plan. The location of the mockup pit on the floor plan is unclear. Figure 2.1.5c provides an aerial view of Building 4163 taken in July 1977.

Former Use(s): Building 4163 was the Component Equipment Repair Facility (CERF) and Box Shop. The west side was used for the repair of radiologically contaminated equipment, such as primary sodium pumps and valves, while the east side, containing a pipe shop and machine shop, was used for the construction of wooden shipping containers and for non-nuclear support work.[4,5]

Information from Interviewees: In 2010, a number of former workers were interviewed about their experiences at the SSFL. One had knowledge of Building 163. Excerpts from his comments are presented below.

- "One end of Building 4163 was used for the disassembly and maintenance of radioactive and non-radioactive SRE components and equipment. The remainder of the building was a machine shop. . . 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 non-radioactive systems. The building was decontaminated as necessary so that personnel access was generally unrestricted."[6] This former employee worked at the SSFL between 1958 and 1968.

Radiological Incident Reports: There have been several incidents associated with Building 4163 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.

[1] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[2] Rockwell International letter from C. C. Comnners to L. Lanni, DOE, re: *Building 003 and Building 163 Ownership*, March 25, 1982.
[3] Ureda, B. F., *SRE Activity Requirement 24, Decontamination of Building 163 (CERF)*, Rockwell International Report No. N704ACR990020, February 15, 1977, p. 2.
[4] Owens, D. E., *Radiological Survey Results - Release to Unrestricted Use, SRE Region II (Building 163, Box Shop)*, Rockwell International Report No. N704TI990028, May 4, 1978, pp. 3, 5-7.
[5] Owen, R. K., *Radiological Survey Plan, Support of D & D Program Operations at T-143 (SRE)*, Rockwell International Report No. N704TP990008, September 15, 1981, p. 2.
[6] Interview No. 300 of former worker conducted by the DOE and EPA on July 16, 2010, p. 2.

Building 4163 Incident Report Summary

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A0424	2/13/1960	SRE PIPE SHOP	ACP	EMPLOYEES UNWRAPPED CONTAMINATED PUMP FOR REPAIR IN CLEAN PIPE SHOP.
A0381	8/5/1964	SRE AREA		IMPROPER HANDLING OF SODIUM COMPONENTS CONTAMINATED PERSONNEL AND AREA.
A0542	9/15/1964	SRE BLDG 163	MFP	DRUM CONTAINING PRIMARY PIPING FROM SRE WAS FOUND SMOKING IN CERF BLDG.
A0461	12/7/1964	SRE CERF	ACP	ARC CUTTING PLUGGED FILTERS CAUSING HIGH AIRBORNE ACTIVITY.
A0385	12/21/1964	T163 CERF		WORK IN THE CONTAMINATED EQUIPMENT REPAIR FACILITY CONTAMINATED 3 EMPLOYEES.
A0600	11/1/1966	CERF T163 BLDG	MFP	PRIMARY SODIUM VALVE CLEANING RESULTED IN EXPLOSION & CONTAMINATION SPREAD.

*Isotopes are written as they are presented in the incident database. The research team believes that MFP is an acronym for mixed fission products and ACP is an acronym for activation products.

- On February 13, 1960, an employee removed a contaminated pump impeller (126 dpm/100 cm^2 beta-gamma) from its protective wrapping in a clean area of the SRE Pipe Shop. A health physicist questioned why this was done and the employee noted there was no other area available to perform the repair operation on the part. The health physicist noted that if the health physics department had been notified arrangements would have been made for a controlled work area. The impeller was rewrapped until it could be decontaminated. The incident report notes that the supervisor involved showed poor management and the employee has constantly shown a lack of respect for established radiological safety practices (Incident Report A0424).[1]

- On August 5, 1964, personnel and equipment were contaminated in the Sodium Component Cleaning Area. An employee discovered his hands and feet were contaminated on a routine checkout survey. Smears of the forklift he had been driving showed 200 to 300 dpm/100 cm^2 beta-gamma. Two bags of radioactive waste on the forklift were 700 dpm/100 cm^2 beta-gamma on the outside surface. Other members of the crew were alerted to the contamination and brought in for monitoring. Contamination of the four men involved ranged from 7 to 18 mrad/h on the shoes, 2 to 6 mrad/h on the hands, and nasal smears ranging from 30 to 2,100 dpm beta-gamma. The rest of their bodies showed nothing above background levels. The men were decontaminated and

[1] Health Physics Department, Atomics International Internal Letter, re: *Health Physics Notice of Rule Infraction*, February 13, 1960.

released, although two men were placed on restriction until bioassay results were received.

An extensive smear survey was then conducted in all areas and building where the men had been working as well as all equipment that had been used by the men. Areas found to have contamination levels exceeding "permissible limits" included: door handles between the SRE lobby and hallway (370 dpm beta-gamma), door handles in the CERF room (1,200 dpm beta-gamma), the ground in front of the CERF door (120 dpm beta-gamma), and the cherry picker seat/steering wheel (300 dpm beta-gamma), and running board (110 dpm beta-gamma). Additional smear surveys found maximum levels of contamination as follows: crane hook on steam pad (3.4×10^4 dpm beta-gamma), Dowanol tank on the steam pad (2.7×10^4 dpm beta-gamma), concrete steam-cleaning pad (1.8×10^3 dpm beta-gamma), concrete oil-bath pad (1.3×10^4 dpm beta-gamma), and floor of building containing oil-bath tank (3.6×10^3 dpm beta-gamma). Both concrete pads and most of the items on the pads were contamination to some level, but none to the levels described above. Smears of the asphalt between the two pads were below 30 dpm beta-gamma.

The incident appears to have resulted from handling of a contaminated pipe during various stages of the component cleaning operation. Nasal contamination may have resulted from the initial unwrapping of the pipe where airborne release may have occurred, or from personnel touching their nose with contaminated hands. The incident report suggests temporarily suspending operations until the exact cause of contamination is found and corrective measures can be implemented (Incident Report A0381).[1]

- On September 15, 1964, an employee noticed smoke coming from under the lid of a 55-gallon waste disposal drum at the CERF. The drum was approximately half full of pipes containing sodium contaminated with fission products. The fire department was called and they arrived in full protective gear. They opened the drum and poured a bag of calcium carbonate in to cover all of the sodium. The drum was closed. No contamination to personnel or equipment resulted from the incident (A0542).[2]

- On December 7, 1964, an arc welder cutting through a contaminated steel and sodium component had to stop because the smoke inside the glove box he was working in obscured his vision. Smoke then started coming out of various openings in the glove box so the operation was shut down and personnel were requested to leave the area. A high volume air sampler that was started at the beginning of the cutting operation was shut off after a 10-minute period and indicated activity of 1.76×10^{-8} $\mu Ci/cm^3$. Two employees had nasal smears that revealed contamination of 72 and 150 dpm and a fireman responding to the incident had a nasal smear of 18 dpm. The men were restricted from radioactive areas until bioassay results were reviewed. The incident report notes that the health physics department should be given a copy of any written procedure for work

[1] Townsend, R. E., and C. L. Young, Atomics International Internal Letter, re: *Radiological Safety Incident Report*, August 23, 1964.
[2] Young, C. L., Atomics International Internal Letter, re: *Incident Report, Building 163 (CERF), 9-15-64*, September 17, 1964.

involving radioactive material with sufficient time prior to the start of the job to fully evaluate hazards involved (Incident Reports A0461).[1]

- On December 21, 1964, a tagged area entry permit was approved for cleanup of the CERF Building 163. The area had been used for the disposition of the SRE main intermediate heat exchanger (MIHE). When a health physicist entered the work area to provide assistance, he noticed that an operation was being performed that was not approved in the permit. An employee was using a skill saw to cut wood used as cribbing for the SRE MIHE. The wood cribbing was saturated with cutting oil and material from within the heat exchanger. The air in the CERF was filled with sawdust and no one was wearing respirators. The employee was told to stop sawing, but he stated he was almost finished and that the health physicist could swipe his nose if he wanted. A nasal smear indicated background activity, but it was suspected the employee blew his nose prior to the swipe. A 10-minute air sample indicated airborne activity at 1.83×10^{-9} µCi/cm^3. Later, the whole work crew was surveyed for contamination and results were negative on all, but three people. Nasal smears ranged from 120 dpm to 300 dpm beta-gamma. No clothing or skin contamination was detected as proper protective clothing was worn. A second 10-minute air sample taken after the dust settled showed a reduction in activity to 7.1×10^{-11} µCi/cm^3. The incident occurred due to haste and lack of foresight in the cutting operation (Incident Report A0385).[2]

- On November 1, 1966, a sodium explosion occurred in the CERF (Building 4163). The incident occurred during cleaning of a valve used in the SRE primary sodium service system. Although the valve had been soaking in Dowanol solvent for approximately 6 weeks prior to the cleaning operation, some unreacted sodium remained in the valve and reacted violently with the cleaning agent. Smear surveys of the area following the explosion indicated contamination levels from 726 to 57,762 dpm/100 cm^2 beta-gamma. A high volume air sample obtained in the CERF change room indicated airborne concentrations of 2×10^{-9} µCi/cm^3. A recount of the air sample 24 hours later indicated a concentration of 1.2×10^{-9} µCi/cm^3. Filter paper from the air sample was analyzed for isotope identification. Results showed the presence of Cs-137, Na-22, Sr-90, and Y-90. The CERF room was decontaminated and SRE employees were reminded of the hazards involved in using solvents to react sodium (Incident Report A0600).[3]

Current Use: Building 4163 was demolished in 1999. 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 1978, Rockwell conducted a radiological survey at the east end of Building 4163 and on asphalt-covered outside areas, to see whether contamination had migrated from the west end of the building. Rockwell did this in preparation for removing the wall between the two parts of Building 4163. Survey results for the east end of Building 4163 indicated

[1] Galperin, A., Atomics International Internal Letter, re: *Incident Report, CERF, 12-7-64*, January 7, 1965.
[2] Tworek, D.D., Atomics International Internal Letter, re: *Incident Report, Contaminated Equipment Repair Facility (CERF) Building 163, 12-21-64*, January 8, 1965.
[3] Unknown Author, Atomics International, re: *Radiation Safety Progress for November 1966*, December 9, 1966.

less than 30 dpm/100 cm^2 for removable contamination, below 0.1 mrad/h for surface gamma radiation, and below 100 dpm/100 cm^2 for beta-gamma emitters. All survey results indicated that the east end of Building 4163 was below Rockwell's applicable limits for release for unrestricted use.[3]

- In October 1981, Rockwell commenced decontamination and removal activities in the contaminated west end of Building 4163. Rockwell removed a 5-ton overhead bridge crane together with the radioactive exhaust system and all aluminum wainscot interior walls. Rockwell scabbled the floor area and packaged all radioactively contaminated equipment for shipment to an unnamed offsite land burial location.[1]

- In early 1982, Rockwell conducted a radiological survey of Building 4163 following the completion of decontamination activities. Survey results for the west end of Building 4163 indicated, for removable contamination, less than 20 dpm/100 cm^2 for alpha emitters, and less than 75 dpm/100 cm^2 for beta-gamma emitters. For surface radiation, all readings were below 0.1 mrad/h. Concrete wall and core samples from the 5.5-foot deep box shop mockup pit were found to be below 25 pCi/g of gross detectable beta activity. Soil samples collected from the bottom of the pit were found to be below 30 pCi/g. All survey results for the west end of Building 4163 were below Rockwell's applicable limits for release for unrestricted use.[1, 2]

- In September 1982, ANL completed a verification survey of the SRE complex. This included instrument and smear surveys and analysis of material samples. ANL found that Building 4163 and its surrounding area had been decontaminated to below limits specified in the Draft ANSI Standard No. N13.12 and NRC 1982 guidelines.[3]

Radiological Use Authorizations: The DOE released the area for unrestricted use on July 23, 1985.[4]

Former Radiological Burial or Disposal Locations: Building 4163 was initially connected to the Buildings 4003, 4143, and 4163 leach field system until it was closed and abandoned in 1964 when the complex was connected to the site-wide sewage treatment plant. In 2000, the septic tank, leach field, and associated piping were excavated and removed.[5]

Aerial Photographs: Aerial photographs show undeveloped land until the 1957 photograph when a rectangular-shaped building is identified as Building 4163. Building 4163 appears to have increased in area by about 50 percent in the 1959 photograph. Building 4163 is seen in the approximately 1960, 1965, 1967, 1972, 1978, 1980, 1983, 1988, and 1995 photographs. A

[1] Wallace, J. H., *Radiological Survey Results - Release to Unrestricted Use, SRE Building 163*, Rockwell International Report No. N704TI990039, April 8, 1982, pp. 3-7.
[2] Wallace, J. H., *Radiological Survey Results - Release to Unrestricted Use, SRE Region III*, Rockwell International Report No. N704TI990029, May 13, 1983, pp. 3-7.
[3] Argonne National Laboratory, *Post Remedial Action Survey Report for the Sodium Reactor Experiment (SRE) Facility, Santa Susana Field Laboratories, Rockwell International, Ventura County, California*, DOE-EV-0005-46, ANL-OHS/HP-84-101, February 1984, pp. 1-3, 15.
[4] U.S. Department of Energy, *Certification for Unrestricted Use of the Sodium Reactor Experiment (SRE) Complex and the Hot Cave Facility (Bldg. 003)*, July 23, 1985.
[5] Letter from B. D. Sujata, The Boeing Company, to J. Evans, County of Ventura, re: *Information Regarding Permit - Septic Tank and Leach Field*, October 23, 2001.

vegetated area is seen in the location of Building 4163 in the 2005 photograph. Dark colored sheeting appears to cover the site in the 2009 photograph.[1]

Radionuclides of Concern: Building 4163 was part of the SRE reactor complex and was located northeast of Building 4143. Possible radionuclides include U-238, U-234, U-235, U-236, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Th-232, H-3, Na-22, Na-24, Cr-51, Mn-54, Fe-59, Co-60, Kr-85, Sr-89, Sr-90, Sb-125, I-129, I-131, Cs-134, Cs-137, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xn-133, Xe-135, Pm-147, Sm-151.[2, 3, 4] All radionuclides of concern listed with the exception of Na-24, Cr-51, Mn-54, Fe-59, Kr-85, Sr-89, I-131, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xe-133, Xe-135, Pm-147 and Sm-151 are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives except for Sm-151 for which no analytical method is available. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Based on general site topography, surface water flows into the storm drain system located south and east of the site, which connects to the SRE retention pond located northeast of the site. Outflow from the retention pond was initially onto the NBZ and Brandeis-Bardin Institute land. In 1959, a 6-foot diameter overflow pipe and a pumped sump were installed at the confluence of the two main drainage channels upstream of the pond. Water was then pumped through a 4-inch diameter overland pipe to a channel connecting to the Area II ponds. The overflow from these ponds is into Bell Canyon and thence to the Los Angeles River.[5]

Radiological Contamination Potential: The preliminary MARSSIM classification for the Building 4163 area is Class 1 due to its documented releases and its former use as an SRE support building.

Recommended Locations for Soil/Sediment Sampling:

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

Previous characterization studies for the Building 4163 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 4163 area. This includes the following Building 4163 areas and appurtenances:

- The flat and low-lying areas surrounding Building 4163. Radionuclides originating from Buildings 4163 and/or 4143 may have migrated to these areas via surface water flow or airborne releases.

[1] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[2] Hart, R. S., *Distribution of Fission Product Contamination in the SRE*, Atomics International Report No. NAA-SR-6890, March 1, 1962, pp. 8-27.
[3] Kinzer, J. and Crawford, A. C., *SRE First Core Fuel*, Atomics International Technical Data Record No. 5301, May 16, 1960, pp. 1-7.
[4] Letter from Heine, W. F., Atomics International, to Proctor, J. F., E. I. du Pont de Nemours & Company, re: *Fission Product and Fissile Content of SRE Fuel*, July 2, 1975.
[5] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.

- The storm drain system located south of the site that connects to the SRE retention pond.

- The sanitary sewer line for Buildings 4003, 4143, and 4163 located south of the site. If radionuclides were released into the sanitary sewer system, residual contamination may exist in the materials surrounding the sewer lines.

2.1.6 Building 4183 Area

Site Description: The Building 4183 area comprised Building 4183 and the land surrounding it located in the SRE complex at the end of E Street. Building 4183 was constructed in approximately 1957 as a fire pump building.[1, 2] Figures 2.1.6a and 2.1.6b provide current and historic photographs. The location of Building 4183 in the SRE complex is presented in Figure 2.1.1g.

Building Features: Building 4183, located northeast of Building 4143, was less than 1,000 square feet in area and was constructed with a steel frame, siding and roof. It contained an emergency generator, which was connected to a 1,500-gallon gasoline fuel underground tank, UT-71. This tank was excavated and removed in 1998 without monitoring for radioactivity.[1, 3] A historical site photograph taken on February 12, 1975, is presented in Figure 2.1.6b. It shows a large diameter pipe, which was connected to the water tower. It also shows bags of material located on the south side of Building 4183, which appear to be related to decontamination and demolition activities.

Former Use(s): Building 4183 was the fire pump building for the SRE complex.[2] This building is assumed to have housed pumps to pump water from the water tower to the SRE complex in the event of a fire.

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: Building 4183 was demolished in 1999. 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 September 1982, ANL completed a verification survey of the SRE complex. This included instrument and smear surveys and analysis of material samples. ANL found that Building 4183 and its surrounding area had been decontaminated to below limits specified in the Draft ANSI Standard No. N13.12 and NRC 1982 guidelines.[4]

[1] Historical Site Photograph from Boeing Database, February 12, 1975.
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[3] Sierra Geoscience, Inc., *Report on UST Closure, Tank #UT-71 Building 4183, Santa Susana Field Laboratory, Ventura County, California*, January 11, 1999, p. 2.
[4] Argonne National Laboratory, *Post Remedial Action Survey Report for the Sodium Reactor Experiment (SRE) Facility, Santa Susana Field Laboratories, Rockwell International, Ventura County, California*, DOE-EV-0005-46, ANL-OHS/HP-84-101, February 1984, pp. 1-3, 15.

- In 1983, Rockwell conducted a radiological survey as part of the SRE survey. Survey results indicated, for surface radiation, an average reading of 10 µR/h. Soil samples collected from this area were found to contain less than 30 pCi/g of gross detectable beta activity. All survey results were below Rockwell's applicable limits for release for unrestricted use.[1]

Radiological Use Authorizations: The DOE released the area for unrestricted use on July 23, 1985.[2]

Former Radiological Burial or Disposal Locations: Building 4183 had a 1,500-gallon underground gasoline fuel tank that was removed in December 1998.[3]

Aerial Photographs: Aerial photographs show undeveloped land until the 1957 photograph when a square-shaped building is identified as Building 4183. Building 4183 is seen in 1959, with a pipe connecting it to the water tower Site 4703. This is also seen in the approximately 1960, 1965, and 1967 photographs. In the 1972, 1978, 1980, 1983, 1988 and 1985 photographs, the pipe extends half-way up the hillside; it does not reach the water tower. A vegetated area is seen in the location of Building 4183 in the 2005 photograph. The 2009 photograph shows dark-colored sheeting covering the location of former Building 4183.[4]

Radionuclides of Concern: Building 4183 was part of the SRE reactor complex and was located northeast of Building 4143. Possible radionuclides include U-238, U-234, U-235, U-236, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Th-232, H-3, Na-22, Na-24, Cr-51, Mn-54, Fe-59, Co-60, Kr-85, Sr-89, Sr-90, Sb-125, I-129, I-131, Cs-134, Cs-137, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xn-133, Xe-135, Pm-147, Sm-151.[5, 6, 7] All radionuclides of concern listed with the exception of Na-24, Cr-51, Mn-54, Fe-59, Kr-85, Sr-89, I-131, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xe-133, Xe-135, Pm-147 and Sm-151 are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives except for Sm-151 for which no analytical method is available. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Building 4183 was located south of a drainage divide. Based on general site topography, surface water flows into the drainage channel located north of the site, which connects to the SRE retention pond located northeast of the site. Outflow from the retention pond was initially onto the NBZ and Brandeis-Bardin Institute land. In 1959, a 6-foot diameter overflow pipe and a pumped sump were installed at the confluence of the two main drainage

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[1] Wallace, J. H., *Radiological Survey Results - Release to Unrestricted Use, SRE Region X*, Rockwell International Report No. N704TI990036, May 31, 1983, pp. 7-8.
[2] U.S. Department of Energy, *Certification for Unrestricted Use of the Sodium Reactor Experiment (SRE) Complex and the Hot Cave Facility (Bldg. 003)*, July 23, 1985.
[3] Sierra Geoscience, Inc., *Report on UST Closure, Tank #UT-71 Building 4183, Santa Susana Field Laboratory, Ventura County, California*, January 11, 1999, pp. 1-2.
[4] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[5] Hart, R. S., *Distribution of Fission Product Contamination in the SRE*, Atomics International Report No. NAA-SR-6890, March 1, 1962, pp. 8-27.
[6] Kinzer, J. and Crawford, A. C., *SRE First Core Fuel*, Atomics International Technical Data Record No. 5301, May 16, 1960, pp. 1-7.
[7] Letter from Heine, W. F., Atomics International, to Proctor, J. F., E. I. du Pont de Nemours & Company, re: *Fission Product and Fissile Content of SRE Fuel*, July 2, 1975.

channels upstream of the pond. Water was then pumped through a 4-inch diameter overland pipe to a channel connecting to the Area II ponds. The overflow from these ponds is into Bell Canyon and thence to the Los Angeles River.[1] Radioactive materials do not appear to have been handled in Building 4183, but the site could have become contaminated by surface water and airborne releases from other buildings within the SRE complex.

Radiological Contamination Potential: The preliminary MARSSIM classification for the Building 4183 area is Class 1 due to its former use as an SRE support building.

Recommended Locations for Soil/Sediment Sampling:

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

Previous characterization studies for the Building 4183 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 4183 area. This includes the following Building 4183 areas and appurtenances:

- The flat and low-lying areas surrounding Building 4183. Radionuclides originating from Building 4143 may have migrated to these areas via surface water flow or airborne releases.

- The area south of Building 4183 where bags of material can be seen in the 1975 historical photograph. It is unclear whether radioactive material was stored in the bags.

- The drainage channel located north of the site that connects to the SRE retention pond.

2.1.7 Building 4184 Area

Site Description: The Building 4184 area comprises Building 4184, and the land surrounding it located in the SRE complex at the end of E Street. Building 4184 was constructed in approximately 1957 as a battery room and diesel generator canopy.[2] Figure 2.1.7a provides a current photograph. Building 4184 was located between Buildings 4183 and 4185, as shown in Figure 1.3.

Building Features: Building 4184 was a single story building of less than 1,000 square feet in area.

Former Use(s): Building 4184 was the SRE battery room and diesel generator canopy.[1]

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

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[1] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.

Current Use: Building 4184 was demolished prior to 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): A chronology of radiological investigations at this building is as follows:

- In September 1982, ANL completed a verification survey of the SRE complex. This included instrument and smear surveys and analysis of material samples. ANL found that Building 4184 and its surrounding area had been decontaminated to below limits specified in the Draft ANSI Standard No. N13.12 and NRC 1982 guidelines.[1]

- In 1983, Rockwell conducted a radiological survey as part of the SRE survey. Survey results indicated, for surface radiation, an average reading of 10 µR/h. Soil samples collected from this area were found to contain less than 30 pCi/g of gross detectable beta activity. All survey results were below Rockwell's applicable limits for release for unrestricted use.[2]

Radiological Use Authorizations: The DOE released the area for unrestricted use on July 23, 1985.[3]

Former Radiological Burial or Disposal Locations: Adjacent Building 4183 had a 1,500-gallon underground gasoline fuel tank that was removed in December 1998.[4]

Aerial Photographs: Aerial photographs show undeveloped land until the 1957 photograph when a rectangular-shaped building is identified as Building 4184. (The HSA team believes that Building 4184 is indistinguishable from Building 4185 in the aerial photographs.) Building 4184 is seen in the 1959, approximately 1960, 1965, 1967, and 1972 photographs. A building slab is observed in the 1978, 1980, and 1983 photographs. Bare ground is seen in the 1988 and 1995 photographs. A vegetated area is seen in the location of Building 4184 in the 2005 photograph. Dark colored sheeting covers the site in the 2009 photograph.[5]

Radionuclides of Concern: Building 4184 was part of the SRE reactor complex and was located northeast of Building 4143. Possible radionuclides include U-238, U-234, U-235, U-236, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Th-232, H-3, Na-22, Na-24, Cr-51, Mn-54, Fe-59, Co-60, Kr-85, Sr-89, Sr-90, Sb-125, I-129, I-131, Cs-134, Cs-137, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xn-133, Xe-135, Pm-147, Sm-151.[6, 7, 1] All radionuclides of concern listed

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[1] Argonne National Laboratory, *Post Remedial Action Survey Report for the Sodium Reactor Experiment (SRE) Facility, Santa Susana Field Laboratories, Rockwell International, Ventura County, California*, DOE-EV-0005-46, ANL-OHS/HP-84-101, February 1984, pp. 1-3, 15.

[2] Wallace, J. H., *Radiological Survey Results Release to Unrestricted Use, SRE Region X*, Rockwell International Report No. N704TI990036, May 31, 1983, pp. 7-8.

[3] U.S. Department of Energy, *Certification for Unrestricted Use of the Sodium Reactor Experiment (SRE) Complex and the Hot Cave Facility (Bldg. 003)*, July 23, 1985.

[4] Sierra Geoscience, Inc., *Report on UST Closure, Tank #UT-71 Building 4183, Santa Susana Field Laboratory, Ventura County, California*, January 11, 1999, pp. 1-2.

[5] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.

[6] Hart, R. S., *Distribution of Fission Product Contamination in the SRE*, Atomics International Report No. NAA-SR-6890, March 1, 1962, pp. 8-27.

[7] Kinzer, J. and Crawford, A. C., *SRE First Core Fuel*, Atomics International Technical Data Record No. 5301, May 16, 1960, pp. 1-7.

with the exception of Na-24, Cr-51, Mn-54, Fe-59, Kr-85, Sr-89, I-131, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xe-133, Xe-135, Pm-147 and Sm-151 are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives except for Sm-151 for which no analytical method is available. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Building 4184 was located south of a drainage divide. Based on general site topography, surface water flows into the drainage channel located north of the site, which connects to the SRE retention pond located northeast of the site. Outflow from the retention pond was initially onto the NBZ and Brandeis-Bardin Institute land. In 1959, a 6-foot diameter overflow pipe and a pumped sump were installed at the confluence of the two main drainage channels upstream of the pond. Water was then pumped through a 4-inch diameter overland pipe to a channel connecting to the Area II ponds. The overflow from these ponds is into Bell Canyon and thence to the Los Angeles River.[2] Radioactive materials do not appear to have been handled in Building 4184, but the site could have become contaminated by surface water and airborne releases from other buildings within the SRE complex.

Radiological Contamination Potential: The preliminary MARSSIM classification for the Building 4184 area is Class 1 due to its former use as an SRE support building.

Recommended Locations for Soil/Sediment Sampling:

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

Previous characterization studies for the Building 4184 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 4184 area. This includes the following Building 4184 areas and appurtenances:

- The flat and low-lying areas surrounding Building 4184. Radionuclides originating from Building 4143 may have migrated to these areas via surface water flow or airborne releases.

- The drainage channel located north of the site that connects to the SRE retention pond.

2.1.8 Building 4185 Area

Site Description: The Building 4185 area comprises Building 4185, and the land surrounding it located in the SRE complex at the end of E Street. Building 4185 was constructed in approximately 1957 as a steam generator control building.[3] Figures 2.1.8a and 2.1.8b provide a

[1] Letter from Heine, W. F., Atomics International, to Proctor, J. F., E. I. du Pont de Nemours & Company, re: *Fission Product and Fissile Content of SRE Fuel*, July 2, 1975.
[2] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.
[3] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.

current photograph and floor plan. The location of Building 4185, west of Building 4184, is shown in Figure 1.3.

Building Features: Building 4185 was of less than 1,000 square feet in area. A floor plan for Building 4185 is presented in Figure 2.1.8b.

Former Use(s): Building 4185 was the steam generator control building.[1]

Information from Interviewees: None to date

Radiological Incident Reports: None found.

Current Use: Building 4185 was demolished prior to 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): A chronology of radiological investigations at this building is as follows:

- In September 1982, ANL completed a verification survey of the SRE complex. This included instrument and smear surveys and analysis of material samples. ANL found that Building 4185 and its surrounding area had been decontaminated to below limits specified in the Draft ANSI Standard No. N13.12 and NRC 1982 guidelines.[1]

- In 1983, Rockwell conducted a radiological survey on Region IX as part of the SRE survey. The western half of Building 4185 was in Region IX. Survey results indicated, for surface radiation, an average reading of 0.04 mrad/h. Soil samples collected from this area were found to contain less than 98 pCi/g of gross detectable beta activity. All survey results were below Rockwell's applicable limits for release for unrestricted use.[2]

- In 1983, Rockwell conducted a radiological survey on Region X as part of the SRE survey. The eastern half of Building 4185 was in Region X. Survey results indicated, for surface radiation, an average reading of 10 µR/h. Soil samples collected from this region were found to contain less than 30 pCi/g of gross detectable beta activity. All survey results were below Rockwell's applicable limits for release for unrestricted use.[3]

Radiological Use Authorizations: The DOE released the area for unrestricted use on July 23, 1985.[4]

Former Radiological Burial or Disposal Locations: Building 4143, located a few feet southwest of Building 4185, had a sanitary septic tank installed as part of the original

[1] Argonne National Laboratory, *Post Remedial Action Survey Report for the Sodium Reactor Experiment (SRE) Facility, Santa Susana Field Laboratories, Rockwell International, Ventura County, California*, DOE-EV-0005-46, ANL-OHS/HP-84-101, February 1984, pp. 1-3, 15.
[2] Wallace, J. H., *Radiological Survey Results – Release to Unrestricted Use, SRE Region IX*, Rockwell International Report No. N704TI990035, May 31, 1983, pp. 7-8.
[3] Wallace, J. H., *Radiological Survey Results – Release to Unrestricted Use, SRE Region X*, Rockwell International Report No. N704TI990036, May 31, 1983, pp. 7-8.
[4] U.S. Department of Energy, *Certification for Unrestricted Use of the Sodium Reactor Experiment (SRE) Complex and the Hot Cave Facility (Bldg. 003)*, July 23, 1985.

construction in 1956-57. The system, tank, and leach field were abandoned in 1964 when the complex was connected to the site-wide sewage treatment plant. In 2000, the septic tank, leach field, and associated piping were excavated and removed.[1]

Aerial Photographs: Aerial photographs show undeveloped land until the 1957 photograph when a rectangular-shaped building is identified as Building 4185. (The HSA team believes that Building 4185 is indistinguishable from Building 4184 in the aerial photographs.) Building 4185 is seen in the 1959, approximately 1960, 1965, 1967, and 1972 photographs. A building slab is seen in the 1978, 1980, and 1983 photographs. Bare ground is seen in the 1988 and 1995 photographs. A vegetated area is seen in the location of Building 4185 in the 2005 photograph. Dark colored sheeting is observed in the location of Building 4185 in the 2009 aerial photograph.[2]

Radionuclides of Concern: Building 4185 was part of the SRE reactor complex and was located northeast of Building 4143. Possible radionuclides include U-238, U-234, U-235, U-236, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Th-232, H-3, Na-22, Na-24, Cr-51, Mn-54, Fe-59, Co-60, Kr-85, Sr-89, Sr-90, Sb-125, I-129, I-131, Cs-134, Cs-137, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xn-133, Xe-135, Pm-147, Sm-151.[3, 4, 5] All radionuclides of concern listed with the exception of Na-24, Cr-51, Mn-54, Fe-59, Kr-85, Sr-89, I-131, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xe-133, Xe-135, Pm-147 and Sm-151 are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives except for Sm-151 for which no analytical method is available. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Building 4185 was located south of a drainage divide. Based on general site topography, surface water flows into the drainage channel located north of the site, which connects to the SRE retention pond located northeast of the site. Outflow from the retention pond was initially onto the NBZ and Brandeis-Bardin Institute land. In 1959, a 6-foot diameter overflow pipe and a pumped sump were installed at the confluence of the two main drainage channels upstream of the pond. Water was then pumped through a 4-inch diameter overland pipe to a channel connecting to the Area II ponds. The overflow from these ponds is into Bell Canyon and thence to the Los Angeles River.[6] Radioactive materials do not appear to have been handled in Building 4185, but the site could have become contaminated by surface water and airborne releases from other buildings within the SRE complex.

Radiological Contamination Potential: The preliminary MARSSIM classification for the Building 4185 area is Class 1 due to its former use as an SRE support building.

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[1] Letter from B. D. Sujata, The Boeing Company, to J. Evans, County of Ventura, r: *Information Regarding Permit Septic Tank and Leach Field*, October 23, 2001.
[2] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[3] Hart, R. S., *Distribution of Fission Product Contamination in the SRE*, Atomics International Report No. NAA-SR-6890, March 1, 1962, pp. 8-27.
[4] Kinzer, J. and Crawford, A. C., *SRE First Core Fuel*, Atomics International Technical Data Record No. 5301, May 16, 1960, pp. 1-7.
[5] Letter from Heine, W. F., Atomics International, to Proctor, J. F., E. I. du Pont de Nemours & Company, re: *Fission Product and Fissile Content of SRE Fuel*, July 2, 1975.
[6] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.

Recommended Locations for Soil/Sediment Sampling:

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

Previous characterization studies for the Building 4185 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 4185 area. This includes the following Building 4185 areas and appurtenances:

- The flat and low-lying areas surrounding Building 4185. Radionuclides originating from Building 4143 may have migrated to these areas via surface water flow or airborne releases.

- The drainage channel located north of the site that connects to the SRE retention pond.

2.1.9 Building 4505 Area

Site Description: The Building 4505 area comprised Building 4505 and the land surrounding it located in the SRE complex at the end of E Street. Building 4505 was constructed prior to 1959 as a storage shed.[1] Figure 2.1.9a provides a current photograph. The location of Building 4505, northeast of Building 4163, is shown in Figure 1.3.

Building Features: Building 4505 was an approximately 600 to 800 square-foot storage shed located northeast of the east end of Building 4163 in the SRE complex.[1]

Former Use(s): Building 4505 was a storage shed. No information has been found concerning the materials stored in the shed, but the shed was in the SRE complex so may have contained radioactive materials.

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: Building 4505 was demolished prior to 1980. The concrete pad of Building 4505 was demolished prior to 1995.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): A chronology of radiological investigations at this building is as follows:

- In 1978, Rockwell conducted a radiological survey at the east end of Building 4163 and on asphalt-covered outside areas extending to Building 4505, to see whether contamination had migrated from the west end of the building. Survey results indicated less than 30 dpm/ 100 cm^2 for removable contamination, below 0.1 mrad/h for surface

[1] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.

gamma radiation, and below 100 dpm/100 cm^2 for beta-gamma emitters. All survey results were below Rockwell's applicable limits for release for unrestricted use.[1]

- In September 1982, ANL completed a verification survey of the SRE complex. This included instrument and smear surveys and analysis of material samples. ANL found that the concrete pad remaining from Building 4505 had been decontaminated to below limits specified in the Draft ANSI Standard No. N13.12 and NRC 1982 guidelines.[2]

Radiological Use Authorizations: The DOE released the area for unrestricted use on July 23, 1985.[3]

Former Radiological Burial or Disposal Locations: None found.

Aerial Photographs: Aerial photographs show undeveloped land until the 1959 photograph when a square-shaped building is identified as Building 4505. This can also be seen in the approximately 1960, 1965, 1967, 1972, and 1978 photographs. A concrete pad is observed in the 1980, 1983, and 1988 photographs. Bare ground is seen in the 1995 photograph, while a vegetated area is seen in the location of Building 4505 in the 2005 photograph. Dark colored sheeting is observed in the location of Building 4505 in the 2009 aerial photograph.[4]

Radionuclides of Concern: Building 4505 was part of the SRE reactor complex and was located northeast of Building 4143. Possible radionuclides include U-238, U-234, U-235, U-236, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Th-232, H-3, Na-22, Na-24, Cr-51, Mn-54, Fe-59, Co-60, Kr-85, Sr-89, Sr-90, Sb-125, I-129, I-131, Cs-134, Cs-137, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xn-133, Xe-135, Pm-147, Sm-151.[5, 6, 7] All radionuclides of concern listed with the exception of Na-24, Cr-51, Mn-54, Fe-59, Kr-85, Sr-89, I-131, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xe-133, Xe-135, Pm-147 and Sm-151 are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives except for Sm-151 for which no analytical method is available. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Based on general site topography, surface water flows into the storm drain system located south and east of the site, which connects to the SRE retention pond located northeast of the site. Outflow from the retention pond was initially onto the NBZ and Brandeis-Bardin Institute land. In 1959, a 6-foot diameter overflow pipe and a pumped sump were

[1] Owens, D. E., *Radiological Survey Results - Release to Unrestricted Use, SRE Region II (Building 163, Box Shop)*, Rockwell International Report No. N704TI990028, May 4, 1978, pp. 5-7.
[2] Argonne National Laboratory, *Post Remedial Action Survey Report for the Sodium Reactor Experiment (SRE) Facility, Santa Susana Field Laboratories, Rockwell International, Ventura County, California*, DOE-EV-0005-46, ANL-OHS/HP-84-101, February 1984, pp. 1-3, 15.
[3] U.S. Department of Energy, *Certification for Unrestricted Use of the Sodium Reactor Experiment (SRE) Complex and the Hot Cave Facility (Bldg. 003)*, July 23, 1985.
[4] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[5] Hart, R. S., *Distribution of Fission Product Contamination in the SRE*, Atomics International Report No. NAA-SR-6890, March 1, 1962, pp. 8-27.
[6] Kinzer, J. and Crawford, A. C., *SRE First Core Fuel*, Atomics International Technical Data Record No. 5301, May 16, 1960, pp. 1-7.
[7] Letter from Heine, W. F., Atomics International, to Proctor, J. F., E. I. du Pont de Nemours & Company, re: *Fission Product and Fissile Content of SRE Fuel*, July 2, 1975.

installed at the confluence of the two main drainage channels upstream of the pond. Water was then pumped through a 4-inch diameter overland pipe to a channel connecting to the Area II ponds. The overflow from these ponds is into Bell Canyon and thence to the Los Angeles River.[1] It is unknown whether radioactive materials were handled in Building 4505, but the site could have become contaminated by surface water and airborne releases from other buildings within the SRE complex.

Radiological Contamination Potential: The preliminary MARSSIM classification for the Building 4505 area is Class 1 due to its former use as an SRE support building.

Recommended Locations for Soil/Sediment Sampling:

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

Previous characterization studies for the Building 4505 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 4505 area. This includes the following Building 4505 areas and appurtenances:

- The flat and low-lying areas surrounding and beneath Building 4505. Radionuclides originating from Buildings 4163 and/or 4143 may have migrated to these areas via surface water flow or airborne releases.

- The former leach field area for Buildings 4003, 4143, and 4163, located east of Building 4505. It is not clear that this area was thoroughly investigated and decontaminated.

- The storm drain system located south of the site that connects to the SRE retention pond.

- The sanitary sewer line located south of the site. If radionuclides were released into the sanitary sewer system, residual contamination may exist in the materials surrounding the sewer lines.

2.1.10 Building 4653 Area

Site Description: The Building 4653 area comprises Building 4653 and the land surrounding it on the hillside north of the SRE on the east side of 11th Street. Building 4653 was constructed in about 1957 as an Interim Radioactive Waste Vault.[2] Figure 2.1.10a provides a current photograph. Figure 2.1.10b provides a plot plan showing Building 4653 located north of the SRE complex. Figure 2.1.10c shows waste holdup tanks in 1977.

Building Features: Building 4653, located on the hillside above Building 4143, consisted of several vaults one of which contained 10 50-gallon tanks and interconnected piping. A compressor vault contained compressors, controls and piping. A suction tank was buried behind

[1] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.

and above Building 4653. Six decay tanks, four for gas and two for liquid, were buried in front of and below Building 4653. Building 4653 was connected to the SRE by piping.[1, 2]

Former Use(s): Building 4653 was an interim radioactive waste vault. Liquid wastes generated in the SRE were directed to one of the two 5,000-gallon liquid holdup tanks before disposal. Liquids were pumped from floor drains in the hot cell area, hot sinks in the controlled areas, and the fuel element wash station located in the high bay area of the reactor room. Most of the radioactivity was from mixed fission products. There were two gas storage systems: a low volume system for the core cover gas, and a larger volume system for all other areas of the SRE. Gas was pumped to one of four gas holdup tanks where short-lived radioactivity decayed. Activation products were the primary isotopes detected in the gas holdup system.[3]

Information from Interviewees: In 2010, a number of former workers were interviewed about their experiences at the SSFL. One had knowledge of Building 4653. An exerpt from his comments is presented below.

- "The reactor gas was stored in four tanks behind the SRE. It was kept in those tanks until the radiation degraded enough for it to be safely released to the environment, which took approximately two weeks. One of my assignments was to check the wind direction and weather conditions. If the wind was directed towards the ocean, or over the San Fernando Valley and Los Angeles, then the gases would be released from the appropriate tank. This occurred at night, to minimize the possibility of exposure to SSFL workers."[3] This interviewee worked at the SSFL between 1959 and 1960.

Radiological Incident Reports: There has been one incident associated with Building 4653 that could have resulted in a release to the environment. The following table provides information presented in an incidents database provided by Boeing. A summary of the incident report is provided following the table.

Building 4653 Incident Report Summary

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A0062	11/14/1977	NORTH OF HIGH BAY	MFP	OVERFILLED LIQUID TRANSFER TANK SPILLED R/A LIQUID OUTSIDE.

*Isotopes are written as they are presented in the incident database. The research team believes that MFP is an acronym for mixed fission products.

- On November 14, 1977, the 500-gallon radioactive liquid transfer tank, one of two on the hillside, was overfilled while performing a backflush of the SRE Culligan filter. An estimated 25 gallons of water overflowed around the tank and to the surrounding asphalt. Activity was estimated at 0.12 $\mu Ci/cm^3$, for a total of 11 mCi. Principal isotopes were Cs-137, Sr-90, and Co-60. Absorbent material was placed on the spill and efforts were

[1] Gallegos, A. N., *Disposal of Radioactive Waste Systems at Bldg 653 and Bldg 143*, Rockwell International Report No. N704-DWP-990-054, April 7, 1977, pp. 3, 9-10.
[2] Owens, D. E., *Radiological Survey Results – Release to Unrestricted Use, SRE Region V (Gas Storage Vault)*, Rockwell International Report No. N704TI990031, November 2, 1978, pp. 3-9.
[3] Interview No. 207 of former worker conducted by the EPA, only, September 2010.

made to cover the areas with plastic and plywood to prevent further spreading of contamination in the high wind conditions at the time. The incident occurred because the operator was not continuously watching the tank sight gage and the backflush operations proved difficult (Incident Report A0062).[1] Contaminated soil does not appear to have been removed.

Current Use: Building 4653 was demolished in 1977. Figure 2.1.10c shows some of the waste holdup tanks undergoing removal in 1977. 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 1977, Rockwell removed, using a back hoe, all buried tanks and associated piping. Contaminated soil was detected between the liquid holdup tanks and near one of the concrete vaults. This soil was excavated and stored in 39-cubic-foot waste containers before being shipped off-site as radioactive waste together with the pipes, valves, and tanks from the building. After the systems had been removed, additional contamination was detected in the concrete walls and floor of one vault. Several inches of concrete were chipped off the vault, packaged, and shipped off-site. It was reported that uncontaminated concrete was left in place to stabilize the hillside before backfilling.[3]

- Following demolition, Rockwell conducted a radiological survey of the site of Building 4653 as part of an SRE survey. Survey results indicated a maximum reading of 0.08 ± 0.05 mrad/h along the south side of the area. Concrete samples were collected during demolition and all concrete with activity above 100 pCi/g was removed. Soil samples were collected throughout the area. The maximum beta activity detected in soil was 49.3 pCi/g. All survey results were below Rockwell's acceptable limits for release to unrestricted use.[2]

- Between November 1979 and September 1982, ANL conducted a series of verification surveys of the SRE complex. This included instrument and smear surveys and analysis of material samples. ANL found that the Building 4653 area was decontaminated below the limits specified in the draft ANSI Standard N13.12 and NRC Guidelines dated 1982.[3]

Radiological Use Authorizations: The DOE released the area for unrestricted use on July 23, 1985.[4]

Former Radiological Burial or Disposal Locations: Building 4653 was a disposal location.

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[1] Brengle, R.G., Rockwell International Internal Letter, re: *Spill of Radioactively Contaminated Water During SRE Backflush Operations*, November 15, 1977.
[2] Owens, D. E., *Radiological Survey Results – Release to Unrestricted Use, SRE Region V (Gas Storage Vault)*, Rockwell International Report No. N704TI990031, November 2, 1978, pp. 3-9.
[3] Argonne National Laboratory, *Post Remedial Action Survey Report for the Sodium Reactor Experiment (SRE) Facility, Santa Susana Field Laboratories, Rockwell International, Ventura County, California*, Report No. DOE-EV-0005/46, ANL-OHS/HP-84-101, February 1984, pp. iii, 15.
[4] U.S. Department of Energy, *Certification for Unrestricted Use of the Sodium Reactor Experiment (SRE) Complex and the Hot Cave Facility (Bldg. 003)*, July 23, 1985.

Aerial Photographs: Aerial photographs show undeveloped land until the 1957 photograph when disturbed ground is seen in the location of Building 4653. Building 4653 can be seen in the 1959, approximately 1960, 1965, 1967, and 1972 photographs. Disturbed ground is seen in the 1978 photograph. The site is vegetated in the 1980, 1983, 1988, 1995, 2005, and 2009 photographs.[1]

Radionuclides of Concern: Building 4653 was part of the SRE reactor complex and was located northwest of Building 4143. Possible radionuclides include U-238, U-234, U-235, U-236, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Th-232, H-3, Na-22, Na-24, Cr-51, Mn-54, Fe-59, Co-60, Kr-85, Sr-89, Sr-90, Sb-125, I-129, I-131, Cs-134, Cs-137, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xn-133, Xe-135, Pm-147, Sm-151.[2, 3, 4] All radionuclides of concern listed with the exception of Na-24, Cr-51, Mn-54, Fe-59, Kr-85, Sr-89, I-131, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xe-133, Xe-135, Pm-147 and Sm-151 are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives except for Sm-151 for which no analytical method is available. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Building 4653 is located on high ground south of a drainage divide and north of SRE Building 4143. Based on general site topography, surface water flows south to a drainage channel located north of Building 4143. This channel carries surface water to the SRE retention pond located northeast of the site. Outflow from the retention pond was initially onto the NBZ and Brandeis-Bardin Institute land. In 1959, a 6-foot diameter overflow pipe and a pumped sump were installed at the confluence of the two main drainage channels upstream of the pond. Water was then pumped through a 4-inch diameter overland pipe to a channel connecting to the Area II ponds. The overflow from these ponds is into Bell Canyon and thence to the Los Angeles River.[5]

Radiological Contamination Potential: The preliminary MARSSIM classification for the Building 4653 area is Class 1 due to its former use as an SRE support building.

Recommended Locations for Soil/Sediment Sampling:

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

Information is lacking regarding the excavation activities at Building 4653. In addition, previous characterization studies for the Building 4653 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 4653 area. This includes the following Building 4653 areas and appurtenances:

[1] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[2] Hart, R. S., *Distribution of Fission Product Contamination in the SRE*, Atomics International Report No. NAA-SR-6890, March 1, 1962, pp. 8-27.
[3] Kinzer, J. and Crawford, A. C., *SRE First Core Fuel*, Atomics International Technical Data Record No. 5301, May 16, 1960, pp. 1-7.
[4] Letter from Heine, W. F., Atomics International, to Proctor, J. F., E. I. du Pont de Nemours & Company, re: *Fission Product and Fissile Content of SRE Fuel*, July 2, 1975.
[5] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.

- The flat and low-lying areas surrounding Building 4653. Radionuclides originating from Building 4653 may have migrated to these areas via surface water flow or airborne releases.

- The hillside downgradient of Building 4653 where one of the two liquid waste tanks overflowed, as a result of overfilling, contaminating soil in the run-off area in 1977.

- The storm drain system located south of the site that connects to the SRE retention pond.

2.1.11 Pad 4684 Area

Site Description: The Pad 4684 area comprised Pad 4684 and the land surrounding it located in the SRE complex at the end of E Street. Pad 4684 was constructed in about 1957 as a steam generator pad.[1] Figure 2.1.11a provides a current photograph. The location of Pad 4684 is shown in Figure 1.3.

Building Features: Pad 4684 was less than 2,000 square feet in area located northeast of the east end of Building 4143 in the SRE complex.[1]

Former Use(s): Pad 4684 was a concrete pad for the steam generator.

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: Pad 4684 was demolished prior to 1980.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): A chronology of radiological investigations at this site is as follows:

- In September 1982, ANL completed a verification survey of the SRE complex. This included instrument and smear surveys and analysis of material samples. ANL found that Pad 4684 and its surrounding area had been decontaminated to below limits specified in the Draft ANSI Standard No. N13.12 and NRC 1982 guidelines.[2]

- In 1983, Rockwell conducted a radiological survey in the area of Pad 4684. The survey area was designated as SRE Region X. Survey results indicated an average reading of 10 µR/h for surface gamma radiation, and 25 soil samples were found to have less than 30 pCi/g of gross detectable beta activity. All survey results were below Rockwell's applicable limits for release for unrestricted use.[3]

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[1] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.

[2] Argonne National Laboratory, *Post Remedial Action Survey Report for the Sodium Reactor Experiment (SRE) Facility, Santa Susana Field Laboratories, Rockwell International, Ventura County, California*, DOE-EV-0005-46, ANL-OHS/HP-84-101, February 1984, pp. 1-3, 15.

[3] Wallace, J. H., *Radiological Survey Results - Release to Unrestricted Use, SRE Region X*, Rockwell International Report No. N704TI990036, May 31, 1983, pp. 5-8.

Radiological Use Authorizations: The DOE released the area for unrestricted use on July 23, 1985.[1]

Former Radiological Burial or Disposal Locations: None found.

Aerial Photographs: Aerial photographs show undeveloped land until the 1957 photograph when a rectangular pad is identified as Pad 4684. This can also be seen in the 1959, approximately 1960, 1965, 1967, 1972, and 1978 photographs. Cleared ground is observed in the 1980 photograph. Open storage is seen in the 1983, 1988, and 1995 photographs. A vegetated area is seen in the 2005 photograph. Dark colored fabric covers the area in the 2009 photograph.[2]

Radionuclides of Concern: Pad 4684 was part of the SRE reactor complex and was located northeast of Building 4143. Possible radionuclides include U-238, U-234, U-235, U-236, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Th-232, H-3, Na-22, Na-24, Cr-51, Mn-54, Fe-59, Co-60, Kr-85, Sr-89, Sr-90, Sb-125, I-129, I-131, Cs-134, Cs-137, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xn-133, Xe-135, Pm-147, Sm-151.[3, 4, 5] All radionuclides of concern listed with the exception of Na-24, Cr-51, Mn-54, Fe-59, Kr-85, Sr-89, I-131, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xe-133, Xe-135, Pm-147 and Sm-151 are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives except for Sm-151 for which no analytical method is available. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Pad 4684 was located northeast of SRE Building 4143. Based on general site topography, surface water flows north to a drainage channel located north of Building 4143. This channel carries surface water to the SRE retention pond located northeast of the site. Outflow from the retention pond was initially onto the NBZ and Brandeis-Bardin Institute land. In 1959, a 6-foot diameter overflow pipe and a pumped sump were installed at the confluence of the two main drainage channels upstream of the pond. Water was then pumped through a 4-inch diameter overland pipe to a channel connecting to the Area II ponds. The overflow from these ponds is into Bell Canyon and thence to the Los Angeles River.[6] Radioactive materials do not appear to have been handled in Pad 4684, but the site could have become contaminated by surface water and airborne releases from other buildings within the SRE complex.

Radiological Contamination Potential: The preliminary MARSSIM classification for the Pad 4684 area is Class 1 due to its former use as an SRE support building.

Recommended Locations for Soil/Sediment Sampling:

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[1] U.S. Department of Energy, *Certification for Unrestricted Use of the Sodium Reactor Experiment (SRE) Complex and the Hot Cave Facility (Bldg. 003)*, July 23, 1985.
[2] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[3] Hart, R. S., *Distribution of Fission Product Contamination in the SRE*, Atomics International Report No. NAA-SR-6890, March 1, 1962, pp. 8-27.
[4] Kinzer, J. and Crawford, A. C., *SRE First Core Fuel*, Atomics International Technical Data Record No. 5301, May 16, 1960, pp. 1-7.
[5] Letter from Heine, W. F., Atomics International, to Proctor, J. F., E. I. du Pont de Nemours & Company, re: *Fission Product and Fissile Content of SRE Fuel*, July 2, 1975.
[6] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.

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

Previous characterization studies for the Pad 4684 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 Pad 4684 area. This includes the following Pad 4684 areas and appurtenances:

- The flat and low-lying areas surrounding Pad 4684. Radionuclides originating from Building 4143 may have migrated to these areas via surface water flow or airborne releases.

- The storm drain system located north of the site that connects to the SRE retention pond.

2.1.12 Site 4686 Area

Site Description: The Site 4686 area comprised Site 4686 and the land surrounding it located at the top of the hill above the SRE complex at the end of E Street. Site 4686 was constructed in about 1957 as a temporary hot radioactive waste storage facility.[1] Figure 2.1.12a provides a current photograph. The location of Site 4686 is shown in Figure 1.3 and in plot plan Figure 2.1.10b.

Building Features: Site 4686 was a fenced-in asphalt-topped storage area containing plastic-wrapped radioactive items in wooden boxes.[2]

Former Use(s): Site 4686 was a temporary "hot" radioactive waste storage facility where solid radioactive waste, such as irradiated core components, moderator cans, and fuel elements were stored temporarily. The principal radioactive material stored in this area was plastic wrapped failed fuel elements containing induced radioactivity and mixed fission products. Aerial photographs indicate that this facility was used for storage until at least 1972.

Information from Interviewees: None to date.

Radiological Incident Reports: There has been one incident associated with Building 4686 that could have resulted in a release to the environment. The following table provides information presented in an incidents database provided by Boeing. A summary of the incident report is provided following the table.

[1] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[2] Owens, D. E., *Radiological Survey Results – Release to Unrestricted Use, SRE Region V*, Rockwell International Report No. N704TI990031, May 26, 1978, pp. 3-9.

Building 4686 Incident Report Summary

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A0396	6/17/1960	SRE WASTE AREA	MFP	R/A STORAGE AREA WAS ENTERED WITH OUT APPROVAL OR PROTECTIVE CLOTHING.

*Isotopes are written as they are presented in the incident database. The research team believes that MFP is an acronym for mixed fission products.

- On June 17, 1960, three employees entered the SRE Temporary Waste Storage Area without contacting the health physics department, despite a sign on the entrance gate requesting this action. The employees were not wearing any protective clothing. They removed a highly contaminated grapple (a type of bucket) from the area and left it unattended. One of the employees later requested a survey of his clothing and found a spot of contamination on his pants. The other employees were checked, but no contamination was found. Investigation found that the SRE Temporary Waste Storage Area gate was usually unlocked and that personnel freely moved in and out of the area without contacting the health physics department. There was also no specific information on whether a tagged area entry permit or protective clothing was required (Incident Report A0396).[1]

Current Use: Site 4686 was demolished prior to 1978. All asphalt has been removed from the site.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): A chronology of radiological investigations at this site is as follows:

- In 1978, Rockwell hired an outside contractor to remove the asphalt-covered fenced area. An unknown amount of contaminated material was packaged and shipped to an unnamed site as radioactive waste. Rockwell then conducted a radiological survey in the area of Site 4686. The survey area was designated as SRE Region V. Survey results indicated a maximum reading of 0.08 mrad/h for surface gamma radiation, and soil samples were found to have less than 50 pCi/g of gross detectable beta activity. All survey results were below Rockwell's applicable limits for release for unrestricted use.[2]

- In September 1982, ANL completed a verification survey of the SRE complex. This included instrument and smear surveys and analysis of material samples. ANL found that Site 4686 and its surrounding area had been decontaminated to below limits specified in the Draft ANSI Standard No. N13.12 and NRC 1982 guidelines.[2]

[1] Health Physics, Atomics International Internal Letter, re: *Notice of Radiological or Industrial Safety Rule Infraction*, August 12, 1960.
[2] Argonne National Laboratory, *Post Remedial Action Survey Report for the Sodium Reactor Experiment (SRE) Facility, Santa Susana Field Laboratories, Rockwell International, Ventura County, California*, DOE-EV-0005-46, ANL-OHS/HP-84-101, February 1984, pp. 1-3, 15.

Radiological Use Authorizations: The DOE released the area for unrestricted use on July 23, 1985.[1]

Former Radiological Burial or Disposal Locations: None found.

Aerial Photographs: Aerial photographs show undeveloped land until the 1957 photograph when disturbed ground is seen in the location of Site 4686. In the 1959 photograph, objects are seen on a rectangular pad that is identified as Site 4686. Objects are also seen in the approximately 1960, 1965, 1967, and 1972 photographs. A rectangular-shaped cleared area is observed in the 1978 photograph. The area is vegetated in the 1980, 1983, 1988, 1995, 2005 and 2009 photographs.[2]

Radionuclides of Concern: Site 4686 was part of the SRE reactor complex and was located on the hill above the SRE complex. Possible radionuclides include U-238, U-234, U-235, U-236, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Th-232, H-3, Na-22, Na-24, Cr-51, Mn-54, Fe-59, Co-60, Kr-85, Sr-89, Sr-90, Sb-125, I-129, I-131, Cs-134, Cs-137, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xn-133, Xe-135, Pm-147, Sm-151.[3, 4, 5] All radionuclides of concern listed with the exception of Na-24, Cr-51, Mn-54, Fe-59, Kr-85, Sr-89, I-131, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xe-133, Xe-135, Pm-147 and Sm-151 are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives except for Sm-151 for which no analytical method is available. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: A drainage divide is located south of the site. Based on general site topography, surface water flows north through the NBZ onto Brandeis-Bardin Institute land through Meier Canyon and into Arroyo Simi in Simi Valley.

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Site 4686 area is Class 1 because of the former use in the SRE complex.

Recommended Locations for Soil/Sediment Sampling:

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

Previous characterization studies for the Site 4686 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 Site 4686 area. This includes the following Site 4686 areas and appurtenances:

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[1] U.S. Department of Energy, *Certification for Unrestricted Use of the Sodium Reactor Experiment (SRE) Complex and the Hot Cave Facility (Bldg. 003)*, July 23, 1985.
[2] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[3] Hart, R. S., *Distribution of Fission Product Contamination in the SRE*, Atomics International Report No. NAA-SR-6890, March 1, 1962, pp. 8-27.
[4] Kinzer, J. and Crawford, A. C., *SRE First Core Fuel*, Atomics International Technical Data Record No. 5301, May 16, 1960, pp. 1-7.
[5] Letter from Heine, W. F., Atomics International, to Proctor, J. F., E. I. du Pont de Nemours & Company, re: *Fission Product and Fissile Content of SRE Fuel*, July 2, 1975.

- The flat and low-lying areas on and surrounding Site 4686. Radionuclides originating from Site 4686 may have migrated to these areas via surface water flow or airborne releases.

- The hillside downgradient of Site 4686 (run-off areas) where solid waste may have been transported during heavy rain or wind events.

2.1.13 Site 4689 Area

Site Description: The Site 4689 area comprised Site 4689 and the land surrounding it located in the northwest corner of the SRE complex at the end of E Street. Site 4689 was constructed in about 1959 as an intermediate storage area for contaminated items from the SRE.[1] Figure 2.1.13a provides a current photograph. The location of Site 4689 is shown in Figure 1.3.

Building Features: Site 4689 was a fenced-in asphalt-topped storage area.[2]

Former Use(s): Site 4689 was the intermediate (sometimes referred to as interim) storage area for contaminated items from the SRE. This is assumed to the an area where intermediate-level radioactive waste was stored.. Aerial photographs indicate that this facility was used for storage until at least 1965.

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: Site 4689 was removed prior to 1967.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): A chronology of radiological investigations at this site is as follows:

- AI removed Site 4689 prior to the decommissioning of the SRE. The contaminated asphalt in the area was removed and the area was repaved.[2] The area appears to have become contaminated from the radioactive waste stored there.

- In 1978, Rockwell conducted a radiological survey in the area of Site 4689. The survey area was designated as SRE Region V. Survey results indicated a maximum reading of 0.08 ± 0.05 mrad/h for surface gamma radiation, and soil samples were found to have less than 50 pCi/g of gross detectable beta activity. All survey results were below Rockwell's applicable limits for release for unrestricted use.[3]

- In September 1982, ANL completed a verification survey of the SRE complex. This included instrument and smear surveys and analysis of material samples. ANL found that

[1] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[2] Rockwell International, *Sodium Reactor Experiment Decommissioning Final Report*, Report No. ESG-DOE-13403, August 15, 1983, p. 196.
[3] Owens, D. E., *Radiological Survey Results – Release to Unrestricted Use, SRE Region V*, Rockwell International Report No. N704TI990031, May 26, 1978, pp. 3-9.

Site 4689 and its surrounding area had been decontaminated to below limits specified in the Draft ANSI Standard No. N13.12 and NRC 1982 guidelines.[1]

Radiological Use Authorizations: The DOE released the area for unrestricted use on July 23, 1985.[2]

Former Radiological Burial or Disposal Locations: None found.

Aerial Photographs: Aerial photographs show undeveloped land until the 1959 photograph when open storage of items is observed that is identified as Site 4689. Different items are seen in the approximately 1960 and 1965 photographs. The items appear to have been removed in the 1967, 1972, 1978, and 1980 photographs. A probable tank pad is identified in the 1983 photograph, which is not visible in the 1988 and 1995 photographs. Vegetation is seen in the location of Site 4689 in the 2005 and 2009 photographs.[3]

Radionuclides of Concern: Site 4689 was part of the SRE reactor complex and was located northwest of Building 4143. Possible radionuclides include U-238, U-234, U-235, U-236, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Th-232, H-3, Na-22, Na-24, Cr-51, Mn-54, Fe-59, Co-60, Kr-85, Sr-89, Sr-90, Sb-125, I-129, I-131, Cs-134, Cs-137, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xn-133, Xe-135, Pm-147, Sm-151.[4, 5, 6] All radionuclides of concern listed with the exception of Na-24, Cr-51, Mn-54, Fe-59, Kr-85, Sr-89, I-131, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xe-133, Xe-135, Pm-147 and Sm-151 are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives except for Sm-151 for which no analytical method is available. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Site 4689 was located northwest of SRE Building 4143. Based on general site topography, surface water on Site 4689 flows into a drainage channel located southeast of the site. This channel carries surface water to the SRE retention pond located northeast of the site. Outflow from the retention pond was initially onto the NBZ and Brandeis-Bardin Institute land. In 1959, a 6-foot diameter overflow pipe and a pumped sump were installed at the confluence of the two main drainage channels upstream of the pond. Water was then pumped through a 4-inch diameter overland pipe to a channel connecting to the Area II ponds. The overflow from these ponds is into Bell Canyon and thence to the Los Angeles River.[7]

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[1] Argonne National Laboratory, *Post Remedial Action Survey Report for the Sodium Reactor Experiment (SRE) Facility, Santa Susana Field Laboratories, Rockwell International, Ventura County, California*, DOE-EV-0005-46, ANL-OHS/HP-84-101, February 1984, pp. 1-3, 15.

[2] U.S. Department of Energy, *Certification for Unrestricted Use of the Sodium Reactor Experiment (SRE) Complex and the Hot Cave Facility (Bldg. 003)*, July 23, 1985.

[3] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.

[4] Hart, R. S., *Distribution of Fission Product Contamination in the SRE*, Atomics International Report No. NAA-SR-6890, March 1, 1962, pp. 8-27.

[5] Kinzer, J. and Crawford, A. C., *SRE First Core Fuel*, Atomics International Technical Data Record No. 5301, May 16, 1960, pp. 1-7.

[6] Letter from Heine, W. F., Atomics International, to Proctor, J. F., E. I. du Pont de Nemours & Company, re: *Fission Product and Fissile Content of SRE Fuel*, July 2, 1975.

[7] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.

Radiological Contamination Potential: The preliminary MARSSIM classification for the Site 4689 area is Class 1 due to its former use as an SRE support building.

Recommended Locations for Soil/Sediment Sampling:

Plate 1 and Figure 2.1 provide a convenient reference for the following recommendations. Information is lacking regarding the excavation activities at Site 4689. In addition, previous characterization studies for the Site 4689 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 Site 4689 area. This includes the following Site 4689 areas and appurtenances:

- The flat and low-lying areas on and surrounding Site 4689. Radionuclides originating from Site 4689 may have migrated to these areas via surface water flow or airborne releases.

- The hillside downgradient of Site 4689 (run-off areas) where solid waste may have been transported during heavy rain or wind events.

- The storm drain system located southeast of the site that connects to the SRE retention pond.

2.1.14 Building 4695 Area

Site Description: The Building 4695 area comprised Building 4695 and the land surrounding it located on the north side of the SRE between Building 4753, the primary fill/drain tank vault, and Building 4153, the sodium service building at the end of E Street. Building 4695 was constructed in about 1957 as the cold trap (vapor condenser) vault.[1] Figures 2.1.14a and 2.1.14b provide a current photograph and elevation views of the below-ground vault. Figure 2.1.14c provides a view of the site after below-ground demolition.

Building Features: Building 4695 was a below-ground vault for the SRE that contained a cold trap (vapor condenser) and two hot traps (heaters).[2] Elevation views of the sodium service vault are presented in Figure 2.1.14b.[3]

Former Use(s): Building 4695 was the cold trap vault for the SRE.

Information from Interviewees: None to date.

[1] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[2] Owen, R. K., *Radiological Survey Plan, Support of D & D Program Operations at T-143 (SRE)*, Rockwell International Report No. N704TP990008, September 15, 1981, p. 3.
[3] Ureda, B. and Heine, W., *Facilities Dismantling Plan for SRE*, Atomics International Report No. FDP-704-990-003, June 26, 1975, p. 26.

Radiological Incident Reports: During the course of reactor operations, several primary sodium leaks and fires occurred within the vault.[1] No additional information has been found about these incidents.

Current Use: Building 4695 was demolished in 1978. All of the below-grade structures were removed and the area was backfilled and paved. Concrete rubble reported to be "clean" was included in the backfill.[2] Figure 2.1.14c shows the site after demolition.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): A chronology of radiological investigations at this building is as follows:

- In September 1982, ANL completed a verification survey of the SRE complex. This included instrument and smear surveys and analysis of material samples. ANL found that the Building 4695 site and its surrounding area had been decontaminated to below limits specified in the Draft ANSI Standard No. N13.12 and NRC 1982 guidelines.[3]

- In 1983, Rockwell conducted a radiological survey in the area of Building 4695. The survey area was designated as SRE Building 143. Survey results indicated a maximum below-grade reading of less than 0.1 mrad/h for surface gamma radiation, and below-grade soil samples were found to have less than 100 pCi/g of gross detectable beta activity, with an average of 51 pCi/g. All survey results were below Rockwell's applicable limits for release for unrestricted use.[4]

Radiological Use Authorizations: None. However, the DOE released the area for unrestricted use on July 23, 1985.[5]

Former Radiological Burial or Disposal Locations: None found.

Aerial Photographs: Aerial photographs show undeveloped land until the 1957 photograph when a rectangular pad adjacent to the north side of Building 4143 is seen and is identified as Building 4695. Because of the small size of Building 4695 and because it is adjacent to Building 4143 and is an underground vault, it is very difficult to see on every aerial photograph. It can be seen on the 1959 photograph, but cannot be see on photographs from the 1960s and 1970s. In the 1980 photograph, an excavation is seen in the location of Building 4695. Open storage is identified in the 1983 photograph. The area appears clear of objects in the 1988 and 1995 photographs. Vegetation is seen in the location of Building 4695 in the 2005 and 2009 photographs.[6]

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[1] Owen, R. K., *Radiological Survey Plan, Support of D & D Program Operations at T-143 (SRE)*, Rockwell International Report No. N704TP990008, September 15, 1981, p. 3.
[2] Rockwell International, *Sodium Reactor Experiment Decommissioning Final Report*, Report No. ESG-DOE-13403, August 15, 1983, pp. 156-157, 196.
[3] Argonne National Laboratory, *Post Remedial Action Survey Report for the Sodium Reactor Experiment (SRE) Facility, Santa Susana Field Laboratories, Rockwell International, Ventura County, California*, DOE-EV-0005-46, ANL-OHS/HP-84-101, February 1984, pp. 1-3, 15.
[4] Wallace, J. H., *Radiological Survey Results Release to Unrestricted Use, SRE Building 143*, Rockwell International Report No. N704TI990038, May 31, 1983, pp. 3-10.
[5] U.S. Department of Energy, *Certification for Unrestricted Use of the Sodium Reactor Experiment (SRE) Complex and the Hot Cave Facility (Bldg. 003)*, July 23, 1985.
[6] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.

Radionuclides of Concern: Building 4695 was part of the SRE reactor complex and was adjacent to the north side of Building 4143. Possible radionuclides include U-238, U-234, U-235, U-236, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Th-232, H-3, Na-22, Na-24, Cr-51, Mn-54, Fe-59, Co-60, Kr-85, Sr-89, Sr-90, Sb-125, I-129, I-131, Cs-134, Cs-137, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xn-133, Xe-135, Pm-147, Sm-151.[1, 2, 3] All radionuclides of concern listed with the exception of Na-24, Cr-51, Mn-54, Fe-59, Kr-85, Sr-89, I-131, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xe-133, Xe-135, Pm-147 and Sm-151 are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives except for Sm-151 for which no analytical method is available. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Based on general site topography, surface water flows into the drainage channel located north of the site, which connects to the SRE retention pond located northeast of the site. Outflow from the retention pond was initially onto the NBZ and Brandeis-Bardin Institute land. In 1959, a 6-foot diameter overflow pipe and a pumped sump were installed at the confluence of the two main drainage channels upstream of the pond. Water was then pumped through a 4-inch diameter overland pipe to a channel connecting to the Area II ponds. The overflow from these ponds is into Bell Canyon and thence to the Los Angeles River.[4]

Radiological Contamination Potential: The preliminary MARSSIM classification for the Building 4695 area is Class 1 due to its former use as a service building for the SRE reactor.

Recommended Locations for Soil/Sediment Sampling:

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

Previous characterization studies for the Building 4695 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 4695 area. This includes the following Building 4695 areas and appurtenances:

- The flat and low-lying areas surrounding Building 4695. Radionuclides originating from Buildings 4143 and/or 4695 may have migrated to these areas via surface water flow or airborne releases.

- The location of open storage on the site as seen in aerial photographs.

- The drainage channel located north of the site that connects to the SRE retention pond.

[1] Hart, R. S., *Distribution of Fission Product Contamination in the SRE*, Atomics International Report No. NAA-SR-6890, March 1, 1962, pp. 8-27.
[2] Kinzer, J. and Crawford, A. C., *SRE First Core Fuel*, Atomics International Technical Data Record No. 5301, May 16, 1960, pp. 1-7.
[3] Letter from Heine, W. F., Atomics International, to Proctor, J. F., E. I. du Pont de Nemours & Company, re: *Fission Product and Fissile Content of SRE Fuel*, July 2, 1975.
[4] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.

2.1.15 Site 4703 Area

Site Description: The Site 4703 area comprised Site 4703 and the land surrounding it located at the top of the hill above the SRE complex at the end of E Street. Site 4703 was constructed in about 1957 as a wooden water tower.[1] Figure 2.1.15a provides a current photograph. The location of Site 4703 is shown in plot plan Figure 2.1.10b.

Building Features: Site 4703 was a tower topped by a large wooden water tank with an access stairway and piping.[2]

Former Use(s): Site 4703 stored emergency cooling water for the Edison Company steam generator portion of the SRE. According to Rockwell, because of its inaccessibility, no other use was made of this site.[2]

Information from Interviewees: In 2010, a number of former workers were interviewed about their experiences at the SSFL. One had knowledge of Site 4703. Excerpts from his comments are presented below.

- "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." This individual worked at the SSFL between 1958 and 1968.[3]

Radiological Incident Reports: None found.

Current Use: Site 4703 was destroyed by a brush fire prior to 1978, according to an interviewee.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): A chronology of radiological investigations at this site is as follows:

- In 1978, Rockwell conducted a radiological survey in the area of Site 4703. The survey area was designated as SRE Region VI. Survey results indicated a maximum reading of 0.05 mrad/h for surface gamma radiation, and 18 soil samples were found to have less than 32 pCi/g of gross detectable beta contamination, with an average of 22 pCi/g. All survey results were below Rockwell's applicable limits for release for unrestricted use.[2]

- In September 1982, ANL completed a verification survey of the SRE complex. This included instrument and smear surveys and analysis of material samples. ANL found that

[1] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[2] Owens, D. E., *Radiological Survey Results Release to Unrestricted Use, SRE Region VI Water Tank Area*, Rockwell International Report No. N704TI990032, November 10, 1978, pp. 3-8.
[3] Interview No. 300 of former worker conducted by the DOE and EPA on July 16, 2010, p. 7.

Site 4703 and its surrounding area had been decontaminated to below limits specified in the Draft ANSI Standard No. N13.12 and NRC 1982 guidelines.[1]

Radiological Use Authorizations: The DOE released the area for unrestricted use on July 23, 1985.[2]

Former Radiological Burial or Disposal Locations: None found.

Aerial Photographs: Aerial photographs show undeveloped land until the 1957 photograph when a vertical tank is seen that is identified as Site 4703. This is also seen in the 1959, approximately 1960, 1965, 1967, and 1972 photographs. The tank is absent from the 1978 photograph, but a tank pad is identified in the 1978, 1980, 1983, 1988, 1995, 2005, and 2009 photographs.[3]

Radionuclides of Concern: Site 4703 was located north of the SRE reactor complex. Radionuclides originating from Building 4143 may have migrated to this area via airborne releases. Possible radionuclides include U-238, U-234, U-235, U-236, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Th-232, H-3, Na-22, Na-24, Cr-51, Mn-54, Fe-59, Co-60, Kr-85, Sr-89, Sr-90, Sb-125, I-129, I-131, Cs-134, Cs-137, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xn-133, Xe-135, Pm-147, Sm-151.[4, 5, 6] All radionuclides of concern listed with the exception of Na-24, Cr-51, Mn-54, Fe-59, Kr-85, Sr-89, I-131, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xe-133, Xe-135, Pm-147 and Sm-151 are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives except for Sm-151 for which no analytical method is available. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Site 4703 was located on a drainage divide. Based on general site topography, surface water from Site 4703 flows north and south on each side of a drainage divide. The portion that flows north passes through the NBZ and the Brandeis-Bardin Institute property through Meier Canyon and into Arroyo Simi in Simi Valley. The portion that flows south reaches the drainage channel north of Building 4143 and is carried to the SRE retention pond, then to ponds in Areas II and III, and finally to Bell Canyon and the Los Angeles River.[7]

Radiological Contamination Potential: The preliminary MARSSIM classification for the Site 4703 area is Class 2 due to its location near the SRE complex.

Recommended Locations for Soil/Sediment Sampling:

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[1] Argonne National Laboratory, *Post Remedial Action Survey Report for the Sodium Reactor Experiment (SRE) Facility, Santa Susana Field Laboratories, Rockwell International, Ventura County, California*, DOE-EV-0005-46, ANL-OHS/HP-84-101, February 1984, pp. 1-3, 15.

[2] U.S. Department of Energy, *Certification for Unrestricted Use of the Sodium Reactor Experiment (SRE) Complex and the Hot Cave Facility (Bldg. 003)*, July 23, 1985.

[3] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.

[4] Hart, R. S., *Distribution of Fission Product Contamination in the SRE*, Atomics International Report No. NAA-SR-6890, March 1, 1962, pp. 8-27.

[5] Kinzer, J. and Crawford, A. C., *SRE First Core Fuel*, Atomics International Technical Data Record No. 5301, May 16, 1960, pp. 1-7.

[6] Letter from Heine, W. F., Atomics International, to Proctor, J. F., E. I. du Pont de Nemours & Company, re: *Fission Product and Fissile Content of SRE Fuel*, July 2, 1975.

[7] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.

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

Previous characterization studies for the Site 4703 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 Site 4703 area. This includes the following Site 4703 areas:

- The flat and low-lying areas surrounding Site 4703. Radionuclides originating from Buildings 4143 may have migrated to this area via airborne releases.

2.1.16 Site 4714 Area

Site Description: The Site 4714 area comprised Site 4714 and the land surrounding it located north of Building 4163 in the SRE complex at the end of E Street. Site 4714 was constructed prior to 1959 as an outdoor work area for Building 4163.[1] Figure 2.1.16a provides a current photograph. The location of Site 4714 is shown on Figure 1.3.

Building Features: Site 4714 was a square-shaped pad that served as an outdoor work area.[1]

Former Use(s): Site 4714 was used for research and development in the SRE.

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: Site 4714 was demolished prior to 1983.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): A chronology of radiological investigations at this site is as follows:

- In 1978, Rockwell conducted a radiological survey in the area of Site 4714. The survey area was designated as SRE Region II. Survey results indicated an average reading of 0.06 ± 0.05 mrad/h for surface gamma radiation recorded outside Building 4163. No soil samples were collected because the area was covered with asphalt paving. All survey results were below Rockwell's applicable limits for release for unrestricted use.[2]
- In September 1982, ANL completed a verification survey of the SRE complex. This included instrument and smear surveys and analysis of material samples. ANL found that Site 4714 and its surrounding area had been decontaminated to below limits specified in the Draft ANSI Standard No. N13.12 and NRC 1982 guidelines.[3]

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[1] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.

[2] Owens, D. E., *Radiological Survey Results – Release to Unrestricted Use, SRE Region II (Building 163, Box Shop)*, Rockwell International Report No. N704TI990028, May 4, 1978, pp. 3-7.

[3] Argonne National Laboratory, *Post Remedial Action Survey Report for the Sodium Reactor Experiment (SRE) Facility, Santa Susana Field Laboratories, Rockwell International, Ventura County, California*, DOE-EV-0005-46, ANL-OHS/HP-84-101, February 1984, pp. 1-3, 15.

Radiological Use Authorizations: The DOE released the area for unrestricted use on July 23, 1985.[1]

Former Radiological Burial or Disposal Locations: None found.

Aerial Photographs: Aerial photographs show undeveloped land until the 1959 photograph when a square-shaped pad is seen that is identified as Site 4714. This is also seen in the approximately 1960, 1965, 1967, 1972, 1978, and 1980 photographs. Site 4714 cannot be seen in the 1983, 1988, and 1995 photographs. A vegetated area is seen in the location of Site 4714 in the 2005 photograph, and dark colored sheeting is seen in the 2009 photographs.[2]

Radionuclides of Concern: Building 4714 was associated with SRE Building 4163. Possible radionuclides include U-238, U-234, U-235, U-236, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Th-232, H-3, Na-22, Na-24, Cr-51, Mn-54, Fe-59, Co-60, Kr-85, Sr-89, Sr-90, Sb-125, I-129, I-131, Cs-134, Cs-137, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xn-133, Xe-135, Pm-147, Sm-151.[3, 4, 5] All radionuclides of concern listed with the exception of Na-24, Cr-51, Mn-54, Fe-59, Kr-85, Sr-89, I-131, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xe-133, Xe-135, Pm-147 and Sm-151 are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives except for Sm-151 for which no analytical method is available. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Based on general site topography, surface water flows into the storm drain system located south and east of the site, which connects to the SRE retention pond located northeast of the site. Outflow from the retention pond was initially onto the NBZ and Brandeis-Bardin Institute land. In 1959, a 6-foot diameter overflow pipe and a pumped sump were installed at the confluence of the two main drainage channels upstream of the pond. Water was then pumped through a 4-inch diameter overland pipe to a channel connecting to the Area II ponds. The overflow from these ponds is into Bell Canyon and thence to the Los Angeles River.[6]

Radiological Contamination Potential: The preliminary MARSSIM classification for the Site 4714 area is Class 1 due to its former use as an SRE support building.

Recommended Locations for Soil/Sediment Sampling:

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

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[1] U.S. Department of Energy, *Certification for Unrestricted Use of the Sodium Reactor Experiment (SRE) Complex and the Hot Cave Facility (Bldg. 003)*, July 23, 1985.
[2] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[3] Hart, R. S., *Distribution of Fission Product Contamination in the SRE*, Atomics International Report No. NAA-SR-6890, March 1, 1962, pp. 8-27.
[4] Kinzer, J. and Crawford, A. C., *SRE First Core Fuel*, Atomics International Technical Data Record No. 5301, May 16, 1960, pp. 1-7.
[5] Letter from Heine, W. F., Atomics International, to Proctor, J. F., E. I. du Pont de Nemours & Company, re: *Fission Product and Fissile Content of SRE Fuel*, July 2, 1975.
[6] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.

Previous characterization studies for the Site 4714 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 Site 4714 area. This includes the following Site 4714 areas:

- The flat and low-lying areas surrounding Building 4714. Radionuclides originating from Buildings 4163 and/or 4143 may have migrated to these areas via surface water flow or airborne releases. In 1978, asphalt paving reportedly prevented Rockwell from collecting soil samples at the time of demolition. Therefore, site characterization is incomplete.

2.1.17 Site 4723 Area

Site Description: The Site 4723 area comprised Site 4723 and the land surrounding it located at the extreme east end of the SRE complex at the end of E Street, about 250 feet northeast of Building 4003. Site 4723 was constructed in about 1957 as a sodium cleaning pad.[1] Figure 2.1.17a provides a current photograph. The location of Site 4723 is shown in Figure 1.3.

Building Features: Site 4723 was a 20- by 20-foot concrete pad according to one source and a 25- by 28-foot concrete pad according to a second source.[2, 3]

Former Use(s): Site 4723 was used as a steam cleaning pad for equipment and materials in the SRE. Prior to an incident in March 1960, the pad was used to clean low-level radioactivity from items of equipment. After the incident, AI decided not to use the pad for radioactive decontamination.[4] The pad was then used for sand blasting items and equipment that were believed to be free of radioactivity.[2]

Information from Interviewees: None to date.

Radiological Incident Reports: There has been one incident associated with Building 4723 that could have resulted in a release to the environment. The following table provides information presented in an incidents database provided by Boeing. A summary of the incident report is provided following the table, when available.

Building 4723 Incident Report Summary

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A0004	3/19/1960	SRE STEAM PAD	MFP	STEAM CLEANED R/A SODIUM PIPE AT CLEAN PAD CONTAMINATING AREA.

*Isotopes are written as they are presented in the incident database. The research team believes that MFP is an acronym for mixed fission products.

[1] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[2] Owens, D. E., *Radiological Survey Results – Release to Unrestricted Use, SRE Region I (Building 724 Area)*, Rockwell International Report No. N704TI990027, May 4, 1978, pp. 3-11.
[3] Ureda, B. F., *SRE Activity Requirement No. 25, Decontamination and Dismantling of Building 724 and Pad 723*, Rockwell International Report No. N704ACR990021, p. 2.
[4] Inter-office letter from J. Borg and E. J. Marcotte to W. L. Fisher, re: *Steam Clean Pad Incident*, June 2, 1960.

- On March 19, 1960, employees were decontaminating a 2-inch valve containing radioactively contaminated sodium at the SRE steam cleaning pad. The valve was placed in an oil bath and then removed for steam cleaning. The residual sodium was blasted from the valve and spread over the greater portion of the concrete pad. The employees were not wearing protective clothing and their shoes were contaminated as a result. The pad was hosed down, washing contaminated sodium and water onto the soil.

  Two of the men had contamination on their shoes that ranged from 1.5 to 3.0 mrad/h beta-gamma activity. Surveys from the south, east, and west edges of the pad to the center ranged from 0.5 to 30 mrad/h; however, the north edge of the pad to the center ranged from 30 to 100 mrad/h. Ten representative soil samples were collected from the north edge of the pad down the hillside to the retention pond. Beta-gamma activity in soil ranged from 2.7×10^{-7} to 1.5×10^{-2} µCi/g. According to Rockwell, water samples from the retention pond revealed nothing in excess of normal ground water activity.

  Decontamination efforts included chipping the pad surface and removing soil on the hillside. Sixteen barrels of concrete and 46 barrels of contaminated soil were collected for disposal. Follow-up soil samples found beta-gamma contamination ranging from 5.3×10^{-6} to 4.8×10^{-5} µCi/g showing decontamination was successful as the average soil activity for the area was 10^{-5} µCi/g. Smears taken of the concrete pad showed beta-gamma activity ranging from 4 to 20 dpm/100 cm^2, with the exception of one sample that was 40 dpm/100 cm^2. A survey of the pad found readings between 0.08 and 0.15 mrad/h, which were deemed by Rockwell as low enough to resurface the pad (Incident Report A004).[1]

Current Use: Site 4723 was demolished in 1998.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): A chronology of radiological investigations at this site is as follows:

- In 1978, Rockwell conducted a radiological survey in the area of Site 4723. The survey area was designated as SRE Region I. Survey results indicated a maximum reading of 0.04 ± 0.05 mrad/h for surface gamma radiation, and 27 soil samples were found to have less than 46 pCi/g of gross detectable beta contamination. All survey results were below Rockwell's applicable limits for release for unrestricted use.[2]

- In September 1982, ANL completed a verification survey of the SRE complex. This included instrument and smear surveys and analysis of material samples. ANL found that Site 4686 and its surrounding area had been decontaminated to below limits specified in the Draft ANSI Standard No. N13.12 and NRC 1982 guidelines.[2]

[1] Borg, J. and E.J. Marcotte, Atomics International Internal Letter, re: *Steam Clean Pad Incident*, June 2, 1960.
[2] Argonne National Laboratory, *Post Remedial Action Survey Report for the Sodium Reactor Experiment (SRE) Facility, Santa Susana Field Laboratories, Rockwell International, Ventura County, California*, DOE-EV-0005-46, ANL-OHS/HP-84-101, February 1984, pp. 1-3, 15.

Radiological Use Authorizations: The DOE released the area for unrestricted use on July 23, 1985.[1]

Former Radiological Burial or Disposal Locations: None found.

Aerial Photographs: Aerial photographs show undeveloped land until the 1957 photograph when disturbed ground is seen in the location of Site 4723. In the 1959 photograph, a square-shaped pad is identified as Site 4723. This is also seen in the approximately 1960, 1965, 1967, 1972, 1978, 1980, 1983, 1988, and 1995 photographs. A vegetated area is seen in the location of Site 4723 in the 2005 and 2009 photographs.[2]

Radionuclides of Concern: Site 4723 was initially used for cleaning low-level radioactivity from items of equipment. Possible radionuclides include U-238, U-234, U-235, U-236, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Th-232, H-3, Na-22, Na-24, Cr-51, Mn-54, Fe-59, Co-6, Kr-85, Sr-89, Sr-90, Sb-125, I-129, I-131, Cs-134, Cs-137, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xn-133, Xe-135, Pm-147, Sm-151.[3, 4, 5] All radionuclides of concern listed with the exception of Na-24, Cr-51, Mn-54, Fe-59, Kr-85, Sr-89, I-131, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xe-133, Xe-135, Pm-147 and Sm-151 are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives except for Sm-151 for which no analytical method is available. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Based on general site topography, surface water flows northwest into the SRE retention pond located northwest of the site. Outflow from the retention pond was initially onto the NBZ and Brandeis-Bardin Institute land. In 1959, a 6-foot diameter overflow pipe and a pumped sump were installed at the confluence of the two main drainage channels upstream of the pond. Water was then pumped through a 4-inch diameter overland pipe to a channel connecting to the Area II ponds. The overflow from these ponds is into Bell Canyon and thence to the Los Angeles River.[6]

Radiological Contamination Potential: The preliminary MARSSIM classification for the Site 4723 area is Class 1 because of its former use within the SRE complex.

Recommended Locations for Soil/Sediment Sampling:

Plate I and Figure 2.I provide a convenient reference for the following recommendations.

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[1] U.S. Department of Energy, *Certification for Unrestricted Use of the Sodium Reactor Experiment (SRE) Complex and the Hot Cave Facility (Bldg. 003)*, July 23, 1985.
[2] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[3] Hart, R. S., *Distribution of Fission Product Contamination in the SRE*, Atomics International Report No. NAA-SR-6890, March 1, 1962, pp. 8-27.
[4] Kinzer, J. and Crawford, A. C., *SRE First Core Fuel*, Atomics International Technical Data Record No. 5301, May 16, 1960, pp. 1-7.
[5] Letter from Heine, W. F., Atomics International, to Proctor, J. F., E. I. du Pont de Nemours & Company, re: *Fission Product and Fissile Content of SRE Fuel*,July 2, 1975.
[6] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.

Previous characterization studies for the Site 4723 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 Site 4723 area. This includes the following Site 4723 areas:

- The flat and low-lying areas on and surrounding Site 4723. Radionuclides originating from Site 4723 may have migrated to these areas via surface water flow or airborne releases. The steam cleaning incident in 1960 spread radioactive contamination in the area.

2.1.18 Building 4724 Area

Site Description: The Building 4724 area comprised Building 4724, and auxiliary skid Building 4688, and the land surrounding these buildings located at the extreme east end of the SRE complex at the end of E Street, about 250 feet northeast of Building 4003. Building 4724 was constructed in about 1966 as a contaminated sodium cleaning building.[1] Figure 2.1.18a provides a current photograph. The location of Building 4724 is shown in Figure 1.3.

Building Features: Building 4724 was a 10- by 22- by 12-foot high steel enclosure containing a monorail crane that extended 222 feet beyond the enclosure entrance. The enclosure was vented through duct work, an air filter, blowers, and an exhaust stack. The interior of the facility was posted as a radiation area. A concrete pit, containing an oil heater and oil supply tank, was located south of the steel enclosure. A concrete sump was located west of the enclosure.[2]

Former Use(s): Building 4724 was a hot oil sodium cleaning facility that was designed for cleaning sodium, in a hot oil bath, from large pipes and assemblies from the secondary loop of the SRE.[3] No further details about the cleaning method have been found.

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: In 1978, the Building 4724 steel enclosure was decontaminated, dismantled and relocated to become Building 4133.[3, 4] Building 4133 is discussed in the TM for HSA-7.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): A chronology of radiological investigations at this site is as follows:

- In 1977, Rockwell found that Building 4724 had a buildup of contamination from mixed fission products. Most of the activity was located inside a small trench dug along the

[1] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[2] Ureda, B. F., *SRE Activity Requirement No. 25, Decontamination & Dismantling of Building 724 and Pad 723*, Rockwell International Report No. N704ACR990021, March 28, 1977, pp. 2-5.
[3] Owens, D. E., *Radiological Survey Results – Release to Unrestricted Use, SRE Region I (Building 724 Area)*, Rockwell International Report No. N704TI990027, May 4, 1978, pp. 3-11.
[4] Boeing letter from B. Sujata to S. Baxter, California Environmental Protection Agency, re: *Radiological Release of Former Building 724*, November 14, 2005.

west wall of Building 4724. The metal diamond-plate floor was cut free in an attempt to remove the contamination, which was also detected in the underlying concrete. Rockwell decontaminated the walls and ceiling of Building 4724 to bring them under the limits of 20 dpm/100 cm^2 removable alpha activity, 100 dpm/100 cm^2 removable beta activity, 100 dpm/100 cm^2 total alpha activity and 0.1 mrad/h total beta-gamma activity. When certified clean, Rockwell cut the walls free from the metal floor and relocated the walls and roof to become Building 4133.[1] All that remained at the site was some contaminated metal flooring and concrete. Rockwell used a jack hammer to break the metal and remove the concrete in large sections. After the operation began, a network of rebar prevented use of this method for removing the concrete. Contaminated concrete was then broken free, placed in 34-cubic-foot waste containers, and shipped to an unnamed burial site. Each location that had been contaminated was tested for residual activity by collecting loose powder and dust from the concrete.[2]

- In 1978, Rockwell conducted a radiological survey in the area of Building 4724. The survey area was designated as SRE Region I. After all the contaminated concrete had been removed, 45 smear swipes of concrete were collected and the highest recorded level was 48 dpm/100 cm^2. Rockwell's applicable limit for removable contamination was 100 dpm/100 cm^2 for beta-gamma emitters. For surface radiation, survey results indicated a maximum reading of 0.04 mrad/h, and 27 soil samples were found to have less than 46 pCi/g of gross detectable beta activity. Five concrete samples were collected from the Building 4724 pad. Four of five samples were found to contain less than 100 pCi/g. A layer of concrete was removed from the west trench where the fifth sample had been collected. No source of activity was then detected in the trench. Two water samples were collected from the 3-foot-deep concrete pit located outside of Building 4724. Activity was measured at 2.3 x 10^{-6} $\mu Ci/cm^3$ for Sr-90. All survey results were below Rockwell's applicable limits for release for unrestricted use.[1]

- In September 1982, ANL completed a verification survey of the SRE complex. This included instrument and smear surveys and analysis of material samples. ANL found that Building 4724 and its surrounding area had been decontaminated to below limits specified in the Draft ANSI Standard No. N13.12 and NRC 1982 guidelines.[3]

Radiological Use Authorizations: The DOE released the area for unrestricted use on July 23, 1985.[4]

Former Radiological Burial or Disposal Locations: None found.

Aerial Photographs: Aerial photographs show undeveloped land until the 1967 photograph when a rectangular building is identified as Building 4724. This is also seen in the 1972

[1] Rockwell International internal letter from F. E. Begley to R. J. Tuttle, re: *Unconditional Release of Building T724 – for Unrestricted Use*, January 18, 1976.
[2] Owens, D. E., *Radiological Survey Results – Release to Unrestricted Use, SRE Region I (Building 724 Area)*, Rockwell International Report No. N704TI990027, May 4, 1978, pp. 3-11.
[3] Argonne National Laboratory, *Post Remedial Action Survey Report for the Sodium Reactor Experiment (SRE) Facility, Santa Susana Field Laboratories, Rockwell International, Ventura County, California*, DOE-EV-0005-46, ANL-OHS/HP-84-101, February 1984, pp. 1-3, 15.
[4] U.S. Department of Energy, *Certification for Unrestricted Use of the Sodium Reactor Experiment (SRE) Complex and the Hot Cave Facility (Bldg. 003)*, July 23, 1985.

photograph. A building pad is seen in the 1978, 1980, 1983, 1988, and 1995 photographs. A vegetated area is seen in the location of Building 4724 in the 2005 and 2009 photographs.[1]

Radionuclides of Concern: Building 4724 was used for cleaning items of equipment from the secondary loop of the SRE. Possible radionuclides include U-238, U-234, U-235, U-236, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Th-232, H-3, Na-22, Na-24, Cr-51, Mn-54, Fe-59, Co-60, Kr-85, Sr-89, Sr-90, Sb-125, I-129, I-131, Cs-134, Cs-137, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xn-133, Xe-135, Pm-147, Sm-151.[2, 3, 4] All radionuclides of concern listed with the exception of Na-24, Cr-51, Mn-54, Fe-59, Kr-85, Sr-89, I-131, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xe-133, Xe-135, Pm-147 and Sm-151 are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives except for Sm-151 for which no analytical method is available. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Based on general site topography, surface water flows northwest into the SRE retention pond located northwest of the site. Outflow from the retention pond was initially onto the NBZ and Brandeis-Bardin Institute land. In 1959, a 6-foot diameter overflow pipe and a pumped sump were installed at the confluence of the two main drainage channels upstream of the pond. Water was then pumped through a 4-inch diameter overland pipe to a channel connecting to the Area II ponds. The overflow from these ponds is into Bell Canyon and thence to the Los Angeles River.[5]

Radiological Contamination Potential: The preliminary MARSSIM classification for the Building 4724 area is Class 1 because of its former use within the SRE complex.

Recommended Locations for Soil/Sediment Sampling:

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

Previous characterization studies for the Building 4724 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 4724 area. This includes the following Building 4724 areas:

- The flat and low-lying areas on and surrounding Building 4724. Radionuclides originating from Building 4724 may have migrated to these areas via surface water flow or airborne releases. It is unclear whether soil in the region of the Building 4724 concrete pad was sampled. In 1977, Building 4724 was found to have a buildup of contamination from mixed fission products.

[1] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[2] Hart, R. S., *Distribution of Fission Product Contamination in the SRE*, Atomics International Report No. NAA-SR-6890, March 1, 1962, pp. 8-27.
[3] Kinzer, J. and Crawford, A. C., *SRE First Core Fuel*, Atomics International Technical Data Record No. 5301, May 16, 1960, pp. 1-7.
[4] Letter from Heine, W. F., Atomics International, to Proctor, J. F., E. I. du Pont de Nemours & Company, re: *Fission Product and Fissile Content of SRE Fuel*, July 2, 1975.
[5] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.

- The concrete pit and sump located west of the building enclosure.

2.1.19 Site 4733 Area

Site Description: The Site 4733 area comprised Site 4733 and the land surrounding it located north of Building 4143 in the SRE complex at the end of E Street. Site 4733 was constructed in about 1957 as a sodium cleaning pad.[1] Figure 2.1.19a provides a current photograph. The location of Site 4733 is shown in Figure 1.3.

Building Features: Site 4733 was a small rectangular concrete pad.

Former Use(s): Site 4733 was used to clean sodium from items from the SRE.

Information from Interviewees: None to date.

Radiological Incident Reports: There has been one incident associated with Building 4733 that could have resulted in a release to the environment. The following table provides information presented in an incidents database provided by Boeing. A summary of the incident report is provided following the table.

Building 4733 Incident Report Summary

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A0282	5/12/1961	SRE NORTH PAD	MFP	STEAM CLEANING OPERATION CONTAMINATED A CONCRETE PAD, EQUIPMENT AND & SHOES.

*Isotopes are written as they are presented in the incident database. The research team believes that MFP is an acronym for mixed fission products.

- On May 12, 1961, parts were being steam cleaned near an open SRE high bay door. A smear survey of the area outside the open door indicated contamination levels as high as 1,200 dpm beta-gamma. The area was roped off and a meter survey of personnel was made. Contamination was found on the bottom of two employees' shoes and the shoes had to be discarded. Additionally, 60 packages that were wrapped for storage outside the high bay doors were contaminated. A smear survey of the control room floor indicated 50 dpm beta-gamma. The control room and areas outside the high bay door were decontaminated (Incident Report A0282).[2]

Current Use: Site 4733 was demolished in the 1970s.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): A chronology of radiological investigations at this site is as follows:

[1] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[2] Galperin, A. Atomics International Internal Letter, re: *Radiological Safety Incident Report, SRE, 5-12-1961*, May 19, 1961.

- In September 1982, ANL completed a verification survey of the SRE complex. This included instrument and smear surveys and analysis of material samples. ANL found that Site 4733 and its surrounding area had been decontaminated to below limits specified in the Draft ANSI Standard No. N13.12 and NRC 1982 guidelines.[1]

- In 1983, Rockwell conducted a radiological survey in the area of Site 4733. The survey area was designated as SRE Region IX. Survey results indicated an average reading of 0.04 mrad/h for surface radiation, and 108 soil samples were found to have less than 100 pCi/g of gross detectable beta contamination, with an average of 33 pCi/g. All survey results were below Rockwell's applicable limits for release for unrestricted use.[2]

Radiological Use Authorizations: The DOE released the area for unrestricted use on July 23, 1985.[3]

Former Radiological Burial or Disposal Locations: None found.

Aerial Photographs: Aerial photographs show undeveloped land until the 1957 photograph when a rectangular pad is seen in the location of Site 4733. This is also seen in the 1959, approximately 1960, 1965, 1967, 1972 photographs. Open storage is seen in the 1978, 1980, 1983, 1988, and 1995 photographs. These may have been items awaiting cleaning. A vegetated area is seen in the location of Site 4733 in the 2005 and 2009 photographs.[4]

Radionuclides of Concern: Site 4733 was used for cleaning sodium from items from the SRE. Possible radionuclides include U-238, U-234, U-235, U-236, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Th-232, H-3, Na-22, Na-24, Cr-51, Mn-54, Fe-59, Co-60, Kr-85, Sr-89, Sr-90, Sb-125, I-129, I-131, Cs-134, Cs-137, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xn-133, Xe-135, Pm-147, Sm-151.[5, 6, 7] All radionuclides of concern listed with the exception of Na-24, Cr-51, Mn-54, Fe-59, Kr-85, Sr-89, I-131, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xe-133, Xe-135, Pm-147 and Sm-151 are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives except for Sm-151 for which no analytical method is available. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Based on general site topography, surface water flows into the drainage channel located in the region of the site, which connects to the SRE retention pond located

[1] Argonne National Laboratory, *Post Remedial Action Survey Report for the Sodium Reactor Experiment (SRE) Facility, Santa Susana Field Laboratories, Rockwell International, Ventura County, California*, DOE-EV-0005-46, ANL-OHS/HP-84-101, February 1984, pp. 1-3, 15.
[2] Wallace, J. H., *Radiological Survey Results – Release to Unrestricted Use, SRE Region IX*, Rockwell International Report No. N704TI990035, May 31, 1983, pp. 3-8.
[3] U.S. Department of Energy, *Certification for Unrestricted Use of the Sodium Reactor Experiment (SRE) Complex and the Hot Cave Facility (Bldg. 003)*, July 23, 1985.
[4] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[5] Hart, R. S., *Distribution of Fission Product Contamination in the SRE*, Atomics International Report No. NAA-SR-6890, March 1, 1962, pp. 8-27.
[6] Kinzer, J. and Crawford, A. C., *SRE First Core Fuel*, Atomics International Technical Data Record No. 5301, May 16, 1960, pp. 1-7.
[7] Letter from Heine, W. F., Atomics International, to Proctor, J. F., E. I. du Pont de Nemours & Company, r: *Fission Product and Fissile Content of SRE Fuel*, July 2, 1975.

northeast of the site. Outflow from the retention pond was initially onto the NBZ and Brandeis-Bardin Institute land. In 1959, a 6-foot diameter overflow pipe and a pumped sump were installed at the confluence of the two main drainage channels upstream of the pond. Water was then pumped through a 4-inch diameter overland pipe to a channel connecting to the Area II ponds. The overflow from these ponds is into Bell Canyon and thence to the Los Angeles River.[1]

Radiological Contamination Potential: The preliminary MARSSIM classification for the Site 4733 area is Class 1 due to its former use as a cleaning pad for the SRE reactor.

Recommended Locations for Soil/Sediment Sampling:

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

Previous characterization studies for the Site 4733 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 Site 4733 area. This includes the following Site 4733 areas and appurtenances:

- The flat and low-lying areas on and surrounding Site 4733. Radionuclides originating from Buildings 4143 and/or Site 4733 may have migrated to these areas via surface water flow or airborne releases.

- The drainage channel located in the region of the site that connects to the SRE retention pond. It is unknown whether contaminated water from steam cleaning operations was collected in the area.

2.1.20 Site 4743 Area

Site Description: The Site 4743 area comprised Site 4743 and the land surrounding it located north of Building 4143 in the SRE complex at the end of E Street. Site 4743 was constructed in about 1957 to house a tetralin heat exchanger.[2] Figure 2.1.20a, provides a current photograph. The location of Site 4743 is shown in Figure 1.3.

Building Features: Site 4743 was a small rectangular area.

Former Use(s): Site 4743 was used to house a heat exchanger for the hydrocarbon coolant and lubricant tetralin. The decomposition of tetralin in the SRE in 1959 caused multiple fuel element failures. Tetralin was not used in the SRE after this event, but the description "Tetralin Heat Exchanger" remained on site layout maps until at least 1971.

Information from Interviewees: None to date.

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[1] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.

Radiological Incident Reports: None found.

Current Use: Site 4743 was demolished in the 1970s.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): A chronology of radiological investigations at this site is as follows:

- In September 1982, ANL completed a verification survey of the SRE complex. This included instrument and smear surveys and analysis of material samples. ANL found that Site 4743 and its surrounding area had been decontaminated to below limits specified in the Draft ANSI Standard No. N13.12 and NRC 1982 guidelines.[1]

- In 1983, Rockwell conducted a radiological survey in the area of Site 4743. The survey area was designated as SRE Region IX. Survey results indicated an average reading of 0.04 mrad/h for surface radiation, and 108 soil samples were found to have less than 100 pCi/g of gross detectable beta contamination, with an average of 33 pCi/g. All survey results were below Rockwell's applicable limits for release for unrestricted use.[2]

Radiological Use Authorizations: The DOE released the area for unrestricted use on July 23, 1985.[3]

Former Radiological Burial or Disposal Locations: None found.

Aerial Photographs: Aerial photographs show undeveloped land until the 1957 photograph when a rectangular area is seen in the location of Site 4743. This is also seen in the 1959, approximately 1960, 1965, 1967, and 1972 photographs. Open storage is seen in the 1978, 1980, 1983, 1988, and 1995 photographs. A vegetated area is seen in the location of Site 4743 in the 2005 and 2009 photographs.[4]

Radionuclides of Concern: Site 4743 was used to house a tetralin heat exchanger for the SRE. Possible radionuclides include U-238, U-234, U-235, U-236, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Th-232, H-3, Na-22, Na-24, Cr-51, Mn-54, Fe-59, Co-60, Kr-85, Sr-89, Sr-90, Sb-125, I-129, I-131, Cs-134, Cs-137, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xn-133, Xe-135, Pm-147, Sm-151.[5, 6, 7] All radionuclides of concern listed with the exception of Na-24, Cr-51, Mn-54, Fe-59, Kr-85, Sr-89, I-131, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xe-133, Xe-

[1] Argonne National Laboratory, *Post Remedial Action Survey Report for the Sodium Reactor Experiment (SRE) Facility, Santa Susana Field Laboratories, Rockwell International, Ventura County, California*, DOE-EV-0005-46, ANL-OHS/HP-84-101, February 1984, pp. 1-3, 15.
[2] Wallace, J. H., *Radiological Survey Results – Release to Unrestricted Use, SRE Region IX*, Rockwell International Report No. N704TI990035, May 31, 1983, pp. 3-8.
[3] U.S. Department of Energy, *Certification for Unrestricted Use of the Sodium Reactor Experiment (SRE) Complex and the Hot Cave Facility (Bldg. 003)*, July 23, 1985.
[4] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[5] Hart, R. S., *Distribution of Fission Product Contamination in the SRE*, Atomics International Report No. NAA-SR-6890, March 1, 1962, pp. 8-27.
[6] Kinzer, J. and Crawford, A. C., *SRE First Core Fuel*, Atomics International Technical Data Record No. 5301, May 16, 1960, pp. 1-7.
[7] Letter from Heine, W. F., Atomics International, to Proctor, J. F., E. I. du Pont de Nemours & Company, re: *Fission Product and Fissile Content of SRE Fuel*, July 2, 1975.

135, Pm-147 and Sm-151 are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives except for Sm-151 for which no analytical method is available. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Based on general site topography, surface water flows into the drainage channel located in the region of the site, which connects to the SRE retention pond located northeast of the site. Outflow from the retention pond was initially onto the NBZ and Brandeis-Bardin Institute land. In 1959, a 6-foot diameter overflow pipe and a pumped sump were installed at the confluence of the two main drainage channels upstream of the pond. Water was then pumped through a 4-inch diameter overland pipe to a channel connecting to the Area II ponds. The overflow from these ponds is into Bell Canyon and thence to the Los Angeles River.[1]

Radiological Contamination Potential: The preliminary MARSSIM classification for the Site 4743 area is Class 1 due to its former use as a tetralin heat exchanger site for the SRE reactor.

Recommended Locations for Soil/Sediment Sampling:

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

Previous characterization studies for the Site 4743 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 Site 4743 area. This includes the following Site 4743 areas and appurtenances:

- The flat and low-lying areas on and surrounding Site 4743 where open storage was identified from aerial photographs. Radionuclides originating from Buildings 4143 and/or Site 4743 may have migrated to these areas via surface water flow or airborne releases.

- The drainage channel located in the region of the site that connects to the SRE retention pond.

2.1.21 Building 4753 Area

Site Description: The Building 4753 area comprised Building 4753 and the land surrounding it located north of Building 4143 in the SRE complex at the end of E Street. Building 4753 was constructed in about 1957 as the primary sodium fill tank vault.[2] Figure 2.1.21a provides a current photograph. The location of Building 4753 is shown in Figure 1.3.

Building Features: Building 4753 was a below grade concrete vault to facilitate containment and shielding. The vault contained the main primary sodium circuit piping and components

[1] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.

including the fill/drain tank. A nitrogen gas atmosphere was maintained in the vault to provide cooling and dehumidification of the cell and to prevent ignition of leaking sodium.[1, 2]

Former Use(s): Building 4753 housed a storage vault for sodium used in the SRE's primary cooling loop.[2]

Information from Interviewees: None to date.

Radiological Incident Reports: Rockwell reported in 1981 that radioactive contamination occurred when a manhole cover was separated from the primary sodium fill/drain tank after draining primary sodium from the tank into 55-gallon drums.[3]

Current Use: Building 4753 was demolished in the early 1980s.[2]

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): A chronology of radiological investigations at this site is as follows:

- In 1981, at the start of dismantling activities, approximately 7,400 gallons of sodium were stored in the primary fill tank under a 1-pound-per-square-foot gauge nitrogen cover gas. The sodium was "slightly" radioactive. A piping system was fabricated to facilitate draining the sodium from the primary fill tank into 55-gallon drums. A differential pressure between the primary fill tank cover gas and the 55-gallon drum cover gas was used to transfer the sodium into the drums. A total of 158 drums containing 55,000 pounds of radioactive sodium were shipped to Hanford, Washington, for storage and future use. The below-grade structure was then removed and the area was backfilled and paved.[2] Fill soils placed in the excavation consisted of imported soils exported from an off-site borrow site as well as on-site native soils local to the building sites.[4]

- In September 1982, ANL completed a verification survey of the SRE complex. This included instrument and smear surveys and analysis of material samples. ANL found that Building 4753 and its surrounding area had been decontaminated to below limits specified in the Draft ANSI Standard No. N13.12 and NRC 1982 guidelines.[5]

- In 1983, Rockwell conducted a radiological survey in the area of Building 4753. The survey area was designated as SRE Building 143. Survey results indicated a maximum below-grade reading of less than 0.1 mrad/h for surface gamma radiation, and below-grade soil samples were found to have less than 100 pCi/g of gross detectable beta

[1] Rockwell International, *Sodium Reactor Experiment Decommissioning Final Report*, Report No. ESG-DOE-13403, August 15, 1983, pp. 15-16, 53, 196.
[2] Owen, R. K., *Radiological Survey Plan, Support of D & D Program Operations at T-143 (SRE)*, Rockwell International Report No. N704TP990008, September 15, 1981, p. 3.
[3] Owen, R. K., *Radiological Survey Plan, Support of D & D Program Operations at T-143 (SRE)*, Rockwell International Report No. N704TP990008, September 15, 1981, p. 3.
[4] Pacific Materials Laboratory, Inc., *Final Compaction Test Report – Structural Backfill of Former Buildings 4143 and 4003 Test Cells, Area IV Rocketdyne, Santa Susana Field Laboratory, Ventura County, CA*, January 2, 2001.
[5] Argonne National Laboratory, *Post Remedial Action Survey Report for the Sodium Reactor Experiment (SRE) Facility, Santa Susana Field Laboratories, Rockwell International, Ventura County, California*, DOE-EV-0005-46, ANL-OHS/HP-84-101, February 1984, pp. 1-3, 15.

activity, with an average of 51 pCi/g. All survey results were below Rockwell's applicable limits for release for unrestricted use.[1]

Radiological Use Authorizations: The DOE released the area for unrestricted use on July 23, 1985.[2]

Former Radiological Burial or Disposal Locations: None found.

Aerial Photographs: Aerial photographs show undeveloped land until the 1957 photograph when a rectangular pad is seen in the location of Building 4753. This is also seen in the 1959, approximately 1960, 1965, 1967, 1972, and 1978 photographs. An excavated area is seen in the location of Site 4753 in the 1980 photograph. Open storage in the location of Building 4753 is observed in the 1983 photograph. A cleared area is seen in the location of Building 4753 in the 1988 and 1995 photographs. A vegetated area is seen in the location of Building 4753 in the 2005 and 2009 photographs.[3]

Radionuclides of Concern: Building 4753 was the primary fill tank vault for the SRE. Possible radionuclides include U-238, U-234, U-235, U-236, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Th-232, H-3, Na-22, Na-24, Cr-51, Mn-54, Fe-59, Co-60, Kr-85, Sr-89, Sr-90, Sb-125, I-129, I-131, Cs-134, Cs-137, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xn-133, Xe-135, Pm-147, Sm-151.[4, 5, 6] All radionuclides of concern listed with the exception of Na-24, Cr-51, Mn-54, Fe-59, Kr-85, Sr-89, I-131, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xe-133, Xe-135, Pm-147 and Sm-151 are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives except for Sm-151 for which no analytical method is available. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Based on general site topography, surface water flows into the drainage channel located north of the site, which connects to the SRE retention pond located northeast of the site. Outflow from the retention pond was initially onto the NBZ and Brandeis-Bardin Institute land. In 1959, a 6-foot diameter overflow pipe and a pumped sump were installed at the confluence of the two main drainage channels upstream of the pond. Water was then pumped through a 4-inch diameter overland pipe to a channel connecting to the Area II ponds. The overflow from these ponds is into Bell Canyon and thence to the Los Angeles River.[7]

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[1] Wallace, J. H., *Radiological Survey Results Release to Unrestricted Use, SRE Building 143*, Rockwell International Report No. N704TI990038, May 31, 1983, pp. 3-10.

[2] U.S. Department of Energy, *Certification for Unrestricted Use of the Sodium Reactor Experiment (SRE) Complex and the Hot Cave Facility (Bldg. 003)*, July 23, 1985.

[3] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.

[4] Hart, R. S., *Distribution of Fission Product Contamination in the SRE*, Atomics International Report No. NAA-SR-6890, March 1, 1962, pp. 8-27.

[5] Kinzer, J. and Crawford, A. C., *SRE First Core Fuel*, Atomics International Technical Data Record No. 5301, May 16, 1960, pp. 1-7.

[6] Letter from Heine, W. F., Atomics International, to Proctor, J. F., E. I. du Pont de Nemours & Company, re: *Fission Product and Fissile Content of SRE Fuel*, July 2, 1975.

[7] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.

Radiological Contamination Potential: The preliminary MARSSIM classification for the Building 4753 area is Class 1 due to its former use as a primary fill tank vault for the SRE reactor.

Recommended Locations for Soil/Sediment Sampling:

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

Previous characterization studies for the Building 4753 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 4753 area. This includes the following Building 4753 areas and appurtenances:

- The flat and low-lying areas on and surrounding Building 4753 where open storage was identified from aerial photographs. Radionuclides originating from Buildings 4143 and/or 4753 may have migrated to these areas via surface water flow or airborne releases. Building 4753 was attached to Building 4143 that included piping connected to the SRE.

- The drainage channel located north of the site that connects to the SRE retention pond. It is unclear whether this area was decontaminated fully after Rockwell reported in 1981 that radioactive contamination occurred when a manhole cover was separated from the primary sodium fill/drain tank after draining primary sodium from the tank into 55-gallon drums. This channel appears to be the most likely surface-water pathway from the spill area.

2.1.22 Site 4773 Area

Site Description: The Site 4773 area comprised Site 4773, and the land surrounding it located at the extreme east end of the SRE complex at the end of E Street. Site 4773 was constructed in 1956 as a retention pond and dam for the SRE.[1] Figures 2.1.22a and 2.1.22b provide a current photograph and a site layout of Site 4773. The location of Site 4773 is shown in plot plan Figure 2.1.10b. Figure 2.1.22c shows Site 4773 in 1979. Figure 2.1.22d shows an aerial view of the SRE site with the pond in the foreground.

Site Features: Site 4773 was an 800,000-gallon capacity retention pond with a compacted native earth dam. The dam was damaged by storm flow in 1958 and the repairs included the installation of a 1.5-foot diameter valved outlet pipe. A year later, as a result of complaints from downstream property owners, additional repairs included the installation of a 6-foot diameter overflow pipe and a pumped sump located at the confluence of the two main drain channels upstream of the pond. The sump collected all stormwater from the SRE. The pump, acting on an automatic level switch in the sump, pumped the water at 350 gpm through a 4-inch diameter overland pipe to a channel connecting to the Area II ponds. When the sump filled with silt, it was abandoned in place and the pump suction inlet was changed to a raft floating on the SRE retention pond. In 1977, the pond was at about 1/8 capacity (100,000 gallons); it was weed infested and algae laden. An unknown quantity of silt from the SRE had been deposited on the

[1] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.

bottom. The last known cleanout was in 1958 as part of the dam repair project. The 800,000-gallon capacity pond was below the 16 million gallon requirement for regulation and licensing by the California Department of Dam Safety.[1] A site layout plan is presented in Figure 2.1.22b. Figure 2.1.22c shows the pond in 1979. Figure 2.1.22d shows an aerial view of the SRE site with the pond in the foreground.

A septic sewer system was installed above and southwest of the retention pond as part of the original SRE site improvement. It was designed to be the non-radioactive sanitary waste disposal system for Buildings 4143 and 4003, according to Rockwell. Laboratories and radioactive facilities were not connected to it, but were provided with isolation tanks, according to Rockwell. When the central sewer system was built in 1961, the sewer line was connected to it by an ejector pump. The septic tank and leach field were then abandoned in place. In 1977, a 6-inch-diameter pump out stand pipe extended above the ground on the south end of the abandoned septic tank. There was no other physical evidence of the abandoned septic system on the surface at that time.[2]

An industrial waste system, constructed in parallel with the sanitary sewer system, terminated in a dry well located adjacent to the leach field. This was installed during the first improvement to the site, presumably in about 1958. Waste water overflowing from the dry well flowed into the concrete channel connected to the sump and pond. AI claimed that the connections to the industrial waste line may have permitted chemicial concentrations of cooling water algicides.[2]

Former Use(s): Site 4773 was the retention pond and drainage control dam for wastewater from the SRE complex, which operated between 1957 and 1964. No selected impervious materials were placed in the pond or dam. The pond was originally designed for natural seepage and evaporation to control the seasonal water level and provide capacity for winter storm water collection. After 1964, storm water runoff was the only source of water to the SRE pond, according to Rockwell.[2, 3]

Information from Interviewees: None to date.

Radiological Incident Reports: No official incident reports have been compiled for this site. A chronology of radiological incidents cited in Rockwell's reports is as follows:

- During operations, the liquid waste storage tanks overflowed near Building 4653, the intermediate radioactive waste vault, contaminating soil in the run-off area. The spill was cleaned up shortly afterward.[4]

- In 1964, the draining of test water from the new liquid radioactive waste tanks T2 and T3 sent radioactive solutions to the SRE pond and subsequently to the Area II ponds.

[1] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, pp. 6-7.
[2] Groundwater Resources Consultants, Inc., *Assessment of Pond Sediments in R2, SRE and Perimeter Ponds at the Rockwell International Corporation Rocketdyne Division, Santa Susana Field Laboratory, Ventura County, California*, Report No. 8640M-101, July 26, 1990, pp. 4-5.
[3] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, pp. 6-7.
[4] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, pp. 6-7.

Reportedly, the total release did not exceed 60 µCi. The concentration of radioactivity in the SRE retention pond was less than 2 pCi/cm^3, and in the Area II ponds was 0.1 pCi/cm^3. Co-60 was found to contribute about 5 percent of the radioactivity.[1]

Current Use: Site 4773 retention pond was demolished in about 1988.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): A chronology of radiological investigations at this site is as follows:

- In 1979, Rockwell drained the SRE pond and allowed it to dry out. According to Rockwell, all areas of the pond bottom that exceeded 100 pCi/g gross detectable beta activity, were removed and disposed of as radioactive waste. After this decontamination process, Rockwell collected soil samples from the pond bottom, and the pond was subsequently returned to service. Soil sampling results indicated that all samples were below 100 pCi/g, with a mean value of 29 pCi/g. All survey results were below Rockwell's applicable limits for release for unrestricted use.[1]

- In September 1982, ANL completed a verification survey of the SRE complex. This included three soil samples collected at the edge of the pond to about a 2-inch depth. ANL found that Site 4773 and its surrounding area had been decontaminated to below limits specified in the Draft ANSI Standard No. N13.12 and NRC 1982 guidelines.[2]

- In March 1983, Rockwell recommended that water being held in the SRE pond be pumped to the Rockwell water reclamation system and the bottom gate valve be opened to allow for natural runoff.[3]

- In 1990, Groundwater Resources Consultants (GRS) collected 14 sediment samples from the SRE pond. Cs-137 was detected in "low" concentrations at all pond sample locations. GRS considered these concentrations to be reflective of atmospheric fallout. Cs-137 concentrations ranged from 0.033 pCi/g to 1.90 pCi/g. No other man-made gamma emitters were detected. Natural emitters Pb-212, Pb-214, and K-40 were also detected at all locations. GRS considered the concentrations of Pb-212 and Pb-214 to be indicative of the natural Th-232 and U-238 decay series, respectively. Gross alpha and gross beta activity were not elevated above GRS' background levels. The highest gross alpha activity found was 13.1 ± 3.86 pCi/g in a pond outflow sediment sample, and the highest gross beta activity was 35.6 ± 5.57 pCi/g in a pond outflow sediment sample.[4]

- Based on GRS' chemical sampling results, on December 3, 1990, the California Regional Water Quality Control Board requested that Rockwell remove all contaminated sediments

[1] Wallace, J. H., *Radiological Survey results Release to Unrestricted use, SRE Region VII*, Rockwell International Report No. N704TI990033, May 13, 1983, pp. 7-9.
[2] Argonne National Laboratory, *Post Remedial Action Survey Report for the Sodium Reactor Experiment (SRE) Facility, Santa Susana Field Laboratories, Rockwell International, Ventura County, California*, DOE-EV-0005-46, ANL-OHS/HP-84-101, February 1984, pp. 1-3, 15.
[3] Rockwell International internal letter from P. L. Kleinsmith to K. Johns, re: *Deactivation of SRE Retention Pond*, March 28, 1983.
[4] Groundwater Resources Consultants, Inc., *Assessment of Pond Sediments in R2, SRE and Perimeter Ponds at the Rockwell International Corporation Rocketdyne Division, Santa Susana Field Laboratory, Ventura County, California*, Report No. 8640M-101, July 26, 1990, pp. 13-24.

from the pond and stockpile them on the facility for further treatment or move them to an appropriate disposal location. Soil verification samples were requested to determine that all contaminated sediments had been removed. A new sampling station was also requested to be installed in the vicinity of the SRE pond discharge point to verify that rainfall runoff was not causing contaminants to migrate off-site.[1]

- On December 4, 1990, Rockwell responded stating that the company would excavate a 10- by 10- by 4-foot deep portion of the pond at the northern inflow area (the only significantly contaminated area) and stockpile the soil on Visquene® while analyzing three soil samples. Previously, in 1979, Rockwell had removed contamination from the pond and determined that remaining soils were below their acceptable limits for release to unrestricted use. The disposition of the soil would depend upon the analytical results.[2] The HSA team has obtained no additional information about the soil stockpile or analytical results.

- In July 2000, Boeing excavated and surveyed for radiological contamination the drainage lines, septic tank (for Buildings 4003, 4143, and 4163) and leach field. Instrument measurements and wipe samples were collected from the septic tank and associated piping. Boeing found no man-made gamma emitting radionuclides from gamma spectroscopy of concrete debris from the septic tank. The septic tank was full of a mixture of debris and soil. Boeing collected seven samples from the debris within the septic tank, its inlet pipes, and its outlet pipes. Using gamma spectroscopy, Boeing detected Cs-137 in the inlet pipes and inlet chamber in concentrations up to 2.5 pCi/g. These materials were packaged as radioactive waste per Boeing's policy. Boeing also collected four soil samples from beneath the septic tank, but no man-made radionuclides were identified in these samples. Boeing collected seven soil/gravel samples along the length of the leach field lines. The highest concentration detected was Cs-137 at 0.65 pCi/g, which Boeing considered to be consistent with its local background level in 2001.[3]

Radiological Use Authorizations: The DOE released the area for unrestricted use on July 23, 1985.[4]

Former Radiological Burial or Disposal Locations: The pond, the septic sewer system, and the industrial waste system were all disposal locations for waste water.[1] Radioactive contamination was found in the pond

Aerial Photographs: Aerial photographs show undeveloped land until the 1957 photograph when an irregularly shaped impoundment with a dam on its east side are seen in the location of Site 4773. In the 1959 photograph, the impoundment appears to have increased in size by about 50 percent. The impoundment appears unchanged in the approximately 1960, 1965, 1967, 1972,

[1] Letter from J. E. Ross, California Regional Water Quality Control Board, to S. R. Lafflam, Rockwell International Corporation, re: *SRE Pond Modification*, December 3, 1990.
[2] Letter from J. T. Crone, Rockwell International, to J. Ross, California Regional Water Quality Control Board, re: SRE Pond Modifications, December 4, 1990.
[3] Letter from B. D. Sujata, The Boeing Company, to J. Evans, County of Ventura, re: *Information Regarding Permit - Septic Tank and Leach Field*, October 23, 2001.
[4] U.S. Department of Energy, *Certification for Unrestricted Use of the Sodium Reactor Experiment (SRE) Complex and the Hot Cave Facility (Bldg. 003)*, July 23, 1985.

and 1978 photographs. The impoundment appears to have shrunk by about 50 percent in the 1980 and 1983 photographs. The impoundment appears to be vegetated and without water in the 1988 and 1995 photographs. In the 2005 and 2009 photographs, the end of a pipe can be seen near where the dam was previously located.[1]

Radionuclides of Concern: Site 4773 was the retention pond and drainage control dam for the SRE. Radiologically contaminated water is known to have flowed to the pond. Possible radionuclides include U-238, U-234, U-235, U-236, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Th-232, H-3, Na-22, Na-24, Cr-51, Mn-54, Fe-59, Co-60, Kr-85, Sr-89, Sr-90, Sb-125, I-129, I-131, Cs-134, Cs-137, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xn-133, Xe-135, Pm-147, Sm-151.[2, 3, 4] All radionuclides of concern listed with the exception of Na-24, Cr-51, Mn-54, Fe-59, Kr-85, Sr-89, I-131, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xe-133, Xe-135, Pm-147 and Sm-151 are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives except for Sm-151 for which no analytical method is available. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Up until 1958, surface water from the SRE complex flowed directly into the SRE retention pond. After 1958, a pumped sump collected water from the SRE areas. The pump, controlled by an automatic level switch in the sump, pumped the water at 350 gpm through a 4-inch diameter overland pipe to a channel connecting to the Area II ponds. The overflow from these ponds is into Bell Canyon and thence to the Los Angeles River.[5]

Radiological Contamination Potential: The preliminary MARSSIM classification for the Site 4773 area is Class 1 due to its former use as the retention pond and drainage control dam for the SRE reactor.

Recommended Locations for Soil/Sediment Sampling:

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

Previous characterization studies for the Site 4773 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 Site 4773 area. This includes the following Site 4773 areas and appurtenances:

- Areas within and underneath the former pond and upgradient areas that lead to this pond. Radionuclides originating from Building 4143 may have migrated to these areas via surface water flow or airborne releases.

[1] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[2] Hart, R. S., *Distribution of Fission Product Contamination in the SRE*, Atomics International Report No. NAA-SR-6890, March 1, 1962, pp. 8-27.
[3] Kinzer, J. and Crawford, A. C., *SRE First Core Fuel*, Atomics International Technical Data Record No. 5301, May 16, 1960, pp. 1-7.
[4] Letter from Heine, W. F., Atomics International, to Proctor, J. F., E. I. du Pont de Nemours & Company, re: *Fission Product and Fissile Content of SRE Fuel*, July 2, 1975.
[5] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.

- The areas of the Buildings 4003, 4143, and 4163 septic tank and leach field. It is not clear that a full site characterization has been conducted in these areas.

- The dry well located adjacent to the leach field. If the dry well has not been demolished, this is an area where radiologically contaminated water may have accumulated.

- The sump located upstream of the pond. If the sump has not been demolished, this is an area where radiologically contaminated water may have accumulated.

- The outlet pipe located at the east end of the pond. This is an area where radiologically contaminated water may have accumulated.

- Locations downhill from the pond. Outflow from the pond originally followed along a path to the NBZ. Multiple spills occurred at the pond over time and the water would have flowed to lower elevations.

- Locations below the dam. Because the dam was earthen, water would have flowed under and around the dam to reach lower elevations.

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-6 Group 2 are presented. HSA-6 Group 2 includes three building areas containing the radioactive laundry buildings and electronics shop.

2.2.1 Building 4063 Area

Site Description: The Building 4063 area comprises Building 4063, substation Building 4763, and the land surrounding these two buildings located on E Street. Building 4063 was constructed prior to 1957.[1] Figures 2.2.1a and 2.2.1b provide a current photograph and a floor plan. Figure 2.2.1c provides a plot plan.

Building Features: Building 4063 had two rooms and three doors. A floor plan is presented in Figure 2.2.1b.

Former Use(s): Building 4063 was initially used as an electronics shop, and later as a maintenance service and storage building for non-radiological equipment. After Building 4063 was demolished in 1976, its concrete slab floor was used for storing bottled industrial gases.[1, 2]

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] Chapman, J. A., *Radiological Survey of the T513 Parking Lot; Old R/A Laundry Area; Plot 333; and Areas between SRE to RMDF, and KEWB to RMDF*, GEN-ZR-0009, August 26, 1988, pp. 8, 19, 54, 61-64, 77.

Current Use: Building 4063 was demolished to its concrete slab floor in 1976.[2] The slab was removed after 1995.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): A chronology of radiological investigations at this building is as follows:

- After the facility was decommissioned and dismantled in 1976, Rockwell performed a radiation survey to ensure that residual radioactivity levels met its unrestricted-use acceptance criteria. Gamma scanning results (14.0 ± 0.25 µR/h) were consistent with Rockwell's background exposure rate of 14.0 ± 0.25 µR/h.[2]

- In 1988, Rockwell conducted a radiological survey to determine whether radioactive material accidentally remained at the site. Building 4063 was part of the Old Radioactive Laundry area that was surveyed for mixed fission products by measuring ambient gamma exposure rates. The radioactive laundry area is discussed below. The maximum exposure rate in the area was 17.72 µR/h. Rockwell's acceptance limit was 5 µR/h above a background level of approximately 15 µR/h. Survey results were below Rockwell's acceptance limits.[2]

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Locations: None found.

Aerial Photographs: Aerial photographs show undeveloped land until the 1957 photograph when a rectangular building is observed that is identified as Building 4063. Building 4063 is seen in photographs from 1959, approximately 1960, 1965, and 1967, but only building slab appears visible in photographs from 1972, 1978, 1980, 1983, 1988, and 1995. In the 2005 and 2009 photographs, the site appears to be vegetated.[1]

Radionuclides of Concern: The research team did not find evidence that radioactive materials were used or stored within Building 4063. However, Building 4063 was located across E street from Parking Lot 4513, which was used by personnel working in Buildings 4030, 4641, and 4064 where radioactive materials were handled. In Building 4064, non-irradiated, fissionable nuclear materials (enriched uranium and plutonium) were stored along with low-level radioactive waste. Building 4063 was also located in the vicinity of the Old Radioactive Laundry area. Potential radioactive contaminants include U-233, U-234, U-235, U-236, U-238, Th-228, Th-232, Pu-238, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Ra-226, Cs-134, Cs-137, Sr-90, H-3, Na-22, K-40, Mn-54, Fe-55, Co-60, Ni-59, Ni-63, Eu-152, Eu-154, Pm-147, Ta-182.[2] All radionuclides of concern listed, with the exception of Mn-54, Pm-147 and Ta-182, are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives and do not meet the criteria for analysis. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Based on general site topography, surface water flows northeast from former Building 4063 to the east-side storm drain on E Street. This storm drain appears to

[1] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[2] Liddy, P., *Area 4064 Final Status Survey Report*, Rocketdyne Report No. RS-00003, March 30, 1999, p. 4.

connect with a drainage channel that transports water south through Area III to a pond in Area II. The overflow from this pond is into Bell Canyon and thence to the Los Angeles River.[1] Radioactive materials do not appear to have been handled in Building 4063, but the site could have become contaminated by surface water and airborne releases from Building 4064.

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4063 area is Class 2, due to its location near Parking Lot 4513 and the Old Radioactive Laundry area.

Recommended Locations for Soil/Sediment Sampling:

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

Previous characterization studies for the Building 4063 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 4063 area. This includes the following Building 4063 areas:

- The flat and low-lying areas surrounding Building 4063. Radionuclides originating from Buildings 4064, 4273, and/or 4283 may have migrated to these areas via surface water flow or airborne releases.

2.2.2 Building 4273 Area

Site Description: The Building 4273 area comprised Building 4273, maintenance skid shack Building 4316, and the land surrounding these two buildings located on the north side of E Street at its intersection with 10th Street. Building 4273 was constructed in approximately 1957 as a radioactive laundry.[2] Figure 2.2.2a provides a current photograph. Figure 2.2.1c provides a plot plan.

Building Features: Building 4273 included a radioactive laundry and protective clothing storage area. The research team has not located a more detailed description of this building. The sewer system was not connected to this building, but it may have had a septic tank and leach field.

Former Use(s): Building 4273 was a radioactive laundry. Contaminated laundry from the SRE Building 4143, the Engineering Test Building 4003, and the RMDF Building 4021 was brought to this building for cleaning. Operations were discontinued in 1971.[3]

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[1] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.

[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.

[3] Chapman, J. A., *Radiological Survey of the T513 Parking Lot; Old R/A Laundry Area; Plot 333; and Areas between the SRE to RMDF, and KEWB to RMDF*, Energy Technology Engineering Center Report No. GEN-ZR-0009, August 26, 1988, pp. 8, 19, 54, 61, 63-64, 77, 79.

Information from Interviewees: In 2010, a number of former workers were interviewed about their experiences at the SSFL. One remembered the radioactive laundry. Excerpts from his comments are presented below.

- "Everything including people and equipment would be decontaminated. Everything had to be cleaned before you left at night and it was smear tested every day. We wore booties and paper whites. The booties would be laundered up there on the hill. The laundry re-circulated the water at the SRE."[1] This former employee worked at the SSFL in the 1950s.

Radiological Incident Reports: None found.

Current Use: Building 4273 was demolished to its concrete slab floor in 1976.[2] The slab was removed after 1995.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): A chronology of radiological investigations at this building is as follows:

- After the facility was decommissioned and dismantled in 1976, Rockwell performed a radiation survey to ensure that residual radioactivity levels met its unrestricted-use acceptance criteria. Gamma scanning results (15.3 ± 0.27 μR/h) were consistent with Rockwell's background exposure rate of 14.0 ± 0.25 μR/h.[2]

- In 1988, Rockwell conducted a radiological survey to determine whether radioactive material accidentally remained at the site. Building 4063 was part of the Old Radioactive Laundry area that was surveyed for mixed fission products by measuring ambient gamma exposure rates. The maximum exposure rate in the area was 17.72 μR/h. Rockwell's acceptance limit was 5 μR/h above a background level of approximately 15 μR/h. Survey results were below Rockwell's acceptance limits.[2]

Radiological Use Authorizations: The DOE released the area for unrestricted use on July 23, 1985.[2]

Former Radiological Burial or Disposal Locations: None found.

Aerial Photographs: Aerial photographs show undeveloped land until the 1957 photograph when a rectangular-shaped building is identified as Building 4273. Building 4273 can be seen in the 1959 and approximately 1960 photographs. In the 1965 photograph, an additional rectangular section can be seen that is identified as Building 4316, the maintenance skid shack. This can also be seen in the 1967 and 1972 photographs. A building slab is observed in photographs from 1978, 1980, 1983, 1988, and 1995. A vegetated area is seen in the location of Building 4273 in the 2005 and 2009 photographs.[3]

Radionuclides of Concern: Building 4273 was used as part of SRE operations. Possible radionuclides include U-238, U-234, U-235, U-236, Pu-239, Pu-240, Pu-241, Pu-242, Am-241,

[1] Interview No. 106 of former employee conducted by the U.S. DOE and EPA, September 2010.
[2] U.S. Department of Energy, *Certification for Unrestricted Use of the Sodium Reactor Experiment (SRE) Complex and the Hot Cave Facility (Bldg. 003)*, July 23, 1985.
[3] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.

Th-232, H-3, Na-22, Na-24, Cr-51, Mn-54, Fe-59, Co-60, Kr-85, Sr-89, Sr-90, Sb-125, I-129, I-131, Cs-134, Cs-137, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xn-133, Xe-135, Pm-147, Sm-151.[1, 2, 3] All radionuclides of concern listed with the exception of Na-24, Cr-51, Mn-54, Fe-59, Kr-85, Sr-89, I-131, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xe-133, Xe-135, Pm-147 and Sm-151 are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives except for Sm-151 for which no analytical method is available. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Building 4273 was located east of a drainage divide. The location of former wastewater lines and storm drains is unknown. Based on general site topography, surface water flows in a northeasterly direction from the site. Ultimately, surface water would discharge to a channel connecting to the Area II ponds. The overflow from these ponds is into Bell Canyon and thence to the Los Angeles River.[4]

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4273 area is Class 1. Items of radioactive laundry were washed and dried in Building 4237 for approximately 14 years. It is not apparent where wastewater from laundry operations discharged or that a full radiological characterization of the area was conducted.

Recommended Locations for Soil/Sediment Sampling:

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

It is not apparent where wastewater from laundry operations discharged. In addition, previous characterization studies for the Building 4273 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 4273 area. This includes the following Building 4273 areas:

- The flat and low-lying areas surrounding Building 4273. Radionuclides originating from Building 4143 may have migrated to these areas as a result of cleaning operations.

- Because little is known about laundry storage areas, site operations, and wastewater and discharge, a comprehensive soil sampling program is warranted at Building 4273.

2.2.3 Building 4283 Area

Site Description: The Building 4283 area comprised Building 4283 and the land surrounding it located on the north side of E Street at the intersection with 10th Street. Building 4283 was

[1] Hart, R. S., *Distribution of Fission Product Contamination in the SRE*, Atomics International Report No. NAA-SR-6890, March 1, 1962, pp. 8-27.
[2] Kinzer, J. and Crawford, A. C., *SRE First Core Fuel*, Atomics International Technical Data Record No. 5301, May 16, 1960, pp. 1-7.
[3] Letter from Heine, W. F., Atomics International, to Proctor, J. F., E. I. du Pont de Nemours & Company, re: *Fission Product and Fissile Content of SRE Fuel*, July 2, 1975.
[4] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.

constructed in approximately 1963 as a radioactive laundry.[1] Figure 2.2.3a provides a current photograph. Figure 2.2.1c provides a plot plan.

Building Features: Building 4283 included a radioactive laundry and protective clothing storage area. The research team has not located a more detailed description of this building. The sewer system was not connected to this building, but it may have had a septic tank and leach field in conjunction with Building 4273.

Former Use(s): Building 4283 was a radioactive laundry. Contaminated laundry from the SRE Building 4143, the Engineering Test Building 4003, and the RMDF Building 4021 was brought to this building for cleaning. Operations were discontinued in 1971.[2]

Information from Interviewees: In 2010, a number of former workers were interviewed about their experiences at the SSFL. One remembered the radioactive laundry. Excerpts from his comments are presented below.

- "Everything including people and equipment would be decontaminated. Everything had to be cleaned before you left at night and it was smear tested every day. We wore booties and paper whites. The booties would be laundered up there on the hill. The laundry re-circulated the water at the SRE."[3] This former employee worked at the SSFL in the 1950s.

Radiological Incident Reports: None found.

Current Use: Building 4283 was demolished in approximately 1976.[2] The slab was removed after 1995.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): A chronology of radiological investigations at this building is as follows:

- After the facility was decommissioned and dismantled in 1976, Rockwell performed a radiation survey to ensure that residual radioactivity levels met its unrestricted-use acceptance criteria. Gamma scanning results (15.3 ± 0.27 μR/h) were consistent with Rockwell's background exposure rate of 14.0 ± 0.25 μR/h.[2]

- In 1988 Rockwell conducted a radiological survey of the Building 4283 area as part of a survey of five areas that had been used to support nuclear-related facilities. Gamma exposure rates were measured to determine whether mixed fission products remained at the site. The maximum exposure rate in the area was 17.72 μR/h. Rockwell's acceptance limit was 5 μR/h above a background level of approximately 15 μR/h. Survey results were below Rockwell's acceptance limits.[2]

[1] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[2] Chapman, J. A., *Radiological Survey of the T513 Parking Lot; Old R/A Laundry Area; Plot 333; and Areas between the SRE to RMDF, and KEWB to RMDF*, Energy Technology Engineering Center Report No. GEN-ZR-0009, August 26, 1988, pp. 8, 19, 61, 63-64, 77, 79.
[3] Interview No. 106 of former employee conducted by the U.S. DOE and EPA, September 2010.

Radiological Use Authorizations: The DOE released the area for unrestricted use on July 23, 1985.[1]

Former Radiological Burial or Disposal Locations: None found.

Aerial Photographs: Aerial photographs show undeveloped land until the approximately 1960 photograph when disturbed ground is observed. In the 1965 photograph, a rectangular-shaped building is identified as Building 4283. This can be seen in the 1967 and 1972 photographs. A building slab is observed in the 1978, 1980, 1983, 1988, and 1995 photographs. A vegetated area is seen in the location of Building 4283 in the 2005 and 2009 photographs.[2]

Radionuclides of Concern: Building 4283 was used as part of SRE operations. Possible radionuclides include U-238, U-234, U-235, U-236, isotopes of plutonium Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Th-232, H-3, Na-22, Na-24, Cr-51, Mn-54, Fe-59, Co-60, Kr-85, Sr-89, Sr-90, Sb-125, I-129, I-131, Cs-134, Cs-137, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xn-133, Xe-135, Pm-147, Sm-151.[3, 4, 5] All radionuclides of concern listed with the exception of Na-24, Cr-51, Mn-54, Fe-59, Kr-85, Sr-89, I-131, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xe-133, Xe-135, Pm-147 and Sm-151 are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives except for Sm-151 for which no analytical method is available. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Building 4283 was located east of a drainage divide. The location of former wastewater lines and storm drains is unknown. Based on general site topography, surface water flows in a northeasterly direction from the site. Ultimately, surface water would discharge to a channel connecting to the Area II ponds. The overflow from these ponds is into Bell Canyon and thence to the Los Angeles River.[6]

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4283 area is Class 1. Items of radioactive laundry were washed and dried in Building 4237 for approximately 8 years. It is not apparent where wastewater from laundry operations discharged or that a full radiological characterization of the area was conducted.

Recommended Locations for Soil/Sediment Sampling:

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

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[1] U.S. Department of Energy, *Certification for Unrestricted Use of the Sodium Reactor Experiment (SRE) Complex and the Hot Cave Facility (Bldg. 003)*, July 23, 1985.
[2] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[3] Hart, R. S., *Distribution of Fission Product Contamination in the SRE*, Atomics International Report No. NAA-SR-6890, March 1, 1962, pp. 8-27.
[4] Kinzer, J. and Crawford, A. C., *SRE First Core Fuel*, Atomics International Technical Data Record No. 5301, May 16, 1960, pp. 1-7.
[5] Letter from Heine, W. F., Atomics International, to Proctor, J. F., E. I. du Pont de Nemours & Company, re: *Fission Product and Fissile Content of SRE Fuel*, July 2, 1975.
[6] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.

It is not apparent where wastewater from laundry operations discharged. In addition, previous characterization studies for the Building 4283 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 4283 area. This includes the following Building 4283 areas:

- The flat and low-lying areas surrounding Building 4283. Radionuclides originating from Building 4143 may have migrated to these areas as a result of cleaning operations.

- Becaise little is known about laundry storage areas, site operations, and wastewater and discharge, a comprehensive soil sampling program is warranted at Building 4283.

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-6 Group 3 are presented. HSA-6 Group 3 includes four building areas containing the fuel element storage facility and SRE support buildings.

2.3.1 Building 4014 Area

Site Description: The Building 4014 area comprises Building 4014, substation Building 4783, and the land surrounding these two buildings located on E Street. Building 4014 was constructed prior to August 1957.[1, 2] Figure 2.3.1a provides a current photograph. Figure 2.3.1b shows the floor plan. The location of Building 4014 is shown in Figure 2.3.

Building Features: Building 4014, originally 2,100 square-feet in area, changed its shape and size over the years. In 1977, Building 4014 was replaced with a 2,400-square-foot prefabricated galvanized steel building on a concrete slab with translucent fiberglass skylights, electrical lighting and power, and a fire detection system. Figure 2.3.1b shows the floor plan. Buildings 4033, 4043, and 4053 were demolished in the process.[3]

Former Use(s): Building 4014 was a storage building for metallic sodium. In April 1994, 81 55-gallon drums of surplus new product sodium were stored in Building 4014 together with 3 drums and 8 wooden boxes of potassium, 3 drums of lithium, 2 drums and 1 box of NaK, 8 NaK pressure transducers, 1 NaK loop, and 1 NaK loading cart.[4, 5] In May 1995, the DOE was looking for an end user for the sodium.[6] In March 1996, Disposal Authorization No. 16134 indicated that the drums were to be delivered to Surplus Sales within 10 days of financial

[1] Rockwell International, *Area IV Radiological Characterization Survey*, A4CM-ZR-0011, Rev. A, August 15, 1996, pp. 35, 55-58.
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[3] Rockwell International, *Construction Specification for Sodium Storage Facility Building 014, Santa Susana Facility, Ventura County, California*, Specification No. 303-014-1, May 10, 1977.
[4] Rockwell International, *Status of Material in B/014*, circa April 1994.
[5] Rockwell International Inventory of Building 014, April 14, 1994.
[6] U.S. Department of Energy letter from L. Marik to M. Jensen, Rockwell International, re: *ETEC Bulk Sodium*, May 11, 1995.

approval.[1] On June 3, 1996, Rockwell indicated that Building 4014 had been cleared of DOE and Energy Technology Engineering Center (ETEC) materials and equipment, but equipment or materials belonging to Protective Services and Surplus Sales remained in Building 4014.[2] On June 21, 1996, Rockwell granted permission to Industrial Security to store fire department equipment in Building 4014.[3]

Information from Interviewees: None to date.

Radiological Incident Reports: None found.
Current Use: Building 4014 was demolished in 2003.[4]

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): A chronology of radiological investigations at this building is as follows:

- In 1988, Rockwell surveyed for radioactive contaminants the Building 4513 parking lot, adjacent to Building 4014, as part of a larger study. Rockwell found the mean exposure rate at Parking Lot 4513 to be 14.0 ± 0.25 μR/h.[5]

- In 1994 and 1995, Rockwell conducted a radiological characterization survey in Area IV that included Building 4014. The purpose of this survey was to locate and characterize any previously unknown areas of elevated radioactivity in Area IV. Rockwell estimated background to be 15.6 μR/h. Rockwell's acceptable limit was less than 5 μR/h above background. Survey results were below Rockwell's acceptance limits.[1]

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Locations: None found.

Aerial Photographs: Aerial photographs show undeveloped land until the 1957 photograph when a small rectangular building is observed that is identified as Building 4014. Building 4014 appears to have increased in size in the 1959 photograph. This addition is identified as two separate buildings 4033 and 4043. The approximately 1960 photograph shows an additional piece that makes the building L-shaped. This piece is identified as separate Building 4053. The roof of Building 4014 changes and becomes rectangular in the 1978 photograph. This may indicate that a new building has been constructed on the site of the old one. No changes are observed in the 1980, 1983, 1988, and 1995 photographs. In the 2005 photograph, a ground scar appears where Building 4014 was located. Undeveloped land appears in the location of Building 4014 in the 2009 photograph.[6]

[1] Rockwell International email from S. L. Samuels to J. H. Washington, re: *B/014*, circa 1996.
[2] Rockwell International email from R. D. Meyer to M. E. Lee, re: *B/014 Evacuation by ETEC*, June 3, 1996.
[3] Rockwell International email from M. J. Gabler to D. Bunch, re: *Use of DOE Building 4014 by Industrial Security*, June 21, 1996.
[4] Boeing letter from B. K. Ludwig to J. Flores, Ventura County Air Pollution Control District, re: *Demolish Building 4014, Area IV, Santa Susana Field Laboratory*, May 19, 2003.
[5] Chapman, J., *Radiological Survey of the T513 Parking Lot; Old R/A Laundry Area; Plot 333; and Areas between the SRE to RMDF, and KEWB to RMDF*,ETEC Report No. GEN-ZR-0009, pp. 54, 77, 79.
[6] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.

Radionuclides of Concern: The research team did not find evidence that radioactive materials were used or stored within Building 4014. However, Building 4014 was located adjacent to Parking Lot 4513, which was used by personnel working in Buildings 4030, 4641, and 4064 where radioactive materials were handled. In Building 4064, non-irradiated, fissionable nuclear materials (enriched uranium and plutonium) were stored along with low-level radioactive waste. Potential radioactive contaminants include U-233, U-234, U-235, U-236, U-238, Th-228, Th-232, Pu-238, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Ra-226, Cs-134, Cs-137, Sr-90, H-3, Na-22, K-40, Mn-54, Fe-55, Co-60, Ni-59, Ni-63, Eu-152, Eu-154, Pm-147, Ta-182.[1] All radionuclides of concern listed, with the exception of Mn-54, Pm-147 and Ta-182, are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives and do not meet the criteria for analysis. Table 3.3 presents a summary of contaminants of concern.
Drainage Pathways: Based on general site topography, surface water flows northeast from former Building 4014 to the storm drain on the other side of E Street. This storm drain appears to connect with a drainage channel that transports water south through Area III to a pond in Area II. The overflow from this pond is into Bell Canyon and thence to the Los Angeles River.[2] Radioactive materials do not appear to have been handled in Building 4014, but the site could have become contaminated by surface water and airborne releases from Building 4064.

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4014 area is Class 2, due to its location near Building 4064.

Recommended Locations for Soil/Sediment Sampling:

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

Previous characterization studies for the Building 4014 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 4014 area. This includes the following Building 4014 areas:

- The flat and low-lying areas surrounding Building 4014. Radionuclides originating from Building 4064 may have migrated to these areas via surface water flow or airborne releases.

2.3.2 Building 4053 Area

Site Description: The Building 4053 area comprised Building 4053, two skid shacks numbered Buildings 4033 and 4043, and the land surrounding these three buildings located on E Street. Building 4053 was constructed prior to 1962.[3] Figures 2.3.2a and 2.3.2b provide a current photograph and a floor plan. The location of Building 4053 is shown in Figure 2.3.

[1] Liddy, P., *Area 4064 Final Status Survey Report*, Rocketdyne Report No. RS-00003, March 30, 1999, p. 4.
[2] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.
[3] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.

Building Features: Building 4053 was on foundations connected to utilities.[1] Building 4053 had one room, a sliding door, and a canopy. It was located adjacent to and south of Building 4014. Buildings 4033 and 4043 were joined and shared a canopy. Floor plans of Buildings 4053, 4033 and 4043 are presented in Figure 2.3.2b.

Former Use(s): Building 4053 was a Fire Department services building. Building 4033 was a storage building and Building 4043 was an instrument storage building.[1]

Information from Interviewees: In 2010, a number of former workers were interviewed about their experiences at the SSFL. One remembered Building 4053. Excerpts from his comments are presented below.

- "Building 4043 was used exclusively for warehousing non-radioactive spare parts for SRE."[2] This former employee worked at the SSFL between 1958 and 1968.

Radiological Incident Reports: None found.

Current Use: Building 4053 was detached from its foundation and relocated in 1977. Buildings 4033 and 4043 were bulldozed and removed in 1977.[2]

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): A chronology of radiological investigations at this building is as follows:

- In 1988, Rockwell surveyed for radioactive contaminants the Building 4513 parking lot, adjacent to Building 4053, as part of a larger study. Rockwell found the mean exposure rate at Parking Lot 4513 to be 14.0 ± 0.25 µR/h.[3]

- In 1994 and 1995, Rockwell conducted a radiological characterization survey in Area IV that included Building 4053. The purpose of this survey was to locate and characterize any previously unknown areas of elevated radioactivity in Area IV. Rockwell estimated background to be 15.6 µR/h. Rockwell's acceptable limit was less than 5 µR/h above background. Survey results were below Rockwell's acceptance limits.[4]

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Locations: None found.

Aerial Photographs: Aerial photographs show undeveloped land until the 1957 photograph when a parking lot is identified adjacent to the site of Building 4053. Building 4053 appears in the approximately 1960 photograph and is seen up to the 1978 photograph when a new roof and/or new building appear(s) to have been constructed. No changes are observed in the 1980,

[1] Rockwell International, *Construction Specification for Sodium Storage Facility Building 014, Santa Susana Facility, Ventura County, California*, Specification No. 303-014-1, May 10, 1977.
[2] Interview No. 300 of former worker conducted by the DOE and EPA on July 16, 2010, p. 2.
[3] Chapman, J., *Radiological Survey of the T513 Parking Lot; Old R/A Laundry Area; Plot 333; and Areas between the SRE to RMDF, and KEWB to RMDF*,ETEC Report No. GEN-ZR-0009, pp. 54, 77, 79.
[4] Rockwell International, *Area IV Radiological Characterization Survey*, A4CM-ZR-0011, Rev. A, August 15, 1996, pp. 35, 55-58.

1983, 1988, and 1995 photographs. In the 2005 and 2009 photographs, a ground scar appears where Building 4053 had previously been located.[1]

Radionuclides of Concern: The research team did not find evidence that radioactive materials were used or stored within Building 4053. However, Building 4053 was located adjacent to Parking Lot 4513, which was used by personnel working in Buildings 4030, 4641, and 4064 where radioactive materials were handled. In Building 4064, non-irradiated, fissionable nuclear materials (enriched uranium and plutonium) were stored along with low-level radioactive waste. Potential radioactive contaminants include U-233, U-234, U-235, U-236, U-238, Th-228, Th-232, Pu-238, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Ra-226, Cs-134, Cs-137, Sr-90, H-3, Na-22, K-40, Mn-54, Fe-55, Co-60, Ni-59, Ni-63, Eu-152, Eu-154, Pm-147, Ta-182.[2] All radionuclides of concern listed, with the exception of Mn-54, Pm-147 and Ta-182, are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives and do not meet the criteria for analysis. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Based on general site topography, surface water flows northeast from former Building 4053 to the storm drain on the other side of E Street. This storm drain appears to connect with a drainage channel that transports water south through Area III to a pond in Area II. The overflow from this pond is into Bell Canyon and thence to the Los Angeles River.[3] Radioactive materials do not appear to have been handled in Building 4053, but the site could have become contaminated by surface water and airborne releases from Building 4064.

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4053 area is Class 2, due to its location near Building 4064.

Recommended Locations for Soil/Sediment Sampling:

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

Previous characterization studies for the Building 4053 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 4053 area. This includes the following Building 4053 areas:

- The flat and low-lying areas surrounding Building 4053. Radionuclides originating from Building 4064 may have migrated to these areas via surface water flow or airborne releases.

[1] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[2] Liddy, P., *Area 4064 Final Status Survey Report*, Rocketdyne Report No. RS-00003, March 30, 1999, p. 4.
[3] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.

2.3.3 Building 4064 Area

Site Description: The Building 4064 area comprises Building 4064, mechanical equipment slab Site 4864, an extensive side yard, and the land surrounding these areas located on G Street. Building 4064, built in 1958, was the source and special nuclear material storage facility.[1, 2] Figures 2.3.3a through 2.3.3g provide a current photograph and building drawings. The location of Building 4064 is shown in Figure 2.3.

Building Features: Building 4064 was constructed in two phases; the first in 1958 and the second in 1963. The completed building was approximately 50 feet by 90 feet with concrete and block walls. The roof was of corrugated steel with composite roofing material.[3] A floor plan of the completed Building 4064 is presented in Figure 2.3.3b. Phase 1 was a 2,127-square-foot reinforced concrete structure (Room 110 and office Room 100) with 11-inch thick walls on a concrete slab floor. The building eave height was 16 feet, and the structure was open bay except for a 12-foot by 13-foot material handling area in the southeast corner of the building (Room 104 vault). A fume hood was installed in Room 104.[4]

In Phase 2, a new bay was added to the north of Phase 1 (Room 114) with an overhead roll-up door, 12-inch-thick concrete blocks, increasing the floor area to 4,418 square feet. The total square footage included a 50-square-foot restroom (Room 102). Building 4064 had no sinks or processing equipment. The restroom was the only source of water. Waste water was released to a septic system prior to 1961. On the northwest corner was a small supply and storage room of about 50 square feet (Room 116). The concrete slab floors were covered with 12-inch square vinyl-asbestos tiles. In 1980, the facility received a new roof, the interior wall surfaces were patched and painted; the floor tile was removed and replaced; the rest room and office were restored; asphalt was patched; plumbing was repaired; and a window air conditioner was installed in the office.

Storage racks were constructed to accommodate fuel. Each room was ventilated by dedicated blowers through a plenum containing pre-filters and HEPA filters. The fume hood in Room 104 exhausted through the south filter plenum.[3] Building 4064 was built to meet AEC criteria for vaults for the storage of fissionable material. It was equipped with intrusion alarms.[5] Building 4064 was surrounded by an 8-foot tall alarmed perimeter chain-link fence topped with a double roll of barbed tape. The building doors were alarmed with intrusion alarms, and all rooms were equipped with motion detectors. All alarms sounded at the plant security headquarters.[6] The Building 4064 side yard was a trapezoidal area of approximately 4,500 square feet.[4, 7, 8] The

[1] Shah, S. N., *Final Report, Decontamination and Decommissioning of Fuel Storage Facility 4064*, Boeing Report EID-04600, September 11, 1999, pp. 14-15.
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[3] Email from W. J. Gerritsen to P. B. Ramirez, re: *Permit for Demolition of Building 4064*, May 28, 1997.
[4] Dahl, F. C. and Tuttle, J. *Final Radiological Survey Report of Building 064 Interior*, ETEC Report No. SSWA-ZR-0001, January 14, 1994, pp. 9-17.
[5] Boeing Environmental Affairs, Fact Sheet, *Building 4064 – Fuel Storage Facility*, February 10, 2000.
[6] Remley, M. E. General Storage Data for Buildings 064 and 022, October 7, 1977.
[7] Shah, S. N., *Final Report, Decontamination and Decommissioning of Fuel Storage Facility 4064*, Boeing Report EID-04600, September 11, 1999, pp. 14-15.
[8] Vitkus, T. J., *Verification Survey of Buildings 005, 023, and 064 Santa Susana Field Laboratory, Rockwell International, Ventura County, California*, ORISE 94/K-14, October 1994, pp. 1-4, 20.

fenced area is presented in Figure 2.3.3c, and the side yard is presented in Figure 2.3.3d. Figure 2.3.3e presents a plot plan.

Building 4064 had a 750-gallon septic tank that was connected to a 120-linear-foot leach field. The leach field was located approximately 20 feet east of Building 4064, near a boulder northeast of Building 6064.[1] The Building 4064 leach field was removed in 1998/1999 and the area was backfilled by regrading onsite soils.[2] In the early 1960s, Building 4064 was connected to the site sewage system. Figure 2.3.3f shows the connection to the sewage system and the location of the leach field, while Figure 2.3.3g presents the plumbing layout.

Former Use(s): Building 4064 was designed and built as a special nuclear material and source radioactive material storage building. It was used for storing packaged items of source material (natural uranium, depleted uranium, thorium) and special nuclear materials (enriched uranium, plutonium, and U-233) of various forms and configurations. Originally the north (Room 114) and south (Room 110 and 104 vault) contained steel racks for storing material. The south side was primarily used for the storage of highly enriched uranium and plutonium bearing items; the north side was primarily used for source material and "low" enriched uranium storage.[3]

Enriched uranium powders and source material powder packages were split into smaller units or combined into larger units in a glove box located in Room 104. The glove box was removed from Building 4064 at an unknown time. Plutonium was handled only in a packaged form; never as a loose powder.[4] No plutonium repackaging took place other than by transferring sealed packages between containers. Transfers of solid metallic forms of material were generally handled in the glove box, but sometimes larger pieces were transferred and repackaged within the vault. During the shut-down and termination of the SNAP program, excess Zr-U (enriched uranium) alloy material was sectioned into lengths suitable for packaging for shipment in DOE containers. This was done in Room 104. The floor was covered with plastic sheeting and the Zr-U was sectioned using a hack saw.[3]

During the early 1960s, the metal racks in the south half of Room 110 were removed in order to store material in "bird cages" and drums. This storage included large quantities of special nuclear material recoverable scrap. At this time, the fenced yard areas in the front, side, and back of Building 4064 were used to store 55-gallon drums of low-level enriched recoverable scrap. This material was shipped off-site in the mid-to-late 1960s and early 1970s. Rockwell claimed that residual contamination from handling bare metallic pieces was from enriched uranium, natural uranium, depleted uranium, and thorium. Most reactor contracts had ended by the early 1980s. No special nuclear material powders were handled or repackaged after 1980. After all fissionable material had been removed, miscellaneous equipment and containers of radioactive

[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, pp. 4-8, 4-87.
[2] Montgomery Watson Harza, *DOE Leach Fields (Area IV AOC) RCRA Facility Investigation Report, Santa Susana Field Laboratory, Ventura County, California, Draft*, October 2003, pp. 2-3.
[3] Remley, M. E. General Storage Data for Buildings 064 and 022, October 7, 1977.
[4] Chapman, J. A., *Radiological Survey of the Source and Special Nuclear Material Storage Vault-Building T64*, GEN-ZR-0005, August 19, 1988, pp. 7, 16-21.

waste (principally soil) were stored in Building 4064. In 1993, all nuclear material was removed and Building 4064 was decontaminated.[1]

Information from Interviewees: In 2010, a number of former workers were interviewed about their experiences at the SSFL. One had knowledge of Building 4064. Excerpts from his comments are presented below:

- "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." This interviewee worked at the SSFL between 1963 and 1999.[2]

Radiological Incident Reports: There have been several incidents associated with Building 4064 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 4064 Incident Report Summary

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A0523	3/10/1959	SS VAULT SSFL		PERSONNEL ENTERED VAULT AREA WITHOUT REQUIRED FILM BADGES.
A0028	2/18/1963	YARD SS VAULT	MFP	CASK DRAIN PLUG RUSTED OUT DRAINING CONTAMINATED WATER ONTO GROUND.
N/A	5/3/1963	SS VAULT	U	CANS OF UC EXPLODED INSIDE SSFL VAULT.
A0468	10/8/1964	SS VAULT	U	CAN OF UC EXPLODED INSIDE A "BIRDCAGE" SHIPPED TO SSFL VAULT.
A0622	7/20/1967	SSFL SS VAULT	U3O8	OUTSIDE TRANFER OF U POWDER CAUSED INCREASED ACTIVITY IN VEGETATION SAMPLES.
A0095	1/12/1982	VAULT		RAS ALARM RESPONSE.
A0109	9/21/1982	VAULT		RESPONSE TO RAS ALARM AT SS VAULT.
A0218	6/8/1992	STORAGE RACKS	U	EMPLOYEE STACKING FUEL STORAGE RACKS CUT HAND.
A0663	8/8/1995	SIDE YARD	Cs-137	PERFORMING THE MODIFIED AREA IV TRANSIENT SURVEY IN GRID R24S25, A HOT SPOT WAS FOUND.

[1] ICF Kaiser Engineers, *Current Conditions Report and Draft RCRA Facility Investigation Work Plan, Area IV Santa Susana Field Laboratory, Ventura County, California, Part I – Current Conditions Report Volume I*, October 1993, pp. 4-8, 4-87.
[2] Interview No. 3 of former employee conducted by the EPA, September 2010.

Building 4064 Incident Report Summary (continued)

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A0687	9/28/1998	SIDE YARD	Cs-137	EXCAVATED 6 CUBIC YARDS OF Cs-137 CONTAMINATED SOIL.

*Isotopes are written as they are presented in the incident database. The research team believes that MFP is an acronym for mixed fission products.

- On March 10, 1959, an employee entered the storage vault without a film badge and it was not known how long he was in the vault. The employee was reminded on other occasions to wear his film badge (Incident Report A0523).[1]

- On February 18, 1963, soil east of the exclusion fence at the SS Vault was found to be contamination during a routine survey. Three additional surveys revealed an area of 700 square feet of asphalt and soil contaminated with mixed fission products to a maximum of 700 mrad/h at 2 inches. It was deduced that the contamination resulted from a cask containing irradiated Seawolf submarine reactor fuel pins. The cask was received at the vault, stored, transferred to the Hot Lab for inspection, and returned to the vault for storage. After storing the fuel pins for 1.5 to 2 years it was shipped back to Westinghouse around May 1962. Sometime during this last storage period, it is believed that the drain plug rusted through, permitting fluid contaminated within the cask to spill onto the asphalt. A soil sample showed 8,340 pCi/g beta-gamma gross radioactivity, including 1 x 10^6 dpm/g of Cs-137 and 2 x 10^5 dpm/g of Cs-134. Alpha activity was negligible in all samples. Approximately 2,365 gallons of soil and asphalt were removed at the vault to reduce the maximum contamination level to 0.5 mrad/h. Three inches of soil was removed from all the contaminated soil areas and 80 percent of the areas were found to be free of contamination upon resurveying. The remaining areas were excavated up to 1.5 feet. Fill soil was brought in by the maintenance department to return the soil levels to their previous level (Incident Report A0028).[2, 3]

- On May 3, 1963, an explosion occurred in the north vault of Building 4064. The sources of the explosion were a 1-gallon can containing 8.3 kilograms of uranium carbide (3.7 percent enriched U-235) in the form of fines and pieces, and a 1-gallon can containing 2.5 kilograms of uranium carbide (4.9 percent enriched U-235) comprising sintered pieces. The fuel in both cans was immersed in Redline 60 oil. The explosion was believed to have been caused by the release of hydrogen gas from degrading uranium carbide. After 20 minutes elapsed, the AI Fire Department entered the vault and smothered the cans with Metal X. According to AI, a smear survey confirmed that contaminated had been confined to the interior of the vault. The cans were removed and the vault was decontaminated using kerosene and K-pads. AI planned to remove approximately 10 square feet of asphalt floor tiles where the cans had been located.[4]

[1] Loba, M. L., Internal Letter, *Re: Violation of Health Phys. Practices*, March 13, 1959.
[2] Badger, F. H., North American Aviation Internal Letter, re: *Contamination Incident SS Vault Santa Susana*, November 11, 1965.
[3] Moore, J. D., Atomics International Internal Letter, re: *Radioanalysis Report*, February 22, 1963.
[4] Coonce, G. L., Atomics International Internal Letter, re: *UC Fire at Building 064*, May 8, 1963.

- On October 8, 1964, a custodian found black oxidized powder deposited on the inside of a "bird cage" container. Investigation revealed that uranium carbide had oxidized blowing the lid off one 1-gallon can and warping the bottom of the container. The inside of the can was surveyed at 5 x 10^3 dpm/100 cm^2 alpha. Contamination levels on the concrete dock of the Building 064 increased to 200 dpm/100 cm^2 alpha from a "clean" level. Evidence suggested that an inert atmosphere had not been sufficiently established in the 1-gallon container (Incident Report A0468).[1]

- On July 20, 1967, an investigation was performed to identify reasons for increased alpha activity in vegetation samples between Building 4064 and the fire station. It was determined that uranium carbide and uranium oxide powder had been transferred from one 55-gallon drum to another in the Building 4064 storage yard. The drum from which material had been removed was still located in the yard on a piece of plastic sheeting and visible amounts of uranium oxide powder remained. The plastic was folded carefully and disposed of as radioactive waste. No "significant" surface contamination was found in areas other than the plastic sheeting and vegetation samples collected between Building 4064 and the fire station. Personnel were cautioned about procedures for transferring radioactive materials or opening drums of radioactive materials (Incident Report A0622).[2]

- On January 12, 1982, an alarm went off in Building 4064. Crews arrived at the building to check it out and the all clear was given within an hour of arriving on the scene. The cause for the alarm was unknown and the alarm was to be checked by maintenance (Incident Report A0095).[3]

- On September 21, 1982, an alarm went off in Building 4064. Crews arrived at the building to check it out and the all clear was given within an hour of arriving at the scene. The cause for the alarm was unknown and the alarm was to be checked by maintenance (Incident Report A0109).[4]

- On June 8, 1992, an employee was stacking storage racks on a pallet when he cut the palm of his hand. No detectable activity was noted on the employee's hand or the storage racks, despite concern for fixed U-235 contamination under paint on the fuel storage racks (Incident Report A0218).[5]

- On August 8, 1995, a hot spot of approximately 1 square foot was identified during an Area IV survey in grid number R24S25. The hot spot was measured at 10,000 cpm or 46 µR/h. Per Rockwell's procedure, a 1 meter ambient survey was performed, but it was

[1] Owen, D. E., Atomics International Internal Letter, re: *Incident Report, Building 064 Vault, 10-8-64*, October 27, 1964.
[2] Alexander, R. E., Atomics International, re: *Radiation Safety Unit Weekly Newsletter for Period Ending July 22, 1967*, August 2, 1967.
[3] Bradbury, S. M., Rockwell International Internal Letter, re: *Radiological Safety Incident Report, Building 064, 1/12/82*, Unknown Date.
[4] Bradbury, S. M., Rockwell International Internal Letter, re: *Radiological Safety Incident Report, Building 064, 9/21/82*, September 22, 1982.
[5] Wallace, J. H., Rockwell International Internal Letter, re: *Radiological Safety Report, T064 South Vault, 6/8/92*, June 17, 1992.

below the 5 μR/h above background limit for classifying as a hot spot. However, the Building 4064 sideyard was a formally remediated facility so the discovery was reported to the Area IV survey project manager. The hot spot was roped off and a sample was taken. The sample contained 271 pCi/g of Cs-137. The Cs-137 concentration was too low to be considered an inhalation hazard and the surface radiation was only three times background so there were no specific safety concerns. According to Rockwell, the discovery of contamination did not warrant a formal occurrence report because Building 4064 was not yet released for unrestricted use. The hot spot had been identified in a verification survey by the Oak Ridge Institute for Science and Education (ORISE), but had not been properly communicated to Rockwell. The discovery was cited as an example of the importance of walk-about surface gamma surveying used in the Area IV characterization survey (Incident Report A0663).[1] The exact location of this hot spot has not been identified, but it appears to be west of Building 4064.

- On September 28, 1998, ORISE discovered an area of elevated soil contamination in the side yard. The area measured approximately 18 feet by 6 feet and was located on the sloping bank between 10th Street and the Building 4064 parking lot. A total of 6 cubic yards of soil were excavated until radiation levels reached background levels. ORISE resurveyed the area, verified that radiation levels were normal, and collected two soil samples. Rockwell collected additional samples to confirm that the remediation had been successful (Incident Report A0687).[2] The exact location of this hot spot has not been identified, because it is unclear to which sloping bank the reference is made.

Current Use: Building 4064 was demolished in 1997 together with the removal of a septic tank and leach field.[3] 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, Rockwell conducted a radiological survey of the source and special nuclear material storage vault, fenced-in storage yard, and 2-acre surrounding area at Building 4064. The concrete ramps leading to rooms 110 and 114 were found to exhibit alpha radioactivity in higher rates than all other areas surveyed. This alpha activity was concluded to arise from natural elements in the concrete that were not removable. Ambient gamma exposure rate measurements made within the fenced-in storage yard showed a contaminated area bordering and outside of the eastern fence. According to Rockwell, no contamination was detected inside the fenced-in storage yard. Ambient gamma exposure rate measurements made outside the fence in the 2-acre area showed an area of about 4,000 square feet contaminated with Cs-137. Two soil samples collected from an area of greatest exposure rate showed a Cs-137 radioactivity concentration of 2,500 pCi/g, regarded as 2,500 times Rockwell's background concentration. Beta

[1] McGinnis, E. R., Rockwell International Internal Letter, re: *Radiological Incident Report, Soil Contamination Found in T064 Sideyard, 8/8/95*, August 25, 1995.
[2] Rutherford, R., Rockwell International Incident Report, re: *Verification Survey*, September 28, 1998.
[3] Shah, S. N., *Final Report, Decontamination and Decommissioning of Fuel Storage Facility 4064*, Boeing Report EID-04600, September 11, 1999, pp. 14-18.

activity was measured at 1,200 pCi/g in the area of greatest contamination. Further remedial action was recommended.[1]

- In 1990, Rockwell removed topsoil from portions of a 4,500 square-foot area of the Building 4064 side yard where Cs-137 had been found. Additional gamma exposure surveys and soil analyses were performed. Rockwell concluded that residual radioactivity levels at the Building 4064 side yard were within 1990 regulatory limits. This included the fenced-in yard and the 2-acre surrounding area. The average measured concentration of Cs-137 was 4.9 pCi/g. Rockwell's derived soil concentration limit was 60.4 pCi/g for Cs-137. Rockwell recommended that these areas be released for use without radiological restrictions.[2, 3, 4]

- In December 1991, Rockwell prepared a work plan for the decommissioning and decontamination of Building 4064.[5] In March 1992, Rockwell prepared instructions for the removal, size reduction, and disposal of the radiologically contaminated filter plenums located on the north and south sides of Building 4064. These were to be packaged and transferred to the RMDF.[6] In March 1992, Rockwell also prepared instructions for decontaminating the interior structural surfaces (walls, ceilings, floors, storage racks) of Building 064. Waste cleaning materials were to be transferred to the RMDF.[7]

- In 1992, Rockwell surveyed a 6,580-square-foot area comprising the fenced-in yard that surrounded Building 4064 to assess its radiological condition. The area was divided into grid blocks. Alpha activity, beta activity, and gamma exposure rate measurements were made, and samples of soil and asphalt were collected for laboratory analysis to measure concentration levels of man-made residual radioactivity. All alpha surface activity levels were found to be below Rockwell's acceptance limit of 5,000 dpm/100 cm^2. All beta surface activity levels were found to be below Rockwell's acceptance limit of 5,000 dpm/100 cm^2. All gamma exposure rates were found to be below Rockwell's acceptance limit of 5 µR/h above Rockwell's background rate of 15.3 µR/h. Rockwell concluded that the fenced-in yard met its criteria for release for unrestricted use.[8]

- In June 1992, ORISE performed a final verification survey during which gamma surface scans and soil sampling and analysis identified three Cs-137 hotspots in the side yard.

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[1] Chapman, J. A., *Radiological Survey of the Source and Special Nuclear Material Storage Vault-Building T64*, GEN-ZR-0005, August 19, 1988, pp. 2, 91-92.
[2] Subbraman, G. and Oliver, B. M., *Final Decontamination and Radiological Survey of the Building T064 Side Yard*, Rockwell International, N704SRR990031, October 30, 1990, pp. 5, 56-57.
[3] Rockwell International Letter from G. G. Gaylord to R. Liddle, U.S. DOE, re: *Final Survey of Radiological Decontamination of Building 064 Side Yard*, December 11, 1990.
[4] Rockwell International Letter from G. G. Gaylord to D. Williams, U.S. DOE, re: *Building 064 Side Yard Survey*, April 29, 1993.
[5] Richards, C. D., *D & D Work Plan for Building 064, Environmental Restoration*, ETEC Report No. SSWA-AN-001, December 12, 1991.
[6] Richards, C. D., *Building 064 Removal of Filter Plenum Systems*, ETEC Report No. SSWA-SOP-003, March 10, 1992.
[7] Richards, C. D., *Building 064 Structural Surfaces, Final Clean*, ETECReport No. SSWA-SOP-004, March 25, 1992.
[8] Kneff, D. W., Tuttle, R. J., and Subbraman, G., *Radiological Assessment of the Building T064 Fenced-in Yard*, Rockwell International, N704SRR990035, January 12, 1994, pp. 10, 40-41.

This indicates that Rockwell's previous cleanup was incomplete. Rockwell subsequently remediated the hotspots and revised the Building 4064 side yard guidelines to meet a more restrictive 10 mrem/yr maximum dose rate for a residential scenario.[1]

- In 1993, Rockwell removed all known radioactively contaminated equipment, components and structures from Building 4064, as well asbestos containing materials. The equipment in Room 110 included weighing scales, tools, a fume hood, storage racks, empty storage containers, and empty shipping drums. Items stored in Room 114 consisted of contaminated pumps, equipment control consoles, and packaged contaminated soil. All radioactive waste was packaged and shipped to an unnamed disposal facility.[2] Rockwell performed a final radiological survey of the Building 4064 interior to demonstrate regulatory compliance for release for unrestricted use.[3]

- In 1994 and 1995, during the Area IV Radiological Characterization Survey, Rockwell identified two locations, one in the original side yard and one located across G Street as remaining above release limits. Rockwell excavated these areas in 1997 including the removal of an abandoned septic tank and leach field that serviced Building 4064. Rockwell conducted scoping surveys and soil sampling after excavation and concluded that the Building 4064 area beneath the building foundations and surrounding yard areas were below release limits.[4]

- In June 1996, the DOE granted approval to Rockwell to demolish Building 4064. The empty site and the side yard would be combined into one release site.[5]

- In May 1997, a schedule was drawn up for the demolition of Building 4064 in July 1997.[6]

- In May 1998, Boeing reported that it had recently completed soil core sampling of the Building 4064 side yard, including a location across G Street, and core samples under G Street. This was done to verify that the recent excavation activities had removed all subsurface contamination at the site to below DOE-approved cleanup limits. A total of 52 subsurface samples were collected from 14 locations up to depths of 15 feet down to bedrock. The Cs-137 concentrations in these samples ranged from less than 0.02 pCi/g to 0.13 pCi/g with an average of 0.03 pCi/g. According to Boeing, these concentrations were below the Cs-137 cleanup standard of 9.2 pCi/g in 1998 and typical of local background at that time. Uranium and thorium isotopes and K-40 concentrations were also typical of background.[7]

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[1] Vitkus, T. J., *Verification Survey of the Old Conservation Yard, Building 064 Side Yard, and Building 028, Santa Susana Field Laboratory, Rockwell International, Ventura County, California*, ORISE 93/J-107, October 1993, pp. 5-11.
[2] Waite, P., *Building 064 D&D Operations Final Report*, ETEC Report No. SSWA-AR-0002, August 13, 1993, p. 8.
[3] Dahl, F. C. and Tuttle, R. J., *Final Radiological Survey Report of Building 064 Interior*, ETEC Report No. SSWA-ZR-0001, January 14, 1994, pp. 17-19.
[4] Liddy, P, *Area 4064 Final Status Survey Report*, Rocketdyne Report No. RS-00003, March 30, 1999, pp. 6, 25-26.
[5] U.S. Department of Energy Letter from M. Lopez to M. Lee, re: *Demolition of Building 064*, June 25, 1996.
[6] Email from W. J. Gerritsen to P. B. Ramirez, re: *Permit for Demolition of Building 4064*, May 28, 1997.
[7] Boeing Letter from M Lee to M. Lopez, U.S. Department of Energy, re: *Building 064 Side Yard*, May 13, 1998.

- In late 1998, Rockwell performed a final status survey and ORISE and the DHS conducted final verification surveys following the demolition of Building 4064 and the yard. Analysis of soil samples collected after excavation of Building 4064 indicated that Cs-137 activity was below the release limit of 9.2 pCi/g. The agency confirmed that the site could be released for unrestricted use.[1, 2]

- On January 31, 2005, the DOE released Building 4064 for unrestricted use.[3]

Radiological Use Authorizations: The following radiological use authorization was assigned to Building 4064.

- Use Authorization No. 139, dated about 1989, for radiological material storage and decontamination at Building 4064.[4]

Former Radiological Burial or Disposal Locations: A septic tank and leach field were associated with Building 4064.

Aerial Photographs: Aerial photographs show undeveloped land until the 1959 photograph when a square building is observed that is identified as Building 4064. Building 4064 looks the same in the approximately 1960 photograph, but in the 1965 photograph it appears to have doubled in size. In the 1967 photograph, open storage is observed on the north, west, and east sides of Building 4064. In the 1983 photograph, a probable stain is identified outside the southwest corner of Building 4064. In the 1995 photograph, the quantity of open storage has been reduced significantly. In the 2005 and 2009 photographs, Building 4064 is no longer present and the site is vegetated.[5]

Radionuclides of Concern: In Building 4064, non-irradiated, fissionable nuclear materials (enriched uranium and plutonium) were stored along with low-level radioactive waste. Potential radioactive contaminants include U-233, U-234, U-235, U-236, U-238, Th-228, Th-232, Pu-238, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Ra-226, Cs-134, Cs-137, Sr-90, H-3, Na-22, K-40, Mn-54, Fe-55, Co-60, Ni-59, Ni-63, Eu-152, Eu-154, Pm-147, Ta-182.[6] All radionuclides of concern listed, with the exception of Mn-54, Pm-147 and Ta-182, are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives and do not meet the criteria for analysis. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Based on general site topography, surface water flows northeast from former Building 4064 to the storm drain near the side yard on G Street. This storm drain appears

[1] Lupo, R. K., *Confirmatory Survey, Building 4064 Site, Santa Susana Field Laboratory, Boeing-Rocketdyne, Ventura County, California*, California Department of Health Services, Radiologic Health Branch, December 30, 1998, p. 5.
[2] Boeing Internal Letter from J. Shao to P. Rutherford, re: *Soil Sampling Results for Building 064 Area at SSFL (Revision)*, September 24, 1998.
[3] U.S. Department of Energy Letter from M. Lopez to M. Lee, re: *Release of Building 4064*, January 31, 2005.
[4] Rockwell International Internal Letter from V. J. Schaubert to J. P. Page, re: *User Authorization, Building 064 North Vault*, April 24, 1989.
[5] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[6] Liddy, P., *Area 4064 Final Status Survey Report*, Rocketdyne Report No. RS-00003, March 30, 1999, p. 4.

to connect with a drainage channel that transports water south through Area III to in the Area II ponds. The overflow from this pond is into Bell Canyon and thence to the Los Angeles River.[1]

Radiological Contamination Potential: The preliminary MARSSIM classification for the Building 4064 area is Class 1, due to its location within the ETEC, and its former use as storage building for radioactive source and special nuclear materials and radioactive waste.

Recommended Locations for Soil/Sediment Sampling:

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

Information is lacking regarding the excavation activities at Building 4064. In addition, previous characterization studies for the Building 4064 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 4064 area. This includes the following Building 4064 areas and appurtenances:

- The flat and low-lying areas surrounding Building 4064, particularly on the north, west and east sides where open storage was identified in aerial photographs. Radionuclides originating from Building 4064 may have migrated to these areas via surface water flow or airborne releases.

- The site of the probable stain identified from aerial photographs outside the southwest corner of Building 4064.

- The former 750-gallon septic tank and leach field area. Boeing excavated, removed, and surveyed this area in 1997, but it is not clear that this area was thoroughly investigated and decontaminated.

- The storm drain located northeast of the site that connects to ponds in Areas II and III.

- The sanitary sewer line located south of the site. If radionuclides were released into the sanitary sewer system, residual contamination may exist in the materials surrounding the sewer lines.

2.3.4 Parking Lot 4513 Area

Site Description: The Parking Lot 4513 area comprised Parking Lot 4513, Time Clock Building 4333, and the land surrounding these located near the intersection of 10th and E Streets. Parking Lot 4513 was constructed prior to 1959.[2] Figure 2.3.4a provides a current photograph. The location of Parking Lot 4513 is shown in Figure 2.3.

[1] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.

Building Features: Parking Lot 4513 was an asphalt parking lot located on the east side of 10th Street.

Former Use(s): Parking Lot 4513 was used by personnel working in Buildings 4030, 4064, and 4641. Radioactive materials were handled in all of these buildings surrounding the site.[1]

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: Parking Lot 4513 is vegetated and is no longer used.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): A chronology of radiological investigations at this site is as follows:

- In 1988, Rockwell surveyed for radioactive contaminants the Building 4513 parking lot as part of a survey of five sites that were used to support nuclear-related facilities. The parking lot surface and Building 4333 were surveyed for mixed fission products by measuring ambient gamma exposure rates. Rockwell found the mean exposure rate at Parking Lot 4513 to be 14.0 ± 0.25 μR/h.[2]

- In 1994 and 1995, Rockwell conducted a radiological characterization survey in Area IV that included Parking Lot 4513. The purpose of this survey was to locate and characterize any previously unknown areas of elevated radioactivity in Area IV. Rockwell estimated background to be 15.6 μR/h. Rockwell's acceptable limit was less than 5 μR/h above background. Survey results were below Rockwell's acceptance limits.[1]

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Locations: None found.

Aerial Photographs: Aerial photographs show undeveloped land until the 1957 photograph when a parking lot can be seen that is identified as Parking Lot 4513. In the 1959 photograph, the area of Parking Lot 4513 appears to have increased. No significant change is observed in the approximately 1960, 1965, 1967, 1972, 1978, 1980, 1983, 1988, and 1995 photographs. A vegetated area is seen in the location of Parking Lot 4513 in the 2005 and 2009 photographs.[3]

Radionuclides of Concern: The research team did not find evidence that radioactive materials were handled in Parking Lot 4513. However, Parking Lot 4513 was used by personnel working in Buildings 4030, 4641, and 4064 where radioactive materials were handled. In Building 4064, non-irradiated, fissionable nuclear materials (enriched uranium and plutonium) were stored along

[1] Chapman, J. A., *Radiological Survey of the T513 Parking Lot; Old R/A Laundry Area; Plot 333; and Areas between the SRE to RMDF, and KEWB to RMDF*, ETEC Report No. GEN-ZR-0009, August 26, 1988, pp. 3, 8, 15-19, 27, 51-62, 77-79.
[2] Chapman, J., *Radiological Survey of the T513 Parking Lot; Old R/A Laundry Area; Plot 333; and Areas between the SRE to RMDF, and KEWB to RMDF*,ETEC Report No. GEN-ZR-0009, pp. 54, 77, 79.
[3] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.

with low-level radioactive waste. Potential radioactive contaminants include U-233, U-234, U-235, U-236, U-238, Th-228, Th-232, Pu-238, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Ra-226, Cs-134, Cs-137, Sr-90, H-3, Na-22, K-40, Mn-54, Fe-55, Co-60, Ni-59, Ni-63, Eu-152, Eu-154, Pm-147, Ta-182.[1] All radionuclides of concern listed, with the exception of Mn-54, Pm-147 and Ta-182, are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives and do not meet the criteria for analysis. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Based on general site topography, surface water flows northeast from Parking Lot 4513 to the storm drain on the other side of E Street. This storm drain appears to connect with a drainage channel that transports water south through Area III to a pond in Area II. The overflow from this pond is into Bell Canyon and thence to the Los Angeles River.[2] It is unknown whether radioactive materials were handled in Parking Lot 4513, but the site could have become contaminated by surface water and airborne releases from Building 4064.

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Parking Lot 4513 area is Class 2, due to its location near Building 4064.

Recommended Locations for Soil/Sediment Sampling:

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

Previous characterization studies for the Parking Lot 4513 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 Parking Lot 4513 area. This includes the following Parking Lot 4513 areas:

- The flat and low-lying areas surrounding and including Parking Lot 4513. Radionuclides originating from Building 4064 may have migrated to these areas via surface water flow or airborne releases.

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-6 Group 4 are presented. HSA-6 Group 4 includes five building areas containing the contaminated medical/storage facility and the new salvage yard.

2.4.1 Building 4040 Area

Site Description: The Building 4040 area comprises Building 4040, fire truck canopy Building 4624, and the land around these two buildings located on G Street. Building 4040 was

[1] Liddy, P., *Area 4064 Final Status Survey Report*, Rocketdyne Report No. RS-00003, March 30, 1999, p. 4.
[2] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.

constructed in approximately 1966.[1, 2] Figures 2.4.1a and 2.4.1b provide a current photograph and floor plan. A plot plan is presented in Figure 2.4.1c.

Building Features: Building 4040 was an approximately 848-square-foot single-story building constructed with galvanized steel walls and roof anchored to a concrete floor. Water drained from the shower and wash basins in Room 109 to a special holding tank, located east of Building 4040. A negative pressure ventilation system, with intake and outlet absolute filters, was provided for Rooms 103 and 109. Emergency power was provided for the facility. The building entrance at the southwest corner of Building 4040 was designated as the ambulance entrance and the entrance to be used by contaminated personnel. The north entrance was for attending and support personnel.[3] A floor plan is presented in Figure 2.4.1b.

Former Use(s): Building 4040 was first designated as a protective services control center. In the 1970s, it was an emergency medical and decontamination facility that housed an interim sick bay with bed facilities for four persons, medical office, a waiting room, a health physics counting laboratory for sealed check sources, and a laboratory for a low-background alpha/beta counting system to analyze air and wipe samples. In 1984, it was an office supply storage building.[2]

Information from Interviewees: In March 2000, a former worker interviewed by Montgomery Watson Harza stated that an incinerator was present at Building 4040. He believed that it was used for document and photograph burning, a standard historic practice.[4]

Radiological Incident Reports: None found.

Current Use: Building 4040 was demolished in 1997.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): A chronology of radiological investigations at this building is as follows:

- In February 1996, Rockwell conducted direct frisk surveys, a smear survey, and an ambient gamma survey in Building 4040. Results were below Rockwell's acceptable limits of 20 dpm/100 cm^2 of alpha activity and 100 dpm/100 cm^2 of beta activity. Ambient gamma radiation was measured at levels between 10 and 12 µR/h.[5]

- In May 1997, Boeing conducted a survey of the floor and under the floor tiles in Building 4040. No detectable activity was found above Boeing's alpha background of 6cpm and beta background of 100 cpm.[6, 7]

[1] Energy Technology Engineering Center, *Site Development and Facility Utilization Planning: FY 1984-FY 1989*, N-083E-A02-DV001, Rev. A, April 1984.
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[3] Atomics International, *Emergency Medical and Decontamination Facility, Building 040 – Santa Susana*, no date.
[4] Montgomery Watson Harza interview conducted March 25, 2000 to discuss source of ash at Building 4040.
[5] Rockwell International, *Radiation Survey Report, Building T040*, (internal document), February 1996.
[6] Internal letter from P. D. Rutherford to G. E. Shindler, Boeing North American, Inc., re: Radiological Status of Building T040 (4040), April 29, 1997.
[7] Rockwell International Radiation Survey Report, Building T040, May 1, 1997.

Radiological Use Authorizations: It is not known under what use authorization operations in Building 4040 were conducted. Building 4040 was located outside of the ETEC boundary, so use of radioactive materials in Building 4040 would have been authorized by the CDPHE under Radioactive Material License No. 0015-59.

Former Radiological Burial or Disposal Locations: Boeing observed an ash pile outside Building 4040 during site inspections, and in response, implemented erosion control measures at this location.[1]

Aerial Photographs: Aerial photographs show undeveloped land until the 1967 photograph when a rectangular building is observed that is identified as Building 4040. The 1967 photograph shows open storage located south of Building 4040. This remains throughout the 1970s and 1980s, but disappears from the June 1995 photograph. Building 4040 is no longer present in the 2005 photograph. Undeveloped land appears in the location of Building 4040 in the 2009 photograph.[2]

Radionuclides of Concern: Sealed radioactive sources were stored in Building 4040. Low-level radioactive air and wipe samples may have been analyzed in Building 4040.[3] Possible radionuclides include U-233, U-234, U-235, U-236, U-238, Th-228, Th-232, Pu-238, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Ra-226, Cs-134, Cs-137, Sr-90, H-3, Na-22, K-40, Mn-54, Fe-55, Co-60, Ni-59, Ni-63, Eu-152, Eu-154, Pm-147, Ta-182.[4] All radionuclides of concern listed, with the exception of Mn-54, Pm-147 and Ta-182, are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives and do not meet the criteria for analysis. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: A storm drain is located west of the northwest corner of Building 4040. Based on general site topography, surface water in the vicinity of Building 4040 flows into this storm drain, which appears to connect with a drainage channel that transports water south through Area III to a pond in Area II. The overflow from this pond is into Bell Canyon and thence to the Los Angeles River.[5]

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4040 area is Class 2, due to its past use as a laboratory for a low-level background alpha/beta counting system to analyze air and wipe samples and its location near the New Salvage Yard.

Recommended Locations for Soil/Sediment Sampling:

Plate 1 and Figure 2.4 provide a convenient reference for the following recommendations.

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[1] Montgomery Watson Harza, *Group 6 – Northeastern Portion of Area IV, RCRA Facility Investigation Report, Santa Susana Field Laboratory, Ventura County, California, Volume 1*, September 2006, pp. 3-2 – 3-3.
[2] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[3] Internal letter from P. D. Rutherford to G. E. Shindler, Boeing North American, Inc., re: Radiological Status of Building T040 (4040), April 29, 1997.
[4] Liddy, P., *Area 4064 Final Status Survey Report*, Rocketdyne Report No. RS-00003, March 30, 1999, p. 4.
[5] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.

Previous characterization studies for the Building 4040 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 4040 area. This includes the following Building 4040 areas and appurtenances:

- The flat land around the footprints of Buildings 4040 and 4624. Radionuclides originating from Building 4040 may have migrated to this area via surface water flow or airborne releases.

- The location of open storage south of Building 4040 identified from aerial photographs. This may have been related to the ash piles identified during site inspections. If radioactively contaminated personal protective equipment was burned, then the ash pile should be sampled, if till present.

- The storm drain located near the northwest corner of Building 4040. If radiological materials were released from Building 4040, they may have migrated to the storm drain network during precipitation events.

2.4.2 Building 4114 Area

Site Description: The Building 4114 area comprised Building 4114 and the land surrounding it located on E Street. Building 4114 was a trailer that was located on Parking Lot 4511, located at the former main gate to Area IV, in about June 1978. Building 4114 was located south of the old salvage yard and barrel storage yard. [1] Figures 2.4.2a and 2.4.2b provide a current photograph and a floor plan.

Building Features: Building 4114 had a single and a double door entering into a treatment room and an emergency medical room, respectively. It contained a restroom, a shower, a basin, a refrigerator, two cots, a surgical table, three laboratory benches, three tables, a desk, a file cabinet and four wall cabinets. It was connected to the sanitary sewer and the local water supply. It was also furnished with a 150-gallon tank and a HEPA filter.[2] Figure 2.4.2b shows a floor plan and piping layout.

Former Use(s): Building 4114 was a decontamination trailer for radiologically contaminated personnel, but according to Rockwell's Radiation and Nuclear Safety Manager in 1989, Building 4114 was never used for this purpose, and had no unnatural radioactivity in it.[3] It is assumed that this trailer was set up for radiological emergencies, which never eventuated.

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

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[1] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.

[2] Rockwell International, *Santa Susana Field Laboratory Radioactive Decontamination Trailer Piping*, Drawing No. PEWR 75732-RI, March 3, 1977.

[3] Rockwell International internal letter from R. J. Tuttle to R. T. Lancet, re: *Decommissioning of Decontamination Trailer*, August 28, 1989.

Current Use: Building 4114 was removed in approximately 1989. Its final destination is unknown.[3]

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): A chronology of radiological investigations at this Building is as follows:

- In 1994 and 1995, Rockwell conducted a radiological characterization survey in Area IV that covered the area of former Building 4114. The purpose of this survey was to locate and characterize any previously unknown areas of elevated radioactivity in Area IV. Rockwell estimated background to be 15.6 µR/h. Rockwell's acceptable limit was less than 5 µR/h above background. Survey results were below Rockwell's acceptance limits.[1]

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Locations: None found.

Aerial Photographs: Aerial photographs show undeveloped land until the 1980 photograph when a long rectangular building is observed that is identified as Building 4114. Building 4114 is observed in 1983 and 1988 photographs, but can no longer be seen in the 1995 photograph. A vegetated area can be seen in the 2005 and 2009 photographs.[2]

Radionuclides of Concern: The research team did not find evidence that high activity radioactive materials were used or stored within Building 4114. However, there is some potential that radionuclides associated with the nearby ESG salvage yard may have migrated to the area surrounding Building 4114 (see Section 2.5.2 for a discussion of the ESG salvage yard). Radioactive items in the ESG salvage yard were transported from the SRE area. Radionuclides associated with the operations of the SRE include U-238, U-234, U-235, Pu-238, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Th-232, H-3, Na-22, Na-24, Cr-51, Mn-54, Fe-59, Co-60, Kr-85, Sr-89, Sr-90, Sb-125, I-129, I-131, Cs-134, Cs-137, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xn-133, Xe-135, Pm-147, Sm-151.[3, 4, 5] All radionuclides of concern listed with the exception of Na-24, Cr-51, Mn-54, Fe-59, Kr-85, Sr-89, I-131, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xe-133, Xe-135, Pm-147 and Sm-151 are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives except for Sm-151 for which no analytical method is available. Table 3.3 presents a summary of contaminants of concern.

[1] Rockwell International, *Area IV Radiological Characterization Survey*, Final Report, Volume I, A4CM-ZR-0011, Revision A, August 15, 1996, pp. 22-24.
[2] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[3] Hart, R. S., *Distribution of Fission Product Contamination in the SRE*, Atomics International Report No. NAA-SR-6890, March 1, 1962, pp. 8-27.
[4] Kinzer, J. and Crawford, A. C., *SRE First Core Fuel*, Atomics International Technical Data Record No. 5301, May 16, 1960, pp. 1-7.
[5] Letter from Heine, W. F., Atomics International, to Proctor, J. F., E. I. du Pont de Nemours & Company, r: *Fission Product and Fissile Content of SRE Fuel*, July 2, 1975.

Drainage Pathways: Based on general site topography, surface water flows west from the Building 4114 area to a drainage channel connecting to the Area II ponds. The overflow from these ponds is into Bell Canyon and thence to the Los Angeles River.[1]

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4114 area is Class 2, due to its location near the ESG salvage yard area.

Recommended Locations for Soil/Sediment Sampling:

Plate 1 and Figure 2.4 provide a convenient reference for the following recommendations.

Previous characterization studies for the Building 4114 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 4114 area. This includes the following Building 4114 areas and appurtenances:

- The flat and low-lying areas surrounding Building 4114. Radionuclides originating from the ESG salvage yard may have migrated to these areas via surface water flow or airborne releases.

- The drainage channel located west of the site that connects to ponds in Areas II and III.

2.4.3 Parking Lot 4511 Area

Site Description: The Parking Lot 4511 area comprised Parking Lot 4511, Guard Shacks 4113 and 4623, and the land surrounding these located on E Street, near the former main gate to Area IV. Parking Lot 4511 was constructed prior to 1962.[2] Figure 2.4.3a provides a current photograph.

Building Features: Parking Lot 4511 was an asphalted area in two parts located west of and across E Street from the barrel storage yard, near the former main gate to Area IV.

Former Use(s): Parking Lot 4511 served as a parking lot for the main gate and for personnel working in the ESG salvage yard, the barrel storage yard, and adjacent areas. Some radioactively contaminated materials were stored the ESG salvage yard from the 1950s until 1977.

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: Parking Lot 4511 on the north side of E Street is currently vegetated and no longer in use. Parking Lot 4511 on the south side of E Street remains asphalted.

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[1] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): A chronology of radiological investigations at this site is as follows:

- In 1994 and 1995, Rockwell conducted a radiological characterization survey in Area IV that covered the area of Parking Lot 4511. The purpose of this survey was to locate and characterize any previously unknown areas of elevated radioactivity in Area IV. Rockwell estimated background to be 15.6 µR/h. Rockwell's acceptable limit was less than 5 µR/h above background. Survey results were below Rockwell's acceptance limits.[1]

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Locations: Open storage of some radioactive items was sited east of the north side of Parking Lot 4511.[2]

Aerial Photographs: Aerial photographs show undeveloped land until the 1959 photograph when a parking area can be seen on the south side of E Street that is identified as the first part of Parking Lot 4511. In the approximately 1960 photograph a parking lot can also be seen on the north side of E Street as well. Both parts of Parking Lot 4511 can be seen in the 1965 photograph. In the 1967 photograph, the north side parking lot appears to have increased in area by about 100 percent. No change is observed in the 1972, 1978, 1980, 1983, 1988, and 1995 photographs. A vegetated area is seen in the location of Site 4511 in the 2005 and 2009 photograph.[2]

Radionuclides of Concern: Site 4511 was a parking lot located near the Area IV main gate. The site is not expected to be radiologically contaminated, but contamination may have migrated to the site via surface water flow or airborne releases from the ESG salvage yard and barrel storage yard. Possible radionuclides include U-238, U-234, U-235, U-236, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Th-232, H-3, Na-22, Na-24, Cr-51, Mn-54, Fe-59, Co-60, Kr-85, Sr-89, Sr-90, Sb-125, I-129, I-131, Cs-134, Cs-137, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xn-133, Xe-135, Pm-147, Sm-151.[3, 4, 5] All radionuclides of concern listed with the exception of Na-24, Cr-51, Mn-54, Fe-59, Kr-85, Sr-89, I-131, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xe-133, Xe-135, Pm-147 and Sm-151 are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives except for Sm-151 for which no analytical method is available. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Based on general site topography, surface water flows southwest from the west side of Parking Lot 4511 to a drainage channel and is transported south to the Area II ponds. The overflow from these ponds is into Bell Canyon and thence to the Los Angeles

[1] Rockwell International, *Area IV Radiological Characterization Survey*, Final Report, Volume I. A4CM-ZR-0011, Revision A, August 15, 1996, pp. 22-24.
[2] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[3] Hart, R. S., *Distribution of Fission Product Contamination in the SRE*, Atomics International Report No. NAA-SR-6890, March 1, 1962, pp. 8-27.
[4] Kinzer, J. and Crawford, A. C., *SRE First Core Fuel*, Atomics International Technical Data Record No. 5301, May 16, 1960, pp. 1-7.
[5] Letter from Heine, W. F., Atomics International, to Proctor, J. F., E. I. du Pont de Nemours & Company, r: *Fission Product and Fissile Content of SRE Fuel*, July 2, 1975.

River.[1] It is unknown whether radioactive materials were handled in Parking Lot 4511, but the site could have become contaminated by surface water and airborne releases from the ESG salvage yard and barrel storage yard..

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Site 4511 area is Class 2, due to its location near the ESG salvage yard and the barrel storage yard.

Recommended Locations for Soil/Sediment Sampling:

Plate 1 and Figure 2.4 provide a convenient reference for the following recommendations.

Previous characterization studies for the Parking Lot 4511 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 Parking Lot 4511 area. This includes the following Parking Lot 4511 areas and appurtenances:

- The flat and low-lying areas on and surrounding Site 4511. Radionuclides originating from the ESG salvage yard may have migrated to these areas via surface water flow or airborne releases.
- The drainage channel located west of the site that connects to ponds in Areas II and III.

2.4.4 Parking Lot 4540 Area

Site Description: The Parking Lot 4540 area comprised Parking Lot 4540 and the land surrounding it on G Street near the corner with E Street.[2] It was constructed prior to 1965. Figure 2.4.4a provides a current photograph. The location of Parking Lot 4540 is shown in Figure 2.4.

Building Features: Parking Lot 4540 was a paved parking lot located south of Building 4040.

Former Use(s): Parking Lot 4540 was the parking lot for Building 4040. Following the demolition of Building 4040 in 1997, Parking Lot 4540 was no longer used.

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: Parking Lot 4540 is part of G Street.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): None found.

Radiological Use Authorizations: None found.

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[1] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.

Former Radiological Burial or Disposal Locations: None found.

Aerial Photographs: Aerial photographs show undeveloped land until the 1965 photograph when a parking lot can be seen that is identified as Parking Lot 4540. The 1967 photograph, Building 4040 can be seen located north of Parking Lot 4540. No significant change is observed in the 1972 photograph. The 1967 photograph shows open storage located south of Building 4040. This remains throughout the 1970s and 1980s, but disappears from the June 1995 photograph. A vegetated area is seen in the former location of Parking Lot 4540 in the 2005 and 2009 photographs.[1]

Radionuclides of Concern: Sealed radioactive sources were stored in Building 4040 (see Section 2.4.1 for a discussion of Building 4040). Low-level radioactive air and wipe samples may have been analyzed in Building 4040.[2] Radionuclides originating from Buildings 4040 and/or 4064 may have migrated to this area via surface water or airborne releases. Possible radionuclides include U-233, U-234, U-235, U-236, U-238, Th-228, Th-232, Pu-238, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Ra-226, Cs-134, Cs-137, Sr-90, H-3, Na-22, K-40, Mn-54, Fe-55, Co-60, Ni-59, Ni-63, Eu-152, Eu-154, Pm-147, Ta-182.[3] All radionuclides of concern listed, with the exception of Mn-54, Pm-147 and Ta-182, are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives and do not meet the criteria for analysis. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Based on general site topography, surface water in the vicinity of Parking Lot 4540 flows into a storm drain located near the northwest corner of former Building 4040. This storm drain appears to connect with a drainage channel that transports water south through Area III to a pond in Area II. The overflow from this pond is into Bell Canyon and thence to the Los Angeles River.[4] It is unknown whether radioactive materials were handled in Parking Lot 4540, but the site could have become contaminated by surface water and airborne releases from Building 4040.

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Parking Lot 4540 area is Class 2, because of the former use of Building 4040 and because no radiological investigation has been conducted in this area.

Recommended Locations for Soil/Sediment Sampling:

Plate 1 and Figure 2.4 provide a convenient reference for the following recommendations.

Previous characterization studies for the Parking Lot 4540 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

[1] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[2] Internal letter from P. D. Rutherford to G. E. Shindler, Boeing North American, Inc., re: *Radiological Status of Building T040 (4040)*, April 29, 1997.
[3] Liddy, P., *Area 4064 Final Status Survey Report*, Rocketdyne Report No. RS-00003, March 30, 1999, p. 4.
[4] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.

2010 AOC. Therefore, additional characterization is recommended for the Parking Lot 4540 area. This includes the following Parking Lot 4540 areas and appurtenances:

- The flat land on former Parking Lot 4540. Radionuclides originating from Buildings 4040 and/or Building 4064 may have migrated to this area via surface water flow or airborne releases.

- The location of open storage on the site identified from aerial photographs, South of Building 4040.

2.4.5 Site 4583-New Area

Site Description: The Site 4583-New area comprised Site 4583-New and the land surrounding it located on the south side of E Street near Building 4114 and the main gate. Site 4583-New was developed in 1977 as a new salvage yard.[1] Figures 2.4.5a provides a current photograph. Figure 2.4.5b provides a plot plan. The location of Site 4583-New is shown in Figure 2.4.

Building Features: Site 4583-New was accessed by a paved road off G Street. It occupied an area of approximately 0.5 acres south of G Street, was fenced, relatively flat, and was covered with loose dirt and weeds. A drainage ditch extending downhill from the SRE pond formed the western boundary of Site 4583-New. The ditch connected to the Area II ponds.[2]

Former Use(s): Site 4583-New was developed as the new salvage yard after the ESG salvage yard was closed in 1977. All salvageable, non-radioactive materials were moved to the site in and after 1977. Items included used equipment and drums. In 1988, the site was cluttered with items of large metal equipment and scrap metal. Because a number of radioactive spills occurred at the SRE, radioactive contamination is possible in the drainage ditch along the western boundary of Site 4583-New.[2,3]

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: Site 4583-New is a vegetated area no longer in use.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): In 1988, Rockwell conducted a radiological survey of the ESG salvage yard, barrel storage yard, and new salvage yard to determine whether any residual contamination remained from former storage operations. The areas were surveyed for fixed and removable alpha/beta contamination. Rockwell measured ambient gamma exposure rates and collected soil samples for analysis. At the new salvage yard, Rockwell found gamma exposure rate distributions to be equivalent to natural background. Rockwell's background was 15.3 µR/h with an acceptable limit of less than 5 µR/h above background. The average ambient gamma exposure rate was found to be 13.5

[1] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[2] Chapman, J. A., *Radiological Survey of the ESG Salvage Yard (Old), Rocketdyne Barrel Storage Yard, and New Salvage Yard (T583)*, ETEC Report No. GEN-ZR-0008, August 22, 1988, pp. 2-3, 15-26, 57-80.
[3] Description of New Conservation Yard, Boeing North American document, p. 4.

µR/h. Rockwell collected three soil samples from the drainage ditch in the new salvage yard at depths down to 2 feet. Rockwell also collected two soil samples from the ditch north of G Street. Samples were analyzed for U-238 (0.87 pCi/g average), Th-232 (0.76 pCi/g average), K-40 (21.99 pCi/g average) and Cs-137 (0.18 pCi/g average). Survey results were below Rockwell's acceptance limits in the new salvage yard.[2]

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Locations: Site 4583-New was a disposal location for non-radiologically contaminated items.

Aerial Photographs: Aerial photographs show undeveloped land until the 1978 photograph when open storage is observed on an irregularly shaped area that is identified as Site 4583-New. This is also observed in the 1980 photograph. In the 1983 photograph, the area of Site 4583-New appears to have increased in size. In the 1988 photograph, the area appears to have decreased in size. Refuse containers are observed in the 1995 photograph. A vegetated area without open storage of materials is observed in the 2005 and 2009 photographs.[1]

Radionuclides of Concern: Controls were reportedly implemented at the new salvage yard to ensure that no radioactive materials or radioactively contaminated materials were stored there. However, radionuclides originating from Building 4064 may have migrated to this area via surface water flow or airborne releases. Possible radionuclides include U-233, U-234, U-235, U-236, U-238, Th-228, Th-232, Pu-238, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Ra-226, Cs-134, Cs-137, Sr-90, H-3, Na-22, K-40, Mn-54, Fe-55, Co-60, Ni-59, Ni-63, Eu-152, Eu-154, Pm-147, Ta-182.[2] All radionuclides of concern listed, with the exception of Mn-54, Pm-147 and Ta-182, are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives and do not meet the criteria for analysis. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Based on general site topography, surface water from Site 4583-New flows south to the drainage channel that forms the western and southern boundaries of the new salvage yard. This channel is connected to the Area II ponds. This drainage channel also transported water pumped from the SRE retention pond.[3] Radioactive materials were not supposed to have been handled at Site 4583-New, but the site could have become contaminated by surface water and airborne releases from Building 4064.

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Site 4583-New area is Class 1. It is not apparent that a full radiologic characterization of the area was conducted.

Recommended Locations for Soil/Sediment Sampling:

Plate 1 and Figure 2.4 provide a convenient reference for the following recommendations.

[1] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[2] Liddy, P., *Area 4064 Final Status Survey Report*, Rocketdyne Report No. RS-00003, March 30, 1999, p. 4.
[3] Chapman, J. A., *Radiological Survey of the ESG Salvage Yard (Old), Rocketdyne Barrel Storage Yard, and New Salvage Yard (T583)*, ETEC Report No. GEN-ZR-0008, August 22, 1988, pp. 16.

Previous characterization studies for the Site 4583-New 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 Site 4583-New area. This includes the following Site 4583-New areas and appurtenances:

- The flat land and low lying areas on Site 4583-New. Radionuclides may have been deposited on soil via wind and precipitation events.
- The drainage channel located on the western and southern sides of the site that transports surface water southward. If radionuclides were released on other areas of the site, they may have migrated to the drainage channel during precipitation events.

- The sanitary sewer line located in the southern region of the site. If radionuclides were released into the sanitary sewer system, residual contamination may exist in the materials surrounding the sewer line.

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-6 Group 5 are presented. HSA-6 Group 5 includes four building areas containing the Old Salvage Yard and fuel oil storage tanks.

2.5.1 Building 4320 Area

Site Description: The Building 4320 area comprised Building 4320, concrete Pad 4737 that supported four oil pumps, and the land surrounding these located on C Street near 3rd Street. Building 4320 was constructed in approximately 1978 as a fuel oil control/pump building.[1, 2] Figures 2.5.1a and 2.5.1b provide a current photograph and a floor plan.

Building Features: Building 4320, built on ESG salvage yard property, was a 500-square-foot prefabricated steel building (20 feet wide by 25 feet long and 10 feet high) including a restroom, mounted on a concrete pad and connected through two pumping stations to two 1.5 million gallon fuel tanks by carbon steel pipes from 3 to 6 inches in diameter. A transformer was located outside Building 4320 as were four 15-horsepower oil pumps. The area surrounding Building 4320 was fenced and paved with asphalt parking areas.[2, 3, 4] A 20,000-gallon fiberglass diesel/fuel oil underground storage tank (UT-28) was located on the east side of Building 4320.[5] Figure 2.5.1b presents a floor plan of Building 4320.

Former Use(s): Building 4320 was the tank unloading station and distribution system control center used to pump fuel oil from aboveground holding Tanks 4731 (1.5 million gallons) and 4732 (1.5 million gallons) to Tank 4735 (86,000 gallons), located in HSA-5B. A 20,000-gallon

[1] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[2] The Boeing Company, *Building Reconnaissance Report, Building 320*, November 15, 1996, pp. 31-32.
[3] Letter from N. L. Mattera, The Boeing Company, to A. Brown, Ventura County Air Pollution Control District, March 3, 1999.
[4] Jassak, R., *Sodium Components Test Installation Fuel Oil Storage and Distribution System Demolition and Waste Minimization Study*, Rockwell International Report No. 355-XT-0126, February 18, 1998, pp. 7, 20.
[5] Rockwell International, *Underground Tank Removal Reports, Volume I of II*, July 13, 1994.

underground storage tank (UT-28) was used as a holding tank during the transfer of fuel from tanker trucks to the aboveground storage tanks. In May 1988, Rockwell hired a contractor to excavate and remove UT-28 under tank abandonment permit No. 913. The contractor inspected UT-28 for holes, and checked the soil using a HNu portable ionization detector. No holes were found in the tank, and no petroleum contamination was detected in the soil.[5, 1, 2]

Information from Interviewees: In September 2002, Montgomery Watson Harza interviewed a former worker who stated that the SRE discharge pipeline was installed after the fuel farm was constructed. He stated that the pipeline led to the concrete sump near UT-28, which had a motor in it to pump out the contents into the drainage channel at the ESG salvage yard. This sump also collected runoff from each of the two tank bermed areas.[3]

Radiological Incident Reports: None found.

Current Use: Building 4320 was demolished in 1999.[4]

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): Only one radiological survey at this site appears to have been conducted, as follows:

- In 1994 and 1995, Rockwell conducted an Area IV Radiological Characterization Survey that included Building 4320. This survey was designed to locate and characterize any previously unknown areas of elevated radioactivity. Rockwell's background radiation was 15.6 µR/h with an acceptable limit of less than 5 µR/h above background. Survey results were below Rockwell's acceptance limits.[5]

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Locations: None found.

Aerial Photographs: Aerial photographs show undeveloped land until the 1978 photograph when a rectangular-shaped building is identified as Building 4320. A trailer, located south of Building 4320, also appears in this photograph. In the 1980 photograph, 12 vertical tanks are identified where the trailer was previously located. In the 1983, and 1988 photographs, a ground scar is seen located east of the tanks. Building 4320 can also be seen in photographs from 1980, 1983, and 1988. In the 1995 photograph, the ground around Building 4320 appears to have been cleared and a fence erected. A vegetated area is seen in the location of Building 4320 in the 2005 and 2009 photographs.[6]

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[1] Letter from P. B. Ramirez, Boeing North American, Inc., to Robert Laughlin, County of Ventura, February 22, 1999.
[2] Pendleberry, S. L., *Demolition Specification Removal of Fuel Oil Storage and Distribution System*, ETEC Report No. GEN-SP-00051 Rev. NEW, November 2, 1998.
[3] Montgomery Watson Harza, Telephone Discussion Notes re: SRE Discharge Pipeline, ASTs, and UT-28 Details, September 26, 2002.
[4] Letter from P. B. Ramirez, Boeing North American, Inc., to Robert Laughlin, County of Ventura, February 22, 1999.
[5] Rockwell International, *Area IV Radiological Characterization Survey, Final Report, Volume I*, Report No. A4CM-ZR-0011, Revision A, August 15, 1996, pp. 22-24.
[6] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.

Radionuclides of Concern: The research team did not find evidence that radioactive materials were used or stored within Building 4320. However, the site was previously part of the ESG salvage yard and it is not apparent that a full radiologic characterization of the area was conducted. Possible radionuclides include U-238, U-234, U-235, U-236, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Th-232, H-3, Na-22, Na-24, Cr-51, Mn-54, Fe-59, Co-60, Kr-85, Sr-89, Sr-90, Sb-125, I-129, I-131, Cs-134, Cs-137, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xn-133, Xe-135, Pm-147, Sm-151.[1, 2, 3] All radionuclides of concern listed with the exception of Na-24, Cr-51, Mn-54, Fe-59, Kr-85, Sr-89, I-131, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xe-133, Xe-135, Pm-147 and Sm-151 are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives except for Sm-151 for which no analytical method is available. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: The location of former wastewater lines and storm drains is unknown. Based on general site topography, surface water flows in a southerly direction from the site to a drainage channel located north of E Street. From this channel, surface water is ultimately transported to the Area II ponds. The overflow from these ponds is into Bell Canyon and thence to the Los Angeles River.[4] Radioactive materials do not appear to have been handled in Building 4320, but the site could have become contaminated by surface water and airborne releases from the ESG salvage yard.

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4320 area is Class 1. It is not apparent that a full radiological characterization of the area was conducted.

Recommended Locations for Soil/Sediment Sampling:

Plate 1 and Figure 2.5 provide a convenient reference for the following recommendations.

Previous characterization studies for the Building 4320 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 4320 area. This includes the following Building 4320 areas and appurtenances:

- The flat and low-lying areas surrounding Building 4320. Radionuclides originating from Building 4143 may have migrated to these areas via surface water flow or airborne releases.
- The east side of Building 4320. A former worker stated that the SRE discharge pipeline from the pond was connected to a concrete sump located near UT-28, which had a motor

[1] Hart, R. S., *Distribution of Fission Product Contamination in the SRE*, Atomics International Report No. NAA-SR-6890, March 1, 1962, pp. 8-27.
[2] Kinzer, J. and Crawford, A. C., *SRE First Core Fuel*, Atomics International Technical Data Record No. 5301, May 16, 1960, pp. 1-7.
[3] Letter from Heine, W. F., Atomics International, to Proctor, J. F., E. I. du Pont de Nemours & Company, re: *Fission Product and Fissile Content of SRE Fuel*, July 2, 1975.
[4] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.

in it to pump out the contents into the drainage channel at the old salvage yard. Radiological contamination from the SRE may have been transported to the sump.

- The location of the tanks south of Building 4320 identified in aerial photographs.
- The location of a ground scar east of the tanks, above, identified in aerial photographs.
- The location of the trailer south of Building 4320 identified in aerial photographs.

2.5.2 Site 4583-Old Area

Site Description: The Site 4583-Old area comprised Site 4583-Old, a shack Building 4313, a concrete pad Site 4737, and the land surrounding these located on the north side of E Street near Building 4114.[1] This site was first used in 1952 as a salvage yard and later included a barrel storage yard. Figures 2.5.2a provides a current photograph. Figure 2.5.2b provides a historical photograph taken in 1963. Figure 2.5.2c presents a plot plan.

Building Features: Site 4583-Old was a 3-acre area comprising mostly natural terrain that was used between 1952 and 1977 as a salvage yard.[2] Figure 2.5.2b presents a 1963 aerial view of Site 4583-Old in the foreground beyond the power plant.

Former Use(s): Site 4583-Old was known as the conservation yard and later as the old ESG salvage yard. This area incorporated a barrel storage yard. Excess salvageable items were stored at Site 4583-Old and, eventually, its extent spread to surrounding areas. Part of this growth expanded into the barrel storage yard, located immediately south of the ESG salvage yard. Although not operated as a radiologically-controlled facility, Rockwell surveyed these areas for contamination. Rockwell states that there was no deliberate dumping or placing or radioactive materials on the site, but because there were no radiological controls, radiologically contaminated items were found on the site during radiation surveys.

In 1969, the barrel storage yard was converted to a material storage area for Plant Services, which relinquished control of the area in 1986 to Rockwell's Transportation Department. The ESG salvage yard was used extensively during the 1960s and 1970s before it was closed in 1977 and cleared of materials. Some of the material from the ESG salvage yard was transported off site. Rockwell conducted radiation surveys on material and the general area to avoid moving any contaminated items to the new storage yard. In 1988, shipping trailers and casks were stored in the old barrel storage yard. In the early 1980s, the ESG salvage yard became a fuel tank farm, located on U.S. Government optioned land. The barrel storage yard was located on Rockwell-owned land. The areas were fenced in 1982. In 1999, Rockwell demolished the fuel tank farm and associated piping.[3, 4]

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[1] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.

[2] Vitkus, T. J., *Verification Survey of the Old Conservation Yard, Building T064 Side Yard, and Building T028, Santa Susana Field Laboratory, Rockwell International, Ventura County, California*, Oak Ridge Institute for Science and Education Report No. ORISE 93/J-107, October 1993, pp. 2-11.

[3] Chapman, J. A., *Radiological Survey of the ESG Salvage Yard (Old), Rocketdyne Barrel Storage Yard, and New Salvage Yard (T583)*, ETEC Report No. GEN-ZR-0008, August 22, 1988, pp. 2-3, 15-26, 57-80.

[4] Subbaraman, G. and Oliver, B. M., *Final Decontamination and Radiological Survey of the Old Conservation Yard*, Rockwell International Report No. N704SRR990030, August 16, 1990, pp. 5-7.

Information from Interviewees: In 2010, a number of former workers were interviewed about their experiences at the SSFL. Two remembered Site 4583-Old. Excerpts from their comments are presented below.

- "We got surrounded by a 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."[1] This former employee worked at the SSFL between 1967 and 1985.

- "I was in and out of the Conservation Yard three or four times a day as a forklift driver. There were items there, scrap that also came from the DeSoto plant. The items were scrapped out to different dealers with best prices. There were no hazardous materials at the Conservation Yard to my knowledge."[2] This former employee worked at the SSFL for 35 years.

Radiological Incident Reports: There has been one incident associated with Site 4583-Old 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.

Site 4583-Old Incident Report Summary

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A0288	1/15/1976	CONSERVATION YARD	MFP	CONTAMINATED DRUMS AND SOIL DISCOVERED AT CONSERVATION YARD ETC.

*Isotopes are written as they are presented in the incident database. The research team believes that MFP is an acronym for mixed fission products.

- On January 15, 1976, a radioactive spill was detected at the conservation yard with a pug survey meter. The spill spread across the conservation yard access road and terminated in an equipment holding area. Contamination was found on barrels (up to 800 mrad/h), pallets (up to 2 mrad/h), and in the surrounding area (up to 35 mrad/h). Other contaminated items were discovered at the conservation yard, although it is not clear from the incident report when these items were discovered. Contaminated items included a barrel (5 mrad/h), several pallets (up to 8 mrad/h), a concrete block (3 mrad/h), and a radioactive liquid waste drum (5 mrad/h). A barrel was found down the hill on the Simi Valley side of the conservation yard (2 mrad/h), and a pair of gloves belonging to the conservation yard operator (0.3 mrad/h). Externally contaminated barrels appeared to have resulted from a double stacked barrel of radioactive liquid that corroded and leaked out on to the drums and pallet below. As for the source of the contaminated liquid that

[1] Interview No. 255 of former worker conducted by the DOE and EPA in 2010, p. 6.
[2] Interview No. 290 of former worker conducted by the DOE, September 2010.

caused the spill, there were not any significant leads, but the liquid was thought to be a cleaning solution. The area was secured and radioactively contaminated asphalt, soil, barrels and pallets were removed to the RMDF for disposition (Incident Report A0288).[1]

Current Use: Site 4583-Old is a vegetated area no longer in use.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): A chronology of radiological investigations at this site is as follows:

- In 1988, Rockwell conducted a radiological survey of the ESG salvage yard, barrel storage yard, and new salvage yard to determine whether any residual contamination remained from former storage operations. The areas were surveyed for fixed and removable alpha/beta contamination. Ambient gamma exposure rates were measured and soil samples were collected and analyzed. At the ESG salvage yard, Rockwell found gamma exposure rate distributions to be equivalent to what it characterized as natural background except in a low-lying area (puddle in spring) in the southwest corner of the barrel storage yard. Rockwell's background was 15.3 μR/h and an acceptable limit was less than 5 μR/h above background. The average ambient gamma exposure rate was found to be 14.7 μR/h, while the puddle had a reading of 27.9 μR/h. Rockwell collected two soil samples in a ditch on the western side of the ESG salvage yard, three in the northern area, and three in the region of the barrel storage yard puddle where soil was discolored,. Survey results were below Rockwell's acceptance limits except for elevated levels of Cs-137 in the southwest corner of the barrel storage yard. Rockwell recommended that this area be remediated.[2]

- In 1989, Rockwell removed the top layer of soil in a 20- by 20-foot area in the barrel storage yard where Cs-137 contamination had been identified in 1988. Rockwell performed additional gamma exposure surveys and soil analyses. The average measured ambient gamma exposure rate in the decontaminated area was 14.2 μR/h. The average measured Cs-137 activity present in the decontaminated area was 13.1 pCi/g compared to the average of 81.4 pCi/g prior to decontamination. Survey results were below Rockwell's acceptance limits.[3]

- In 1993, ORISE performed a verification survey of the ESG storage yard. Activities included document reviews, surface scans, surface activity measurements, soil sampling, and sample analysis. Soil sample analysis confirmed Rockwell's results and conclusions. ORISE concluded that the area met its requirements for unrestricted use.[4]

- In 1994 and 1995, Rockwell conducted an Area IV Survey. Parts of the ESG salvage yard were surveyed, but no elevated radiation levels were observed over Rockwell's

[1] Harris, J. and Badger, F., Rockwell International Internal Letter, *Re: Conservation Yard Spill*, February 6, 1976.
[2] Chapman, J. A., *Radiological Survey of the ESG Salvage Yard (Old), Rocketdyne Barrel Storage Yard, and New Salvage Yard (T583)*, ETEC Report No. GEN-ZR-0008, August 22, 1988, pp. 2-3, 15-26, 57-80.
[3] Subbaraman, G. and Oliver, B. M., *Final Decontamination and Radiological Survey of the Old Conservation Yard*, Rockwell International Report No. N704SRR990030, August 16, 1990, pp. 5-7, 42-52.
[4] Vitkus, T. J., *Verification Survey of the Old Conservation Yard, Building T064 Side Yard, and Building T028, Santa Susana Field Laboratory, Rockwell International, Ventura County, California*, Oak Ridge Institute for Science and Education Report No. ORISE 93/J-107, October 1993, pp. 2-11.

estimated ambient background of between 14 and 18 μR/h.[1] In December 1995, the California Department of Health Services notified Rockwell that it had found no residual contamination exceeding the 1995 limits for unrestricted use, so the site could be released for unrestricted use.[2]

- In March 2000, Boeing conducted a beta/gamma instrument survey of debris on the ESG salvage yard following brush clearing. No activity above Boeing's estimated ambient background was detected. Boeing collected 40 wipe samples and counted them for gross alpha and gross beta activity. Results were below Boeing's alpha and beta removable release limits of 1,000 dpm/100 cm^2 for mixed fission products and U. They were also below Boeing's alpha removable release limits for Pu of 20 dpm/100 cm^2, and the beta removable release limits for Sr-90 of 200 dpm/100 cm^2. Four surface soil samples were also collected. Survey results were below Boeing's acceptance limits.[3]

- In November and December 2006, Cabrera Services, Inc. (Cabrera) conducted a characterization and final status survey of five sites within Area IV that included the ESG salvage yard. The survey was designed in accordance with MARSSIM guidance. Cabrera conducted a gamma walkover survey of 20 percent of the salvage yard area and collected 15 soil samples. A small area of elevated activity was identified south of a large rock outcropping, so an additional surface soil sample was collected. Cabrera found that none of the soil samples indicated radionuclide concentrations above their respective derived concentration guideline levels. Off-site laboratory analysis did not identify any non-gamma emitting radionuclides of concern above their derived concentration guideline levels.[4]

- In February 2008, ORISE conducted visual inspections, surface scans, and soil sampling of selected areas that included the ESG salvage yard. Gamma radiation surface scans did not identify any locations with elevated direct radiation. Radionuclide concentrations in three soil samples were compared to the modified Cs-137 and Eu-152 release limits of 4.7 pCi/g for Cs-137, and 2.8 pCi/g for Eu-152. All three sample results were lower than the release limits for Cs-137 and Eu-152.[5]

Radiological Use Authorizations: On December 21, 1995, the DHS released Site 4583-Old for unrestricted use. No action by NRC was necessary.[6]

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[1] Rutherford, P., *Area IV Radiological Characterization Survey Final Report*, ETEC Report No. A4CM-ZR-0011, August 15, 1995, pp. 21-24.
[2] California Department of Health Services Letter from G. Wong to P. D. Rutherford, re: *Rocketdyne's Letter Dated July 6, 1995 with Attachments Concerning the Release of Buildings T029, T028 and OCY*, December 21, 1995.
[3] Letter from M. Lee, The Boeing Company, to R. Lupo, California Department of Health Services, May 12, 2000.
[4] Cabrera Services, Inc., *Final Status Survey Report:Final Status Survey Post Historical Site Assessment Sites, Block 1, Santa Susana Field Laboratory, Ventura County, California*, March 2007, pp. 1, 19, 31, 39, Attachment 1, p. 12.
[5] Vitkus, T. J., *Independent Verification Survey Report of the Building 4059 Site (Phase B); Post Historical Site Assessment Sites, Block 1; and Radioactive Materials Handling Facility Holdup Pond (Site 4614), Santa Susana FieldLaboratory, The Boeing Company, Ventura County, California, Final Report*, Oak Ridge Institute for Science and Education, June 2008, pp. 4, 10-11, A-7, A-14, B-1 – B3.
[6] California Department of Health Services Letter from G. Wong to P. D. Rutherford, re:*Rocketdyne's Letter Dated July 6, 1995 with Attachments Concerning the Release of Buildings T029, T028 and OCY*, December 21, 1995.

Former Radiological Burial or Disposal Locations: Site 4583-Old was a material disposal facility.

Aerial Photographs: Aerial photographs show undeveloped land until the 1957 photograph when open storage is observed on an irregularly shaped area that is identified as the ESG salvage yard. This is also observed in 1959, approximately 1960, 1965, 1967, 1972, 1978, 1980, and 1983 photographs. Truck trailers and possible standing liquid are observed in the 1988 photograph. Truck trailers are also observed in the 1995 photograph. A vegetated area without open storage of materials is observed in the 2005 and 2009 photographs.[1]

Radionuclides of Concern: Radioactive and non-radioactive materials from the SRE were brought to Site 4583-Old for storage. Possible radionuclides include U-238, U-234, U-235, U-236, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Th-232, H-3, Na-22, Na-24, Cr-51, Mn-54, Fe-59, Co-60, Kr-85, Sr-89, Sr-90, Sb-125, I-129, I-131, Cs-134, Cs-137, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xn-133, Xe-135, Pm-147, Sm-151.[2, 3, 4] All radionuclides of concern listed with the exception of Na-24, Cr-51, Mn-54, Fe-59, Kr-85, Sr-89, I-131, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xe-133, Xe-135, Pm-147 and Sm-151 are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives except for Sm-151 for which no analytical method is available. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Based on general site topography, surface water from Site 4583-Old flows south and southwest into nearby drainage channels that transport water south through Area III to a pond in Area II. The overflow from this pond is into Bell Canyon and thence to the Los Angeles River.[5]

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Site 4583-Old area is Class 1 because of its former use as a storage area for radioactive materials, and because it is not apparent that a full radiologic characterization of the area was conducted.

Recommended Locations for Soil/Sediment Sampling:

Plate 1 and Figure 2.5 provide a convenient reference for the following recommendations.

Previous characterization studies for the Site 4583 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 Site 4583 area. This includes the following Site 4583 areas and appurtenances:

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[1] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[2] Hart, R. S., *Distribution of Fission Product Contamination in the SRE*, Atomics International Report No. NAA-SR-6890, March 1, 1962, pp. 8-27.
[3] Kinzer, J. and Crawford, A. C., *SRE First Core Fuel*, Atomics International Technical Data Record No. 5301, May 16, 1960, pp. 1-7.
[4] Letter from Heine, W. F., Atomics International, to Proctor, J. F., E. I. du Pont de Nemours & Company, re: *Fission Product and Fissile Content of SRE Fuel*, July 2, 1975.
[5] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.

- The flat land and low lying areas on Site 4583. Radionuclides originating from items of SRE equipment stored at the site may have been deposited on soil via wind and precipitation events.

- The location of the possible standing liquid on the west side of the barrel yard identified in aerial photographs

- The drainage channel located on the west side of the site that transports surface water southward. If radionuclides were released at the site, they may have migrated to the drainage channel during precipitation events.

2.5.3 Site 4731 Area

Site Description: The Site 4731 area comprised Site 4731 and the land surrounding it located north of C Street in the ESG salvage yard. Site 4731 was developed in about 1977 to house a bulk fuel oil storage tank.[1] Figures 2.5.3a and 2.5.3b provide a current photograph and demolition details. The location of the tank is shown in Figure 2.5.

Building Features: Site 4731 was located on the ESG salvage yard property. It was a fenced area that housed one of two 74-foot diameter fuel oil storage tanks that stood 49 feet high and contained 1.5 million gallons of fuel oil. The above-ground vented tank was fabricated in Pittsburgh in 1976.[2] It had above-ground piping and was supported on a sand base with asphaltic/soil containment berms. Demolition details for the tank are presented in Figure 2.5.3b.[3]

Former Use(s): Site 4731 was part of the ETEC fuel oil storage and distribution system that included two 1.5-million gallon tanks (Sites 4371 and 4732), an 86,000-gallon day tank (Site 4735), a 500-square-foot steel frame and siding control center (Building 4320), two pumping stations, 6.75 miles of piping (most above ground), electrical lines, conduits, fencing, supports, foundations, and paving. The bulk fuel oil was removed and sold in 1990. Residual oil was drained in 1991.[4]

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: The fuel oil tank at Site 4731 was demolished in 1999.[3, 5]

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): A chronology of radiological investigations at this site is as follows:

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[1] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[2] Boeing Corporation, Statement of Work, *Removal of ETEC Fuel Oil Storage and Distribution System*, October 14, 1997, p. 2.
[3] Letter from P. B. Ramirez, Boeing North American, Inc., to R. Laughlin, County of Ventura, re: *Building 4320 and Tanks Demolition Project*, February 22, 1999.
[4] Memorandum from DOE Oakland Operations Office to J. Neville, DOE/OAK NEPA Compliance Officer, February 16, 1999, p. 1.
[5] Pendleberry, S. L., *Removal of Fuel Oil Storage and Distribution System*, ETEC Report No. GEN-SP-00051, March, 26, 1999, pp. 5-7.

- In 1976, prior to the relocation of the salvage yard, Rockwell conducted a radiation survey of Site 4731 to confirm that the area contained no radiological contamination. Ambient gamma scanning identified an average exposure rate of 14.7 ±0.26 µR/h, which was consistent with Rockwell's background exposure rate.[1]

- In 1994 and 1995, Rockwell conducted a radiological characterization study in Area IV that included Site 4731. The purpose of the study was to locate and characterize previously unknown areas of elevated radioactivity in Area IV. Survey methods included an ambient gamma survey, a walk-about gamma survey, and soil sampling and analysis. Rockwell's average local background was estimated to be 15.6 µR/h. Rockwell's acceptable limit was less than 5 µR/h above background. Survey results were below Rockwell's acceptance limits.[2]

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Locations: None found.

Aerial Photographs: Aerial photographs show undeveloped land until the 1959 photograph when open storage is seen in the location of Site 4731. This is also seen in the approximately 1960, 1965, 1967, and 1972 photographs. In the 1978 photograph, a large round tank is observed with a berm around it and a pipeline connecting to it. This is seen in the 1980, 1983, 1988, and 1995 photographs. A vegetated area is seen in the location of Site 4731 in the 2005 and 2009 photographs.[3]

Radionuclides of Concern: The research team did not find evidence that radioactive materials were used or stored within the Site 4731 area. However, the site was previously part of the ESG salvage yard and it is not apparent that a full radiologic characterization of the area was conducted. Possible radionuclides include U-238, U-234, U-235, U-236, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Th-232, H-3, Na-22, Na-24, Cr-51, Mn-54, Fe-59, Co-60, Kr-85, Sr-89, Sr-90, Sb-125, I-129, I-131, Cs-134, Cs-137, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xn-133, Xe-135, Pm-147, Sm-151.[4, 5, 6] All radionuclides of concern listed with the exception of Na-24, Cr-51, Mn-54, Fe-59, Kr-85, Sr-89, I-131, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xe-133, Xe-135, Pm-147 and Sm-151 are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives except for Sm-151 for which no analytical method is available. Table 3.3 presents a summary of contaminants of concern.

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[1] Chapman, J. A., *Radiological Survey of the ESG Salvage Yard (OLD), Rocketdyne Barrel Storage Yard, and New Salvage Yard (T583)*, ETEC Report No. GEN-ZR-0008, August 22, 1988, p. 17.
[2] Rutherford, P., *Area IV Radiological Characterization Survey Final Report*, ETEC Report No. A4CM-ZR-0011, August 15, 1995, pp. 21-24.
[3] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[4] Hart, R. S., *Distribution of Fission Product Contamination in the SRE*, Atomics International Report No. NAA-SR-6890, March 1, 1962, pp. 8-27.
[5] Kinzer, J. and Crawford, A. C., *SRE First Core Fuel*, Atomics International Technical Data Record No. 5301, May 16, 1960, pp. 1-7.
[6] Letter from Heine, W. F., Atomics International, to Proctor, J. F., E. I. du Pont de Nemours & Company, re: *Fission Product and Fissile Content of SRE Fuel*, July 2, 1975.

Drainage Pathways: Based on general site topography, surface water flows in a southerly direction from the site to a drainage channel located north of E Street. From this channel, surface water is ultimately transported to the Area II ponds. The overflow from these ponds is into Bell Canyon and thence to the Los Angeles River.[1] Radioactive materials do not appear to have been handled at Site 4731, but the site could have become contaminated by surface water and airborne releases from the ESG salvage yard.

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Site 4731 area is Class 1. This is because the area was used for the open storage of items of used equipment, some of which were radiologically contaminated, prior to the installation of the fuel storage tank. It is not apparent that a full radiological characterization of the area was conducted.

Recommended Locations for Soil/Sediment Sampling:

Plate 1 and Figure 2.5 provide a convenient reference for the following recommendations.

Previous characterization studies for the Site 4731 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 Site 4731 area. This includes the following Site 4731 areas:

- The flat and low-lying areas on and surrounding Site 4731. Radionuclides originating from Building 4143 may have migrated to these areas via surface water flow or airborne releases. This area was used for the open storage of items of used equipment, some of which were radiologically contaminated, prior to the installation of the fuel storage tank.

2.5.4 Site 4732 Area

Site Description: The Site 4732 area comprised Site 4732 and the land surrounding it located north of C Street in the ESG salvage yard. Site 4732 was developed in 1982 to house a bulk fuel oil storage tank.[2] Figure 2.5.4a provides a current photograph. Figure 2.5.4b provides demolition details. The location of the tank is shown in Figure 2.5.

Building Features: Site 4732 was located on the ESG salvage yard property, southwest of Site 4731. It was a fenced area that housed one of two 74-foot diameter fuel storage tanks that stood 49 feet high and contained 1.5 million gallons of fuel oil. The above-ground vented tank was fabricated in Fresno in 1981.[3] It had above-ground piping and was supported on a sand base with asphaltic/soil containment berms. Demolition details for the tank are presented in Figure 2.5.4b.[4]

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[1] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[3] Boeing Corporation, Statement of Work, *Removal of ETEC Fuel Oil Storage and Distribution System*, October 14, 1997, p. 2.
[4] Letter from P. B. Ramirez, Boeing North American, Inc., to R. Laughlin, County of Ventura, re: *Building 4320 and Tanks Demolition Project*, February 22, 1999.

Former Use(s): Site 4732 was part of the ETEC fuel oil storage and distribution system that included two 1.5-million gallon tanks (Sites 4731 and 4732), an 86,000-gallon day tank (Site 4735), a 500-square-foot steel frame and siding control center (Building 4320), two pumping stations, 0.75 miles of piping (most above ground), electrical lines, conduits, fencing, supports, foundations, and paving. The bulk fuel oil was removed and sold in 1990. Residual oil was drained in 1991.[1]

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: The fuel oil tank at Site 4732 was demolished in 1999.[3, 2]

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): A chronology of radiological investigations at this site is as follows:

- In 1976, prior to the relocation of the ESG salvage yard, Rockwell conducted a radiation survey of Site 4732 to confirm that the area contained no radiological contamination. Ambient gamma scanning identified an average exposure rate of 14.7 ±0.26 μR/h, which was consistent with Rockwell's background exposure rate.[3]

- In 1994 and 1995, Rockwell conducted a radiological characterization study in Area IV that included Site 4732. The purpose of the study was to locate and characterize previously unknown areas of elevated radioactivity in Area IV. Survey methods included an ambient gamma survey, a walk-about gamma survey, and soil sampling and analysis. Rockwell's average local background was estimated to be 15.6 μR/h. Rockwell's acceptable limit was less than 5 μR/h above background. Survey results were below Rockwell's acceptance limits.[4]

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Locations: None found.

Aerial Photographs: Aerial photographs show undeveloped land until the approximately 1960 photograph when open storage is seen in the location of Site 4732. This is also seen in the 1965, 1967, and 1972 photographs. Cleared ground is observed in the 1978 and 1980 photographs. A large circular tank is seen in the 1983 photograph. This is also seen in the 1988 and 1995 photographs. A vegetated area is seen in the location of Site 4732 in the 2005 and 2009 photographs.[5]

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[1] Memorandum from DOE Oakland Operations Office to J. Neville, DOE/OAK NEPA Compliance Officer, February 16, 1999, p. 1.
[2] Pendleberry, S. L., *Removal of Fuel Oil Storage and Distribution System*, ETEC Report No. GEN-SP-00051, March, 26, 1999, pp. 5-7.
[3] Chapman, J. A., *Radiological Survey of the ESG Salvage Yard (OLD), Rocketdyne Barrel Storage Yard, and New Salvage Yard (T583)*, ETEC Report No. GEN-ZR-0008, August 22, 1988, p. 17.
[4] Rutherford, P., *Area IV Radiological Characterization Survey Final Report*, ETEC Report No. A4CM-ZR-0011, August 15, 1995, pp. 21-24.
[5] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.

Radionuclides of Concern: The research team did not find evidence that radioactive materials were used or stored within the Site 4732 area. However, the site was previously part of the Old Salvage Yard and it is not apparent that a full radiologic characterization of the area was conducted. Possible radionuclides include U-238, U-234, U-235, U-236, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Th-232, H-3, Na-22, Na-24, Cr-51, Mn-54, Fe-59, Co-60, Kr-85, Sr-89, Sr-90, Sb-125, I-129, I-131, Cs-134, Cs-137, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xn-133, Xe-135, Pm-147, Sm-151.[1, 2, 3] All radionuclides of concern listed with the exception of Na-24, Cr-51, Mn-54, Fe-59, Kr-85, Sr-89, I-131, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xe-133, Xe-135, Pm-147 and Sm-151 are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives except for Sm-151 for which no analytical method is available. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Based on general site topography, surface water flows in a southerly direction from the site to a drainage channel located north of E Street. From this channel, surface water is ultimately transported to the Area II ponds. The overflow from these ponds is into Bell Canyon and thence to the Los Angeles River.[4] Radioactive materials do not appear to have been handled at Site 4732, but the site could have become contaminated by surface water and airborne releases from the ESG salvage yard.

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Site 4732 area is Class 1. This is because the area was used for the open storage of items of used equipment, some of which were radiologically contaminated, prior to the installation of the fuel storage tank. It is not apparent that a full radiological characterization of the area was conducted.

Recommended Locations for Soil/Sediment Sampling:

Plate 1 and Figure 2.5 provide a convenient reference for the following recommendations.

Previous characterization studies for the Site 4732 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 Site 4732 area. This includes the following Site 4732 areas:

- The flat and low-lying areas on and surrounding Site 4732. Radionuclides originating from Building 4143 may have migrated to these areas via surface water flow or airborne releases. This area was used for the open storage of items of used equipment, some of which were radiologically contaminated, prior to the installation of the fuel storage tank.

[1] Hart, R. S., *Distribution of Fission Product Contamination in the SRE*, Atomics International Report No. NAA-SR-6890, March 1, 1962, pp. 8-27.
[2] Kinzer, J. and Crawford, A. C., *SRE First Core Fuel*, Atomics International Technical Data Record No. 5301, May 16, 1960, pp. 1-7.
[3] Letter from Heine, W. F., Atomics International, to Proctor, J. F., E. I. du Pont de Nemours & Company, re: *Fission Product and Fissile Content of SRE Fuel*, July 2, 1975.
[4] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.

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3.0 RADIONUCLIDE LIST

3.1 U.S. Atomic Energy Commission Special Nuclear Material License

The first license issued by the 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 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 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-6 area.

3.2 U.S. Atomic Energy Commission Critical Experiments Facility License

On October 3, 1960, the AEC authorized AI, 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). AI 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. It does not apply to the HSA-6 area.

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 AI. 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: Building 4040, the contaminated medical storage facility, and part of the ESG Salvage Yard in the HSA-6 area. 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 Drawing 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. In the HSA-6 area, this license applied to Building 4040, and part of the ESG Salvage Yard.

3.4 Radionuclide List to be Used in Soil 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: Na-22, Fe-55, Sb-125, Cs-134, Ce-144, and Po-210. The May 2010 Draft Final Field Sampling Plan for Soil Sampling Area IV Radiological Study Santa Susana Field Laboratory 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-6 Sites

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

Table 3.3 (continued)
Summary of Subarea HSA-6 Sites

Site No.	Use(s)	Current Status	Potential Radiological Contaminants of Concern	MARSSIM Class
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
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

Table 3.3 (continued)
Summary of Subarea HSA-6 Sites

Site No.	Use(s)	Current Status	Potential Radiological Contaminants of Concern	MARSSIM Class
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
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

4.0 REACTOR/CRITICALITYFACILITIES/SIGNIFICANT SITES WORKS CITED

4.1 BUILDING 4003

Facility Name	Building No.	Period of Operation	Notes
Engineering Test Building (ETB)	4003	1957-1973	

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4.2 BUILDING 4064

Facility Name	Building No.	Period of Operation	Notes
Fuel Storage Facility	4064	1959-1993	

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Facility Name	Building No.	Period of Operation	Notes
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4.4 SITE 4583-OLD

Facility Name	Building No.	Period of Operation	Notes
Energy Systems Group (ESG) Storage Yard, Old Conservation Yard	4583-Old	1957-1977	

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4.5 SITE 4773

Facility Name	Building No.	Period of Operation	Notes
SRE Pond	4773	1957-1977	

Site 4773 Cited Documents

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FIGURES

PARTIALLY SCANNED
OVERSIZE ITEM(S)

See document # 2266488
for partially scanned image(s).
PLATE 1
SUBAREA HSA - 6
For complete hardcopy version of the oversize document
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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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HGL HydroGeoLogic, Inc.

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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

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Project: EP9038
Sorce: Boeing Company, 2008
CIRGIS, 2007

HGL HydroGeoLogic, Inc.

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Figure 1.3
Subarea HSA-6
Santa Susana Field Laboratory

U.S. EPA Region 9

Legend

Buildings

- Existing
- Removed

N

0 50 100 200
Scale In Feet

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Edited: 04/28/2011 TJ
Source:Boeing Company, 2008
CIRGIS, 2007

HGL HydroGeoLogic, Inc.

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Figure 2.1
Area IV Subarea 6-1
Santa Susana Field Laboratory

U.S. EPA Region 9

Legend

- Subarea 6-1 Boundary
- Primary Roads
- Secondary Roads
- Tertiary Roads
- Underground Storage Tank
- Unknown Tank Type
- French Drain Holding Tank
- Sump
- Dry Well
- Tank Footprint
- Above ground Storage Tank
- Demolished Bldg.
- Existing Bldg.
- Parking Lots
- Drainage
- Drainage Ditch
- Interview Line
- Offsite Seeps and Springs
- Onsite Seeps and Springs
- Drain
- Well

B	Building
CA	Cleared Area
CONT	Container
CR	Crates
DB	Debris
DG	Disturbed Ground
DTM	Dark Tone Material
EX	Excavation
FA	Fill Area
GR	Graded
GS	Ground Scar
HT	Horizontal Tank
IM	Impoundment
LTMM	Light Toned Mounded Material
MTMM	Medium Toned Mounded Material
OS	Open Storage
PA	Processing Area
PL	Pipeline
POSS	Possible
PROB	Probable
SS	Smoke Stack
ST	Stain
S-T	Storage Tank
UO	Unidentified Object
UT	Underground Tank
VT	Vertical Tank
WDA	Waste Disposal Area

Aerial Photography Data

- Aerial Photography Features
- Septic Tank
- Leach Field
- Parking Lots

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
- Water (Removed)
- Water (Removed)
- Pipes (Unknown Type)
- Pipes (Unknown Type)
- Gas
- Storm Drain
- Sanitary Sewer
- Water

Surface Water Flow
(From Boeing Database, 2008)

N

0 25 50 100
Scale In Feet

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HGL HydroGeoLogic, Inc

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U.S. EPA Region 9

Figure 2.1.1a
Building 4003
Site Photograph

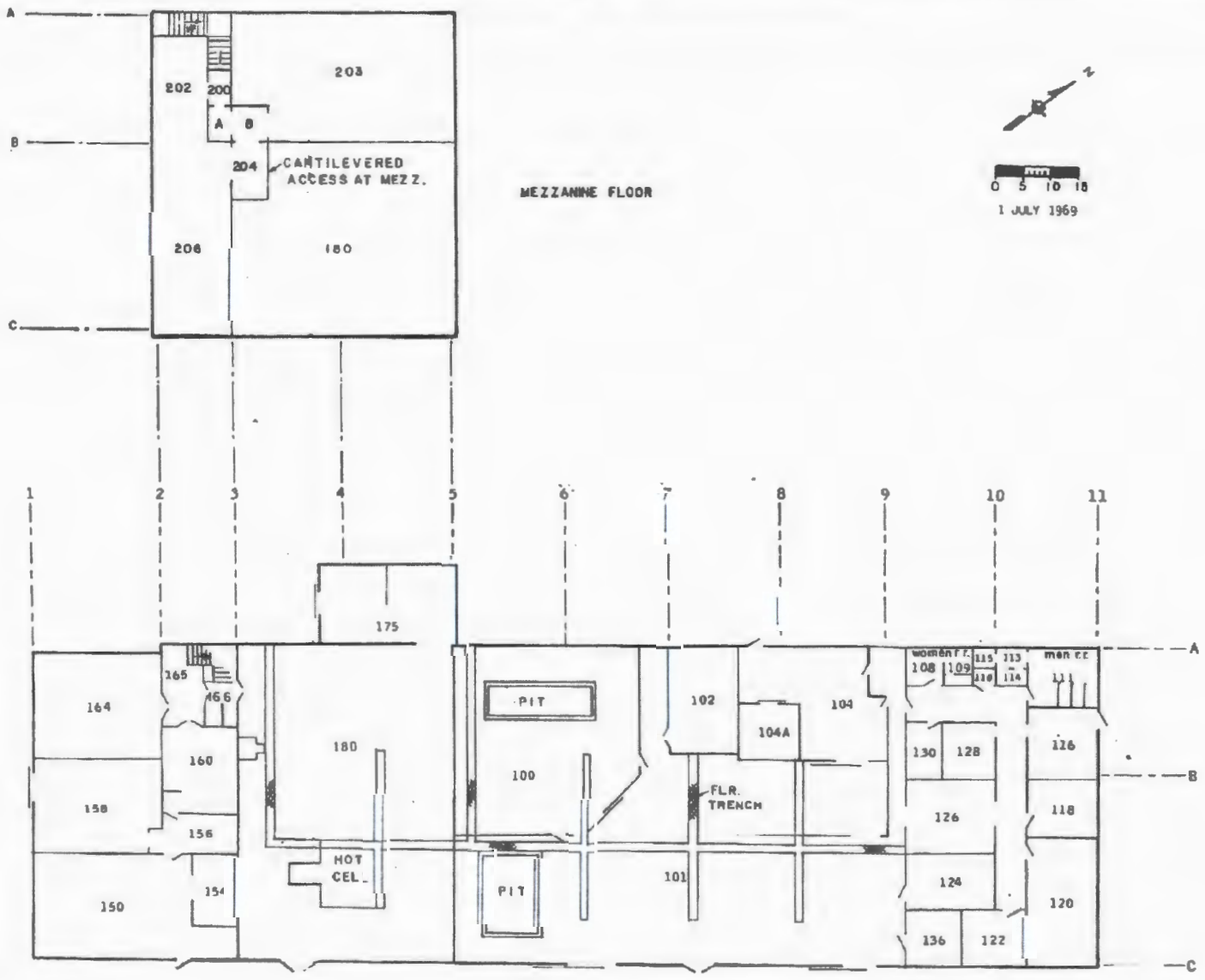

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Figure 2.1.1b
Building 4003
Floor Plan

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Figure 2.1.1c
Building 4003
Aerial Photograph
1974

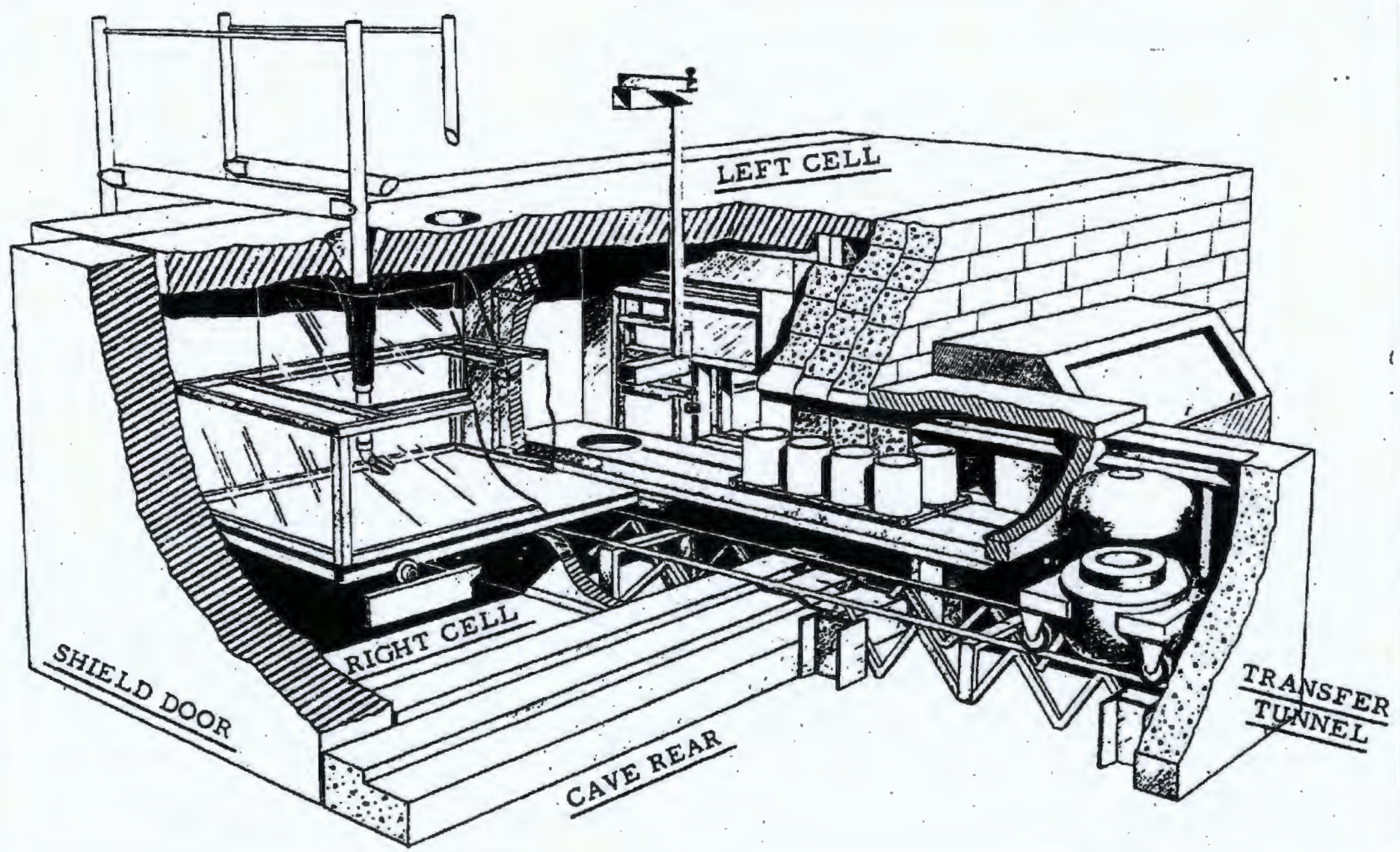

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Figure 2.1.1d
Building 4003
Hot Cave Layout

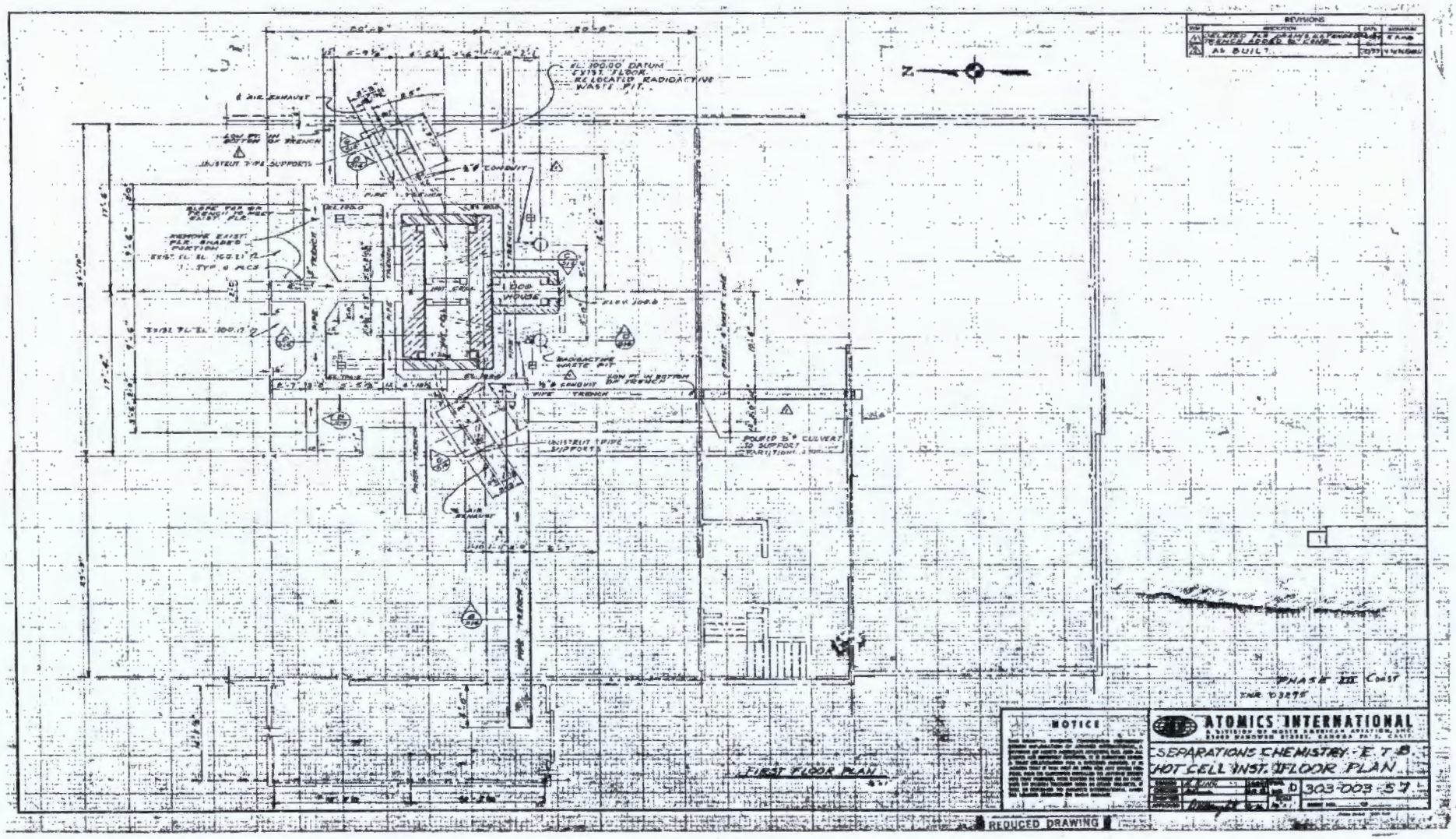

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Figure 2.1.1e
Building 4003
Hot Cell (Cave)
Floor Plan

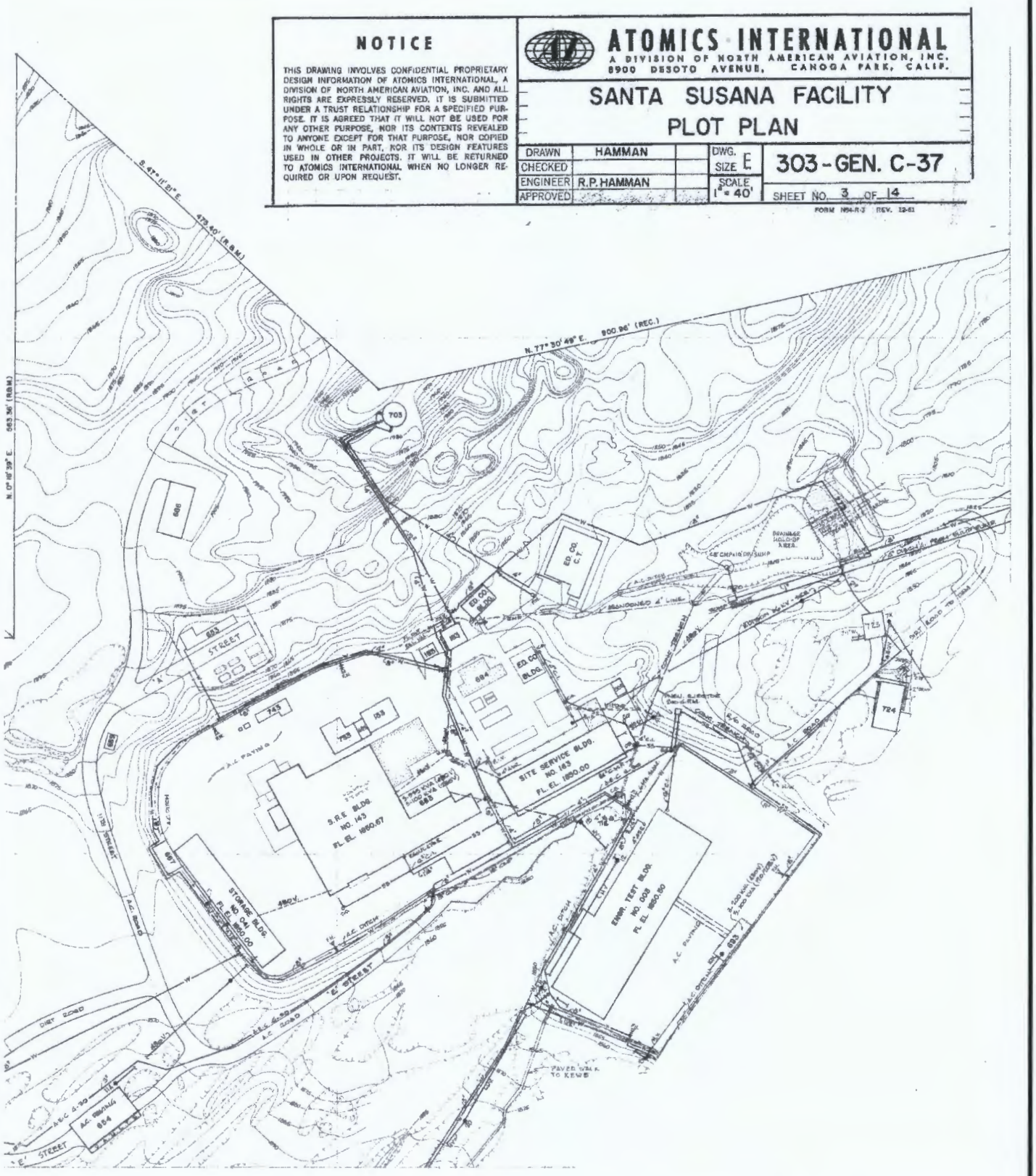

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Figure 2.1.1f
Building 4003
Plot Plan

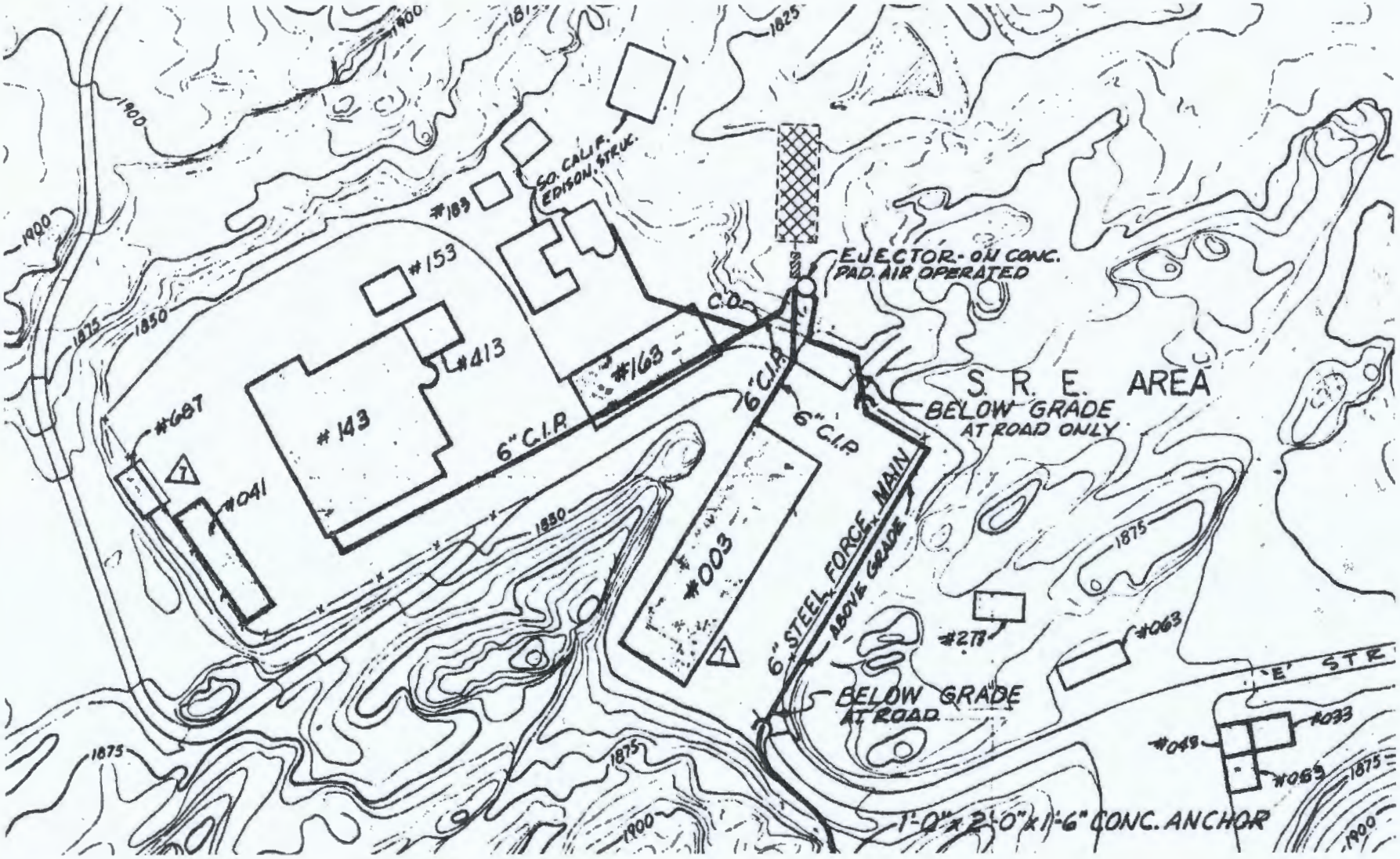

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Figure 2.1.1g
Building 4003
Sewage System

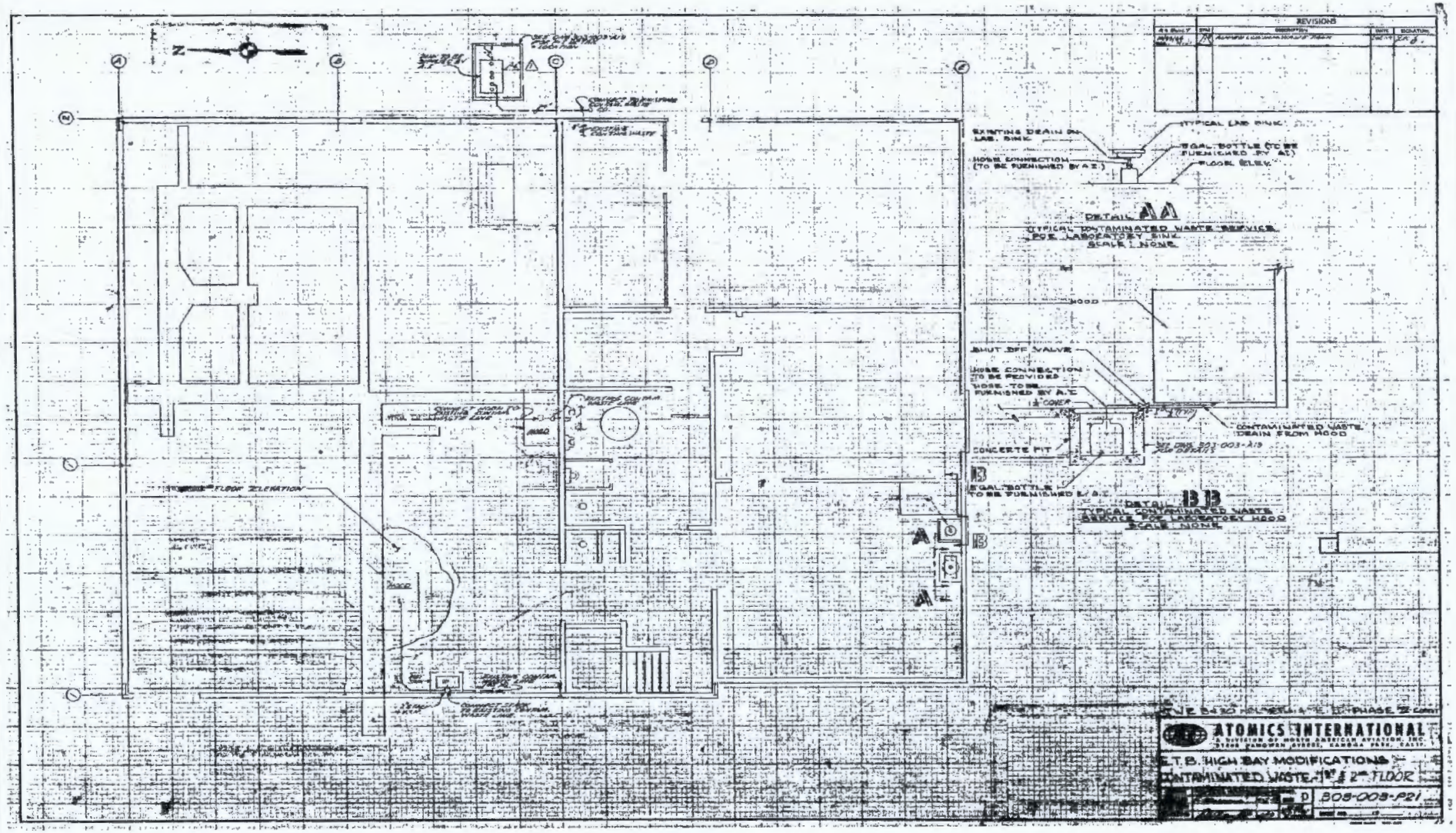

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Figure 2.1.1h
Building 4003
Contaminated
Waste Lines

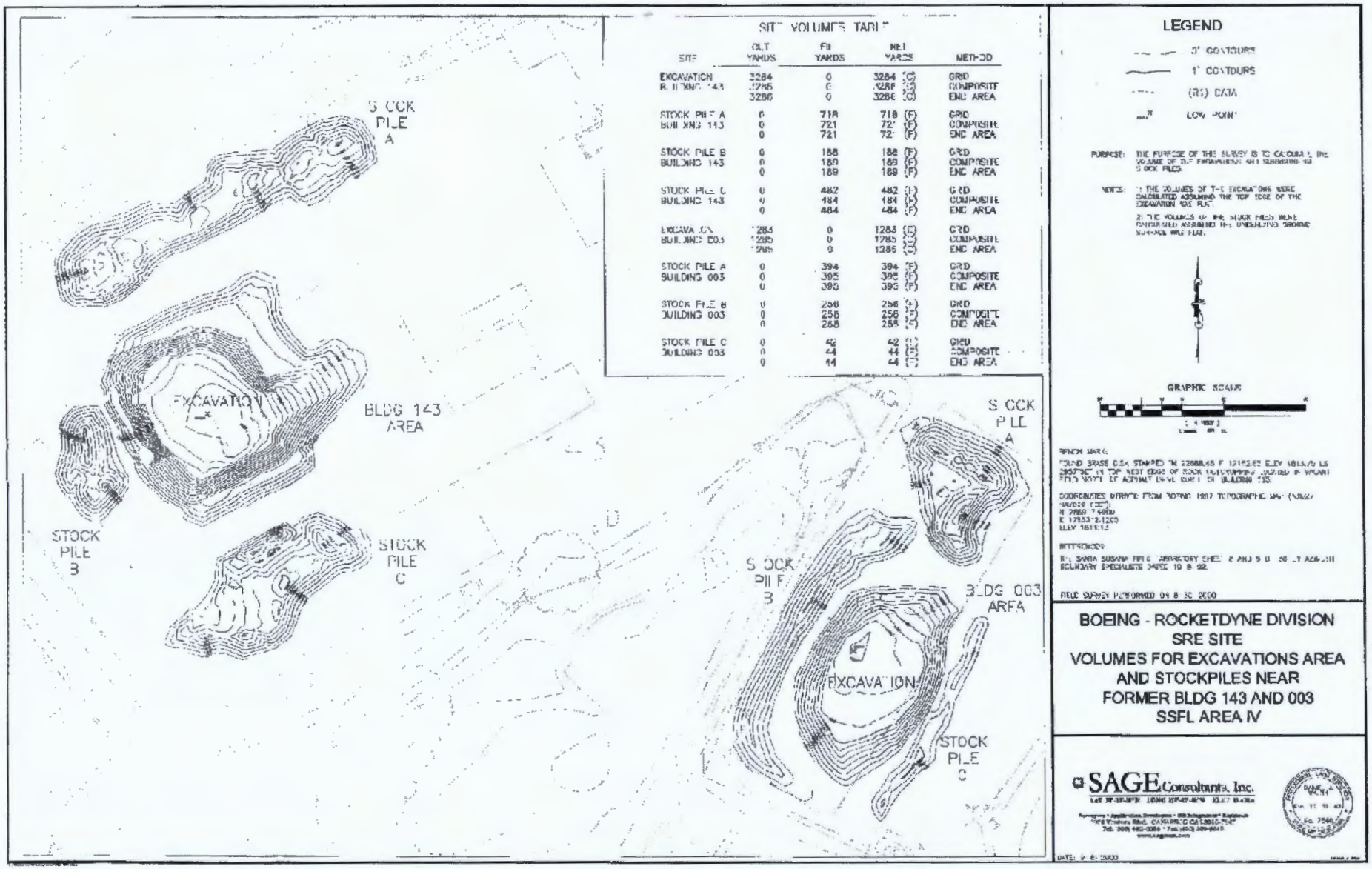

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Figure 2.1.1i
Building 4003
Excavation Area
2000

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Figure 2.1.2a
Building 4041
Site Photograph

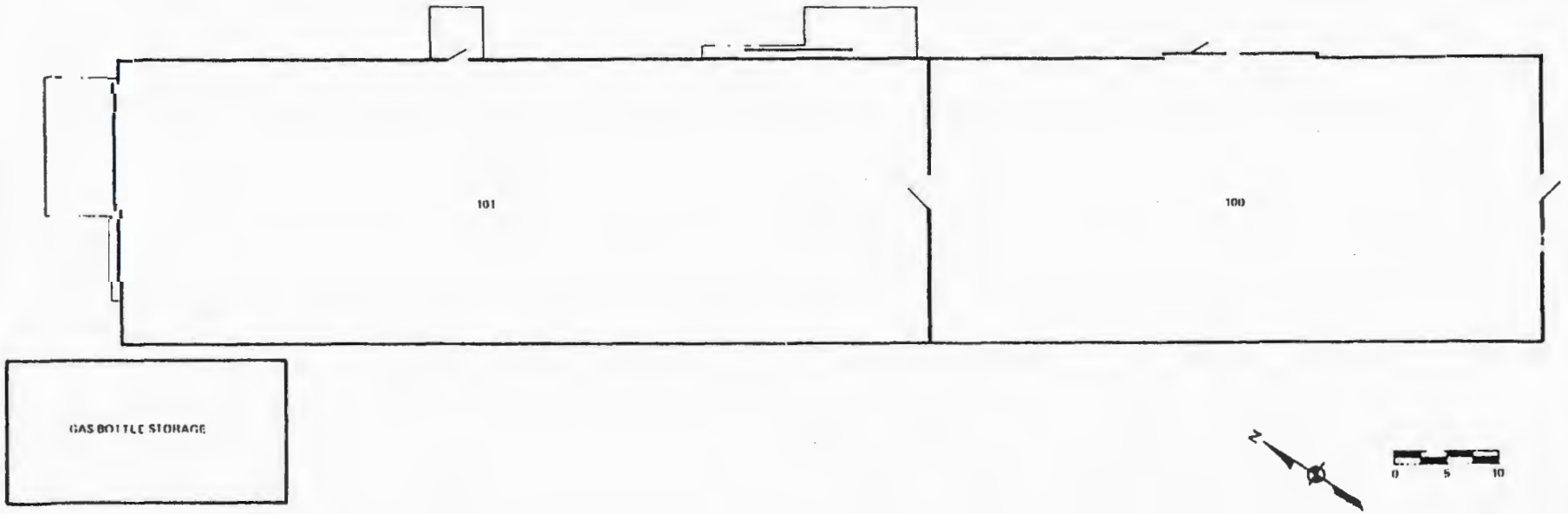

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Figure 2.1.2b
Building 4041
Floor Plan

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Source: Boeing Company, 2008

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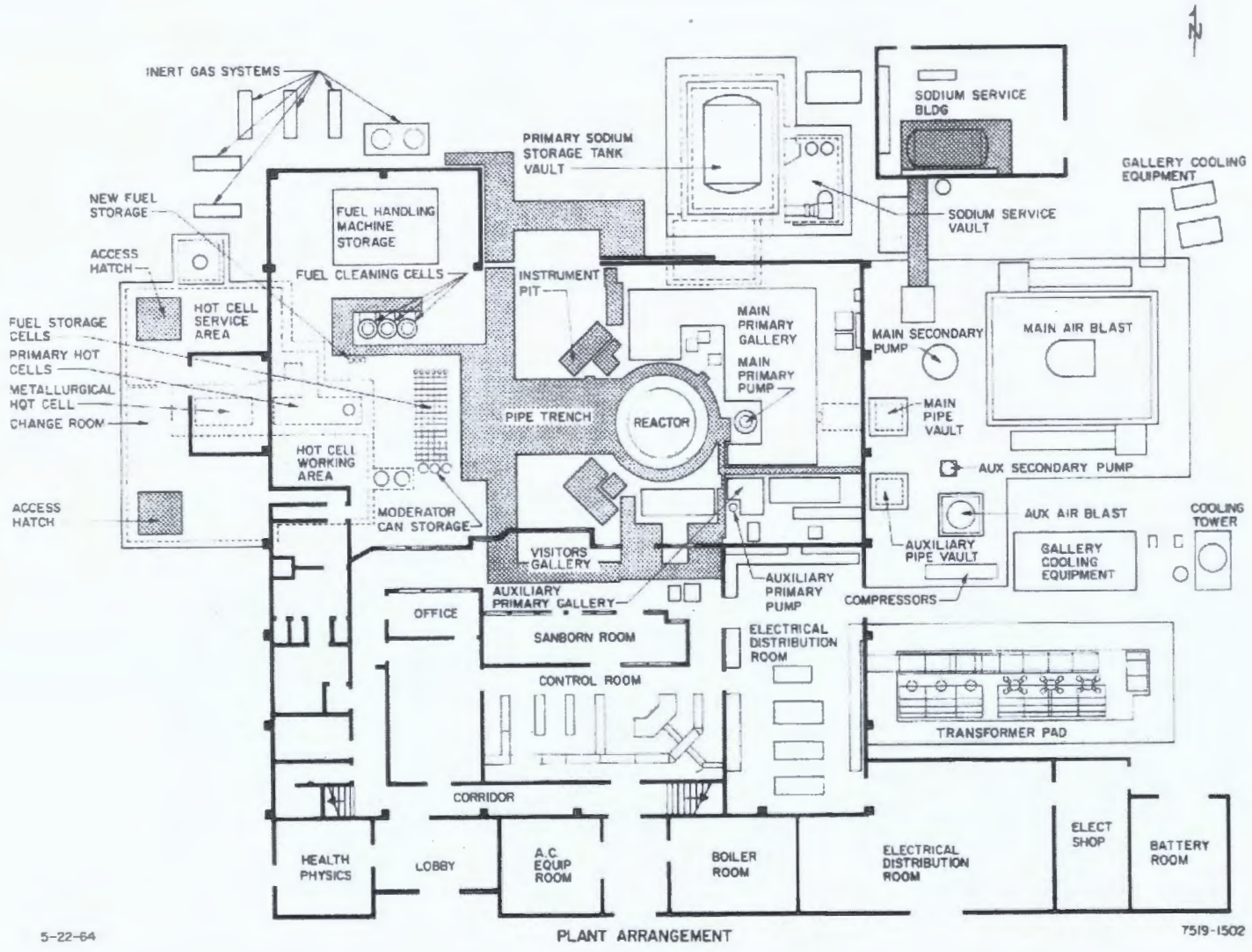
Figure 2.1.3a
Building 4143, 4153, 4695
Site Photograph



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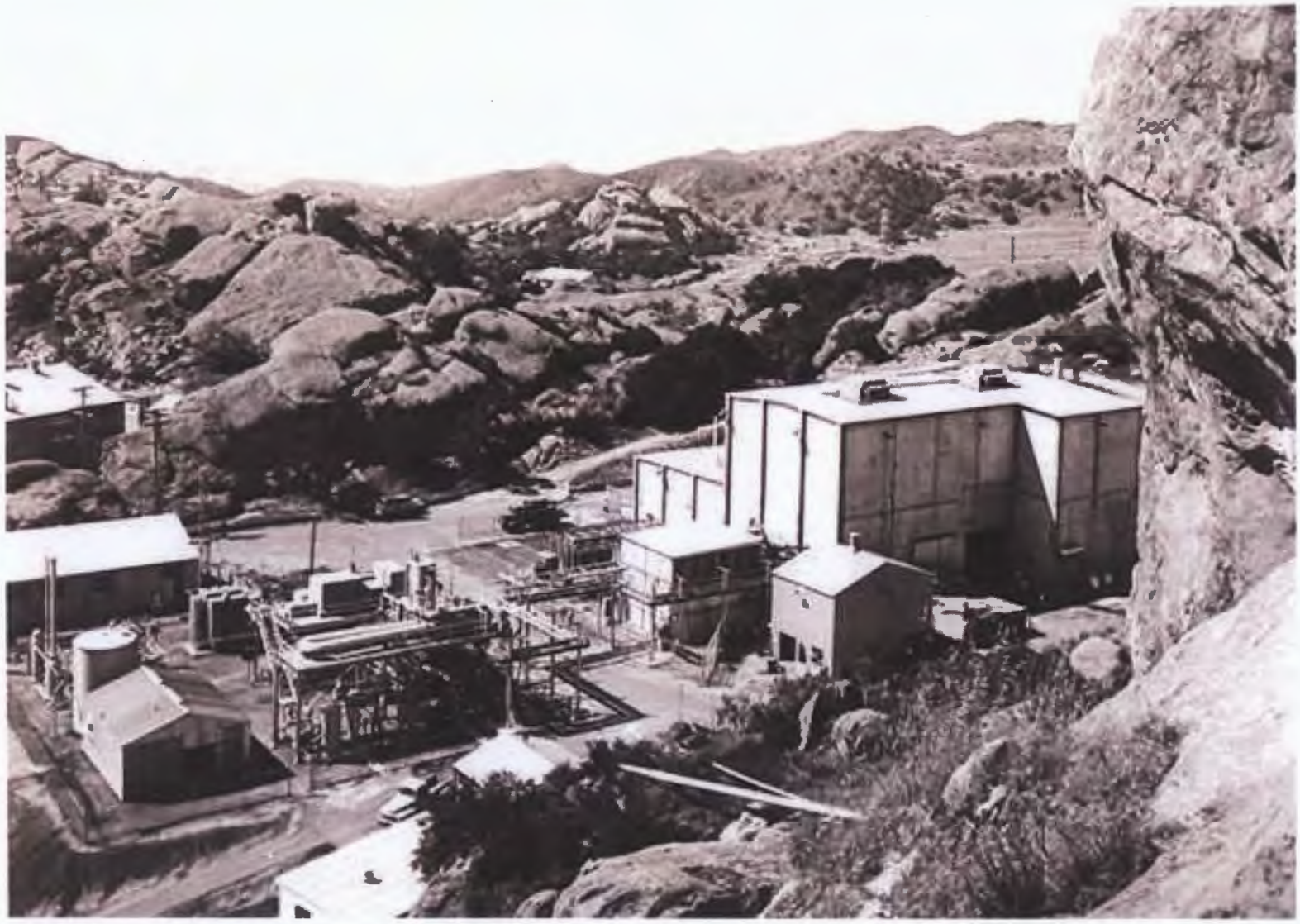
Source: Boeing Company, 2008

U.S. EPA Region 9

Sodium Reactor Experiment Building

Figure 2.1.3b
Building 4143
Floor Plan



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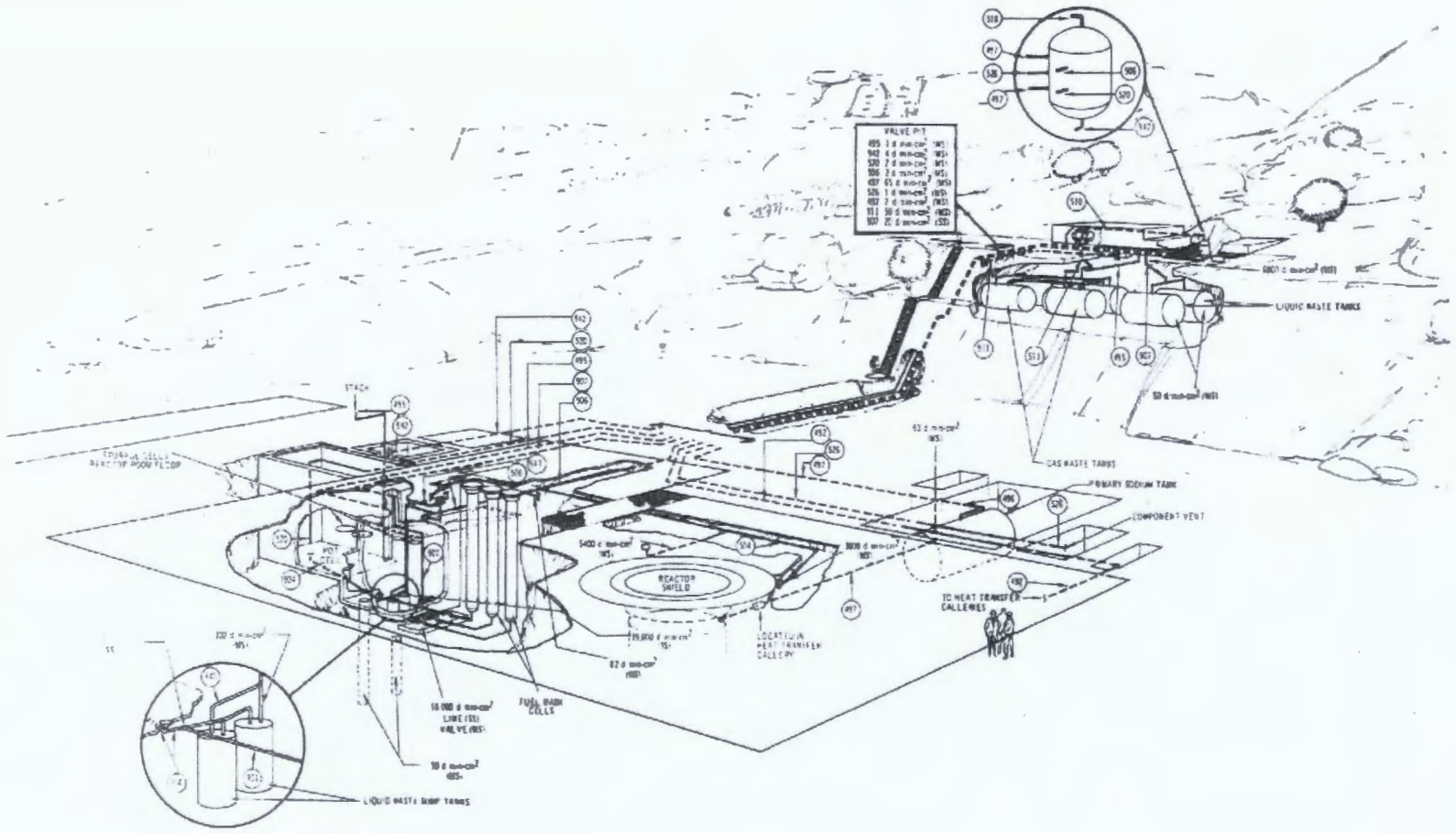
U.S. EPA Region 9

Sodium Reactor Experiment Building

Figure 2.1.3c
Building 4143
Historical Photograph
1962

Figure Not to Scale



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Sodium Reactor Experiment Building

Figure 2.1.3d
Building 4143
Radioactive Liquid Waste and Vent System

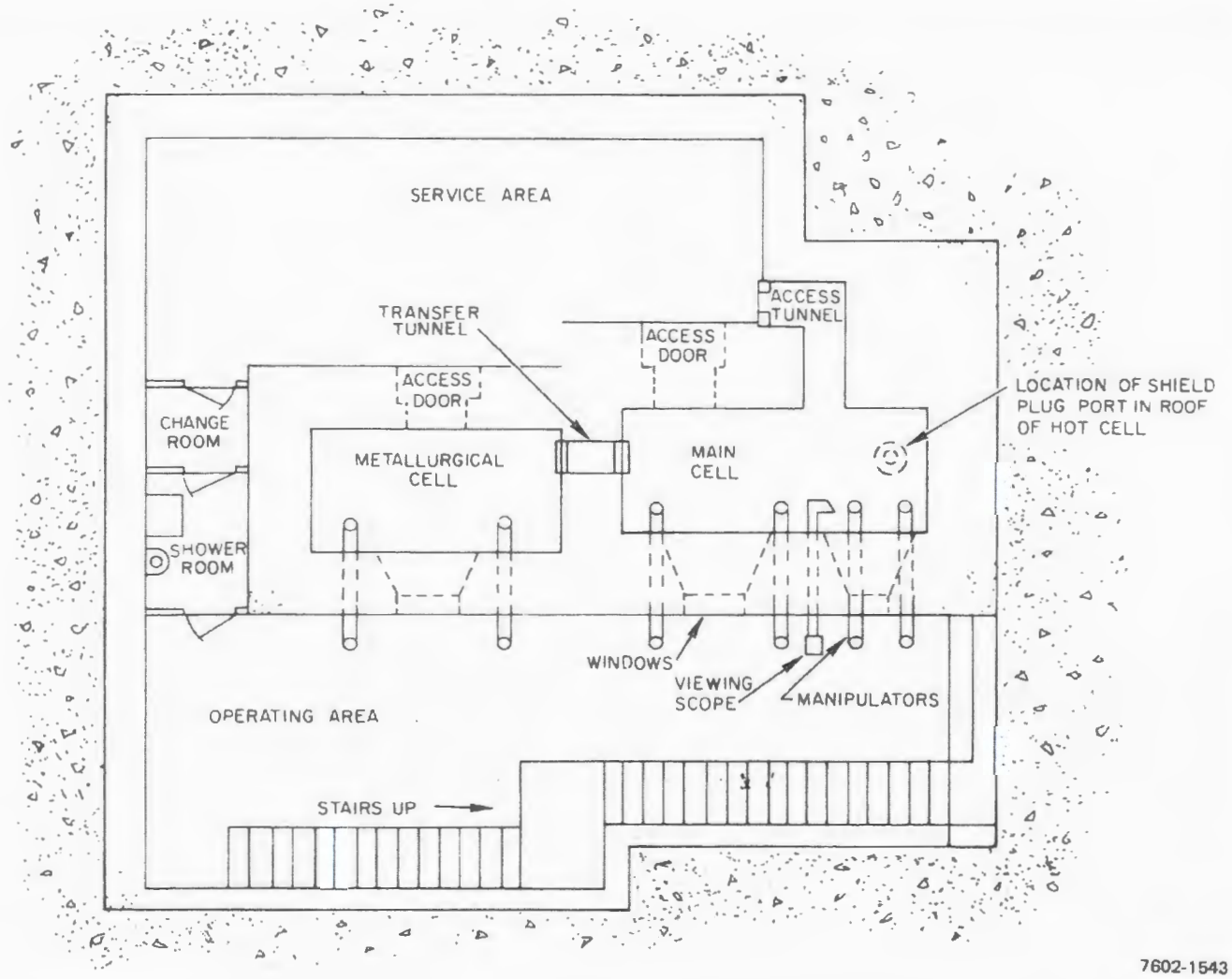


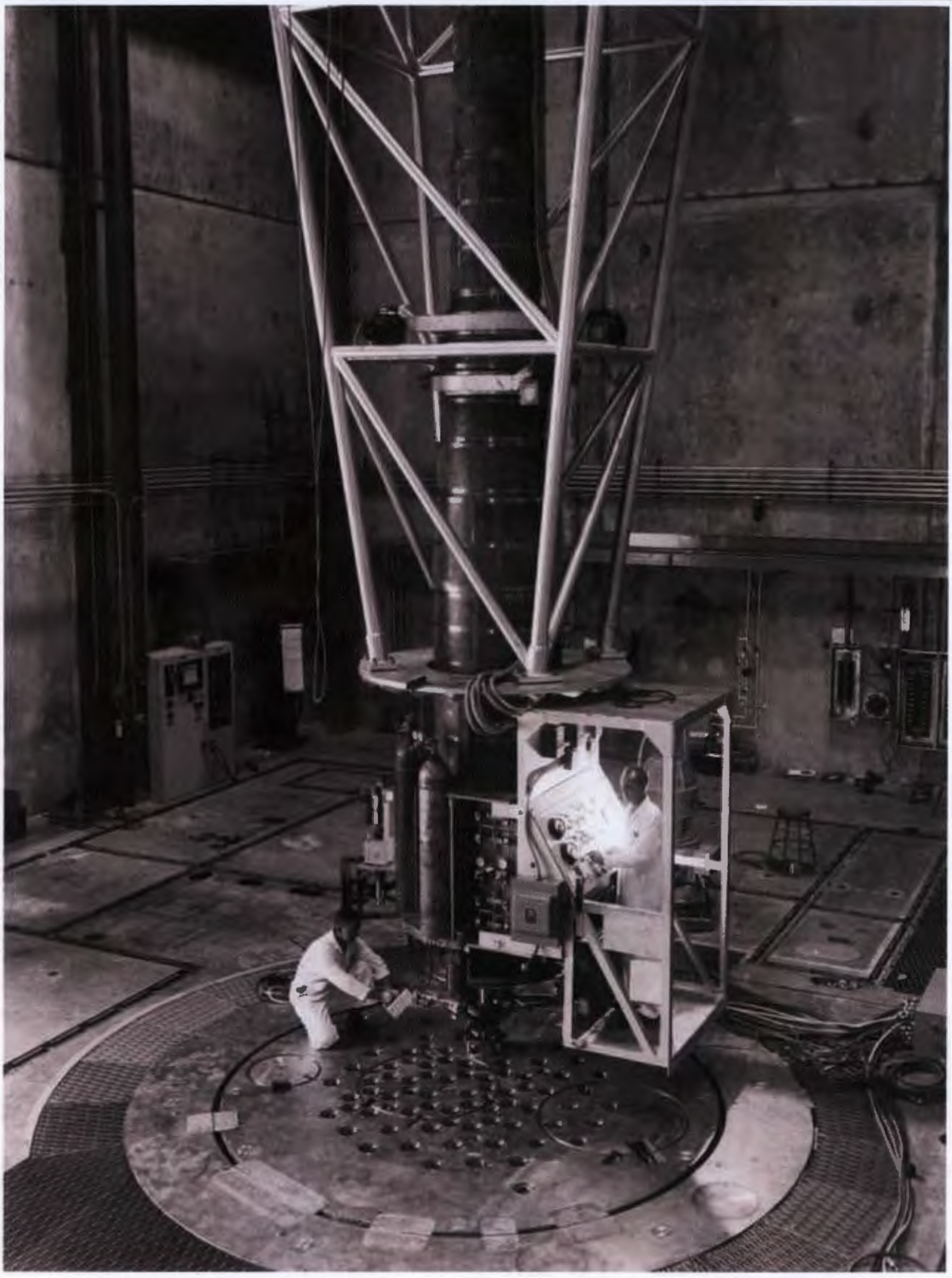
Figure Not to Scale

Y:/Santa_Susana/EP9038/TM/HSA_6 (2-1-3e)bldg4143HC.cdr
Project:EP9038
Revised: 05/23/11 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Sodium Reactor Experiment Building

Figure 2.1.3e
Building 4143
Hot Cells



Y:/Santa_Susana/EP9038/TM/HSA_6 (2-1-3f)Bldg4143HP.cdr
Project:EP9038
Revised: 05/23/11 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

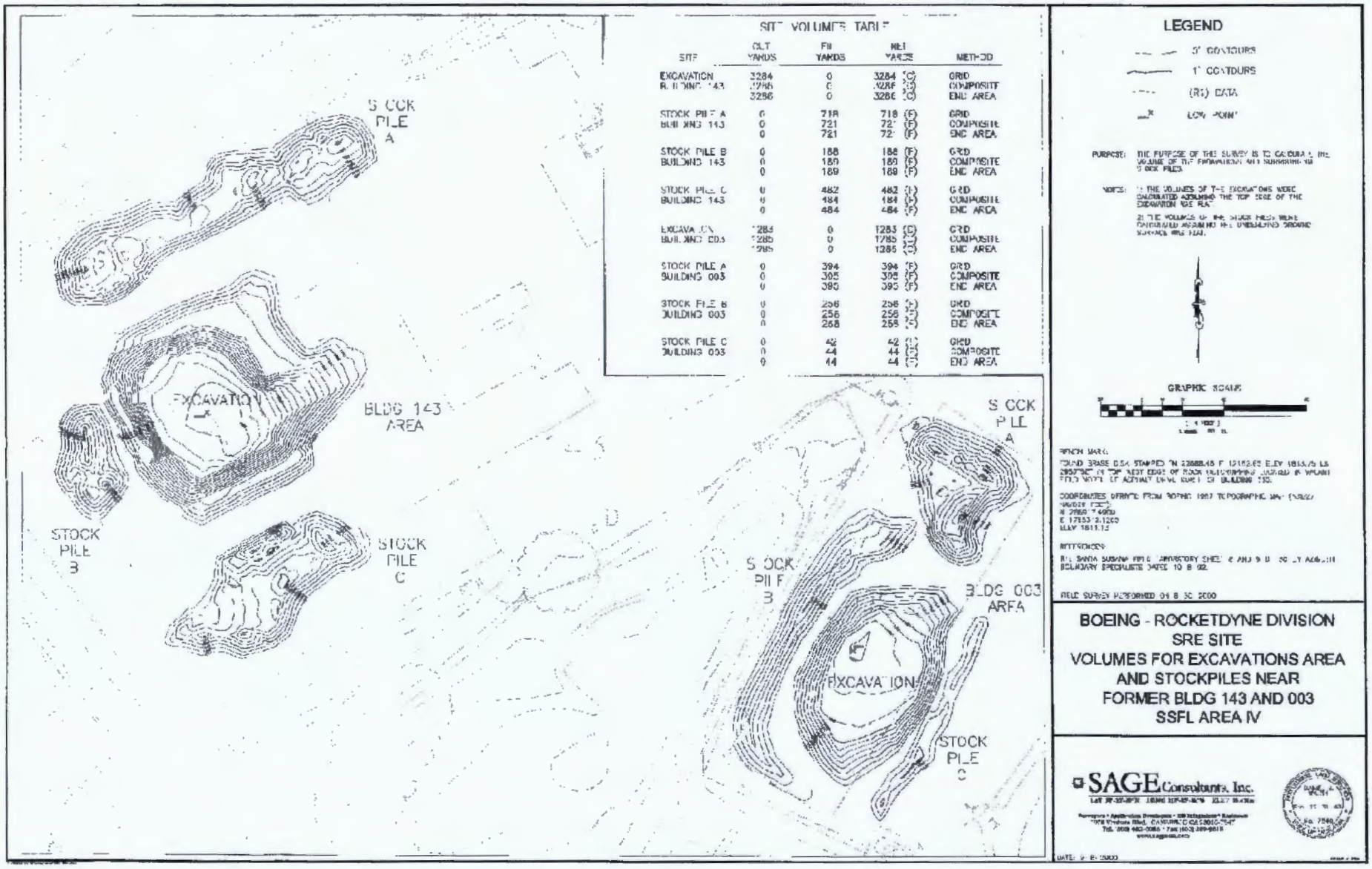
Sodium Reactor Experiment Building
High Bay

Figure 2.1.3f
Building 4143
Fuel Rod Removal

Y:/Santa_Susana/EP9038/TM/HSA_6 (2-1-3g)Bldg4143RC.cdr
Project:EP9038
Revised: 05/23/2011 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.3g
Building 4143
Reactor Core Removal
1977



Y:/Santa_Susana/EP9038/TM/HSA_6 (2-1-3h)bldg4143EA.cdr
Project:EP9038
Revised: 05/23/11 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.3h
Building 4143
Excavation Area
2000

Y:/Santa_Susana/EP9038/TM/HSA_6 (2-1-3i)Bldg4143SE.cdr
Project:EP9038
Revised: 05/23/11 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.3i
Building 4143
Shielding
Excavation
1979

Y:/Santa_Susana/EP9038/TM/HSA_6 (2-1-3j)bldg4143SF.cdr
Project:EP9038
Revised: 05/23/11 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.3j
Building 4143
Fuel Storage Cell
Concrete Excavation
1979

Y:/Santa_Susana/EP9038/TM/HSA_6 (2-1-3k)bldg4143BG.cdr
Project:EP9038
Revised: 05/23/11 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.3k
Building 4143
Below-ground
Excavation
1979

Y:/Santa_Susana/EP9038/TM/HSA_6 (2-1-31)Bldg4143DB.cdr
Project:EP9038
Revised: 05/23/11 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.3l
Building 4143
Drainage to Bottom Midsection of Fuel Element in Channel 55

Y:/Santa_Susana/EP9038/TM/HSA_6 (2-1-3m)Bldg4143DT.cdr
Project:EP9038
Revised: 05/23/11 TJ
Source: Boeing Company, 2008

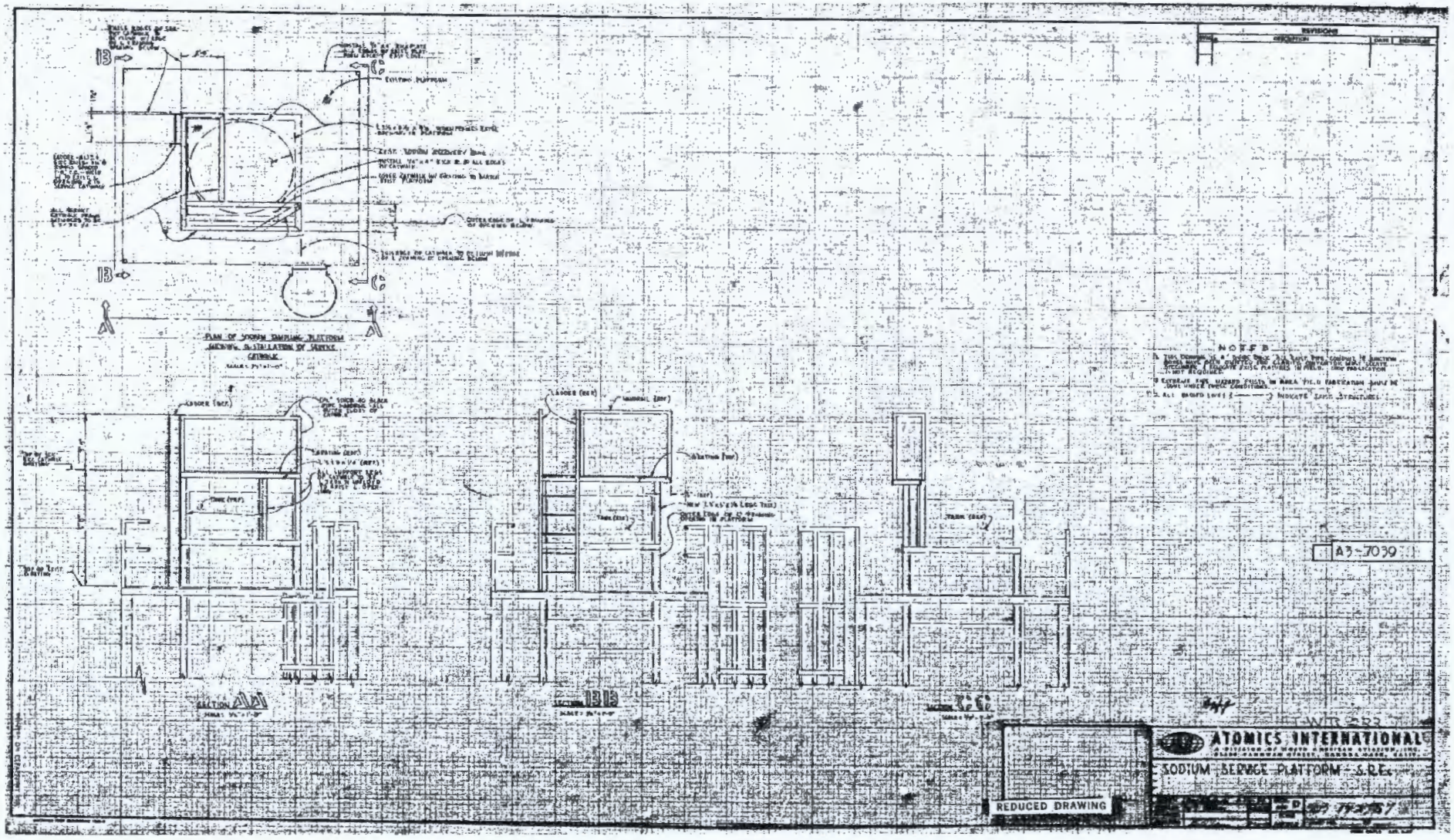
U.S. EPA Region 9

Figure 2.1.3m
Building 4143
Damage to Top of Fuel Element in Channel 55

Y:/Santa_Susana/EP9038/TM/HSA_6 (2-1-4a)bldg4143AP.cdr
Project:EP9038
Revised: 10/20/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.4a
Building 4143, 4153, 4695
Site Photograph



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Project:EP9038
Revised: 04/25/2011 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.4b
Building 4153
Site Layout

Y:/Santa_Susana/EP9038/TM/HSA_6 (2-1-4c)Bldg4153AD.cdr
Project:EP9038
Revised: 04/25/2011 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.4c
Building 4153
Above-ground
Demolition

Y:/Santa_Susana/EP9038/TM/HSA_6 (2-1-4d)Bldg4153BD.cdr
Project:EP9038
Revised: 04/25/2011 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.4d
Building 4153
Below-ground
Demolition

Y:/Santa_Susana/EP9038/TM/HSA_6 (2-1-4e)bldg4153SD.cdr
Project:EP9038
Revised: 04/25/2011 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.4e
Building 4153 Site After Demolition

Y:/Santa_Susana/EP9038/TM/HSA_6 (2-1-5a)bldg4163AP.cdr
Project:EP9038
Revised: 10/20/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.5a
Building 4163, 4183, 4184, 4185, 4684
Site Photograph

Figure Not to Scale

Y:/Santa_Susana/EP9038/TM/HSA_6 (2-1-5b)bldg4163FP.cdr
Project:EP9038
Revised: 09/02/10 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Component Equipment Repair Facility (CERF)

Figure 2.1.5b
Building 4163
Floor Plan

Y:/Santa_Susana/EP9038/TM/HSA_6 (2-1-5c)Bldg4163AP.cdr
Project:EP9038
Revised: 04/08/2011 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.5c
Building 4163
Aerial Photograph
1977

Y:/Santa_Susana/EP9038/TM/HSA_6 (2-1-6a)bldg4163AP.cdr
Project:EP9038
Revised: 10/20/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.6a
Building 4163, 4183, 4184, 4185, 4684
Site Photograph

Y:/Santa_Susana/EP9038/TM/HSA_6 (2-1-6b)bldg4183AP.cdr
Project:EP9038
Revised: 09/02/10 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Fire Pump Building

Figure 2.1.6b
Building 4183
Historical Photograph
1975

Y:/Santa_Susana/EP9038/TM/HSA_6 (2-1-7a)bldg4163AP.cdr
Project:EP9038
Revised: 10/20/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

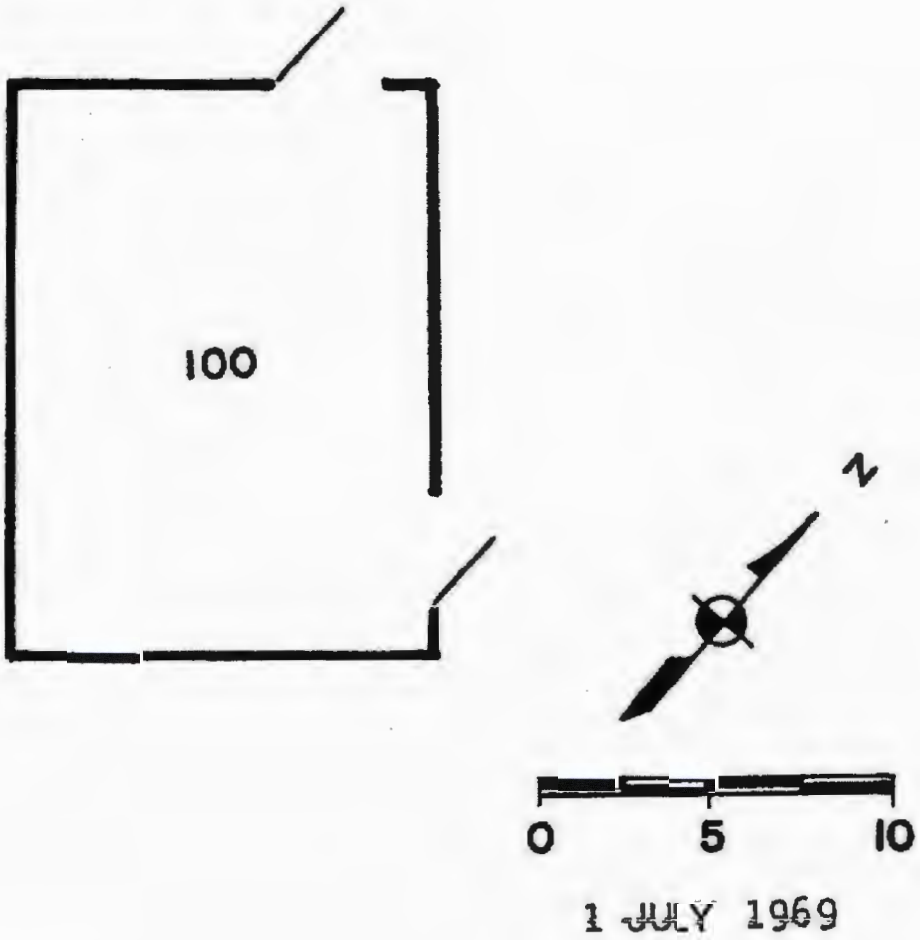
Figure 2.1.7a
Building 4163, 4183, 4184, 4185, 4684
Site Photograph

Y:/Santa_Susana/EP9038/TM/HSA_6 (2-1-8a)bldg4163AP.cdr
Project:EP9038
Revised: 04/08/2011 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.8a
Building 4163, 4183, 4184, 4185, 4684
Site Photograph

Figure Not to Scale



Y:/Santa_Susana/EP9038/TM/HSA_6 (2-1-8b)bldg4185FP.cdr
Project:EP9038
Revised: 09/02/10 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Steam Generator Control Building

Figure 2.1.8b
Building 4185
Floor Plan

Y:/Santa_Susana/EP9038/TM/HSA_6 (2-1-9a)Bldg4505Site4714AP.cdr
Project: EP9038
Revised: 10/20/2010 TJ
Source: Boeing Company, 2008

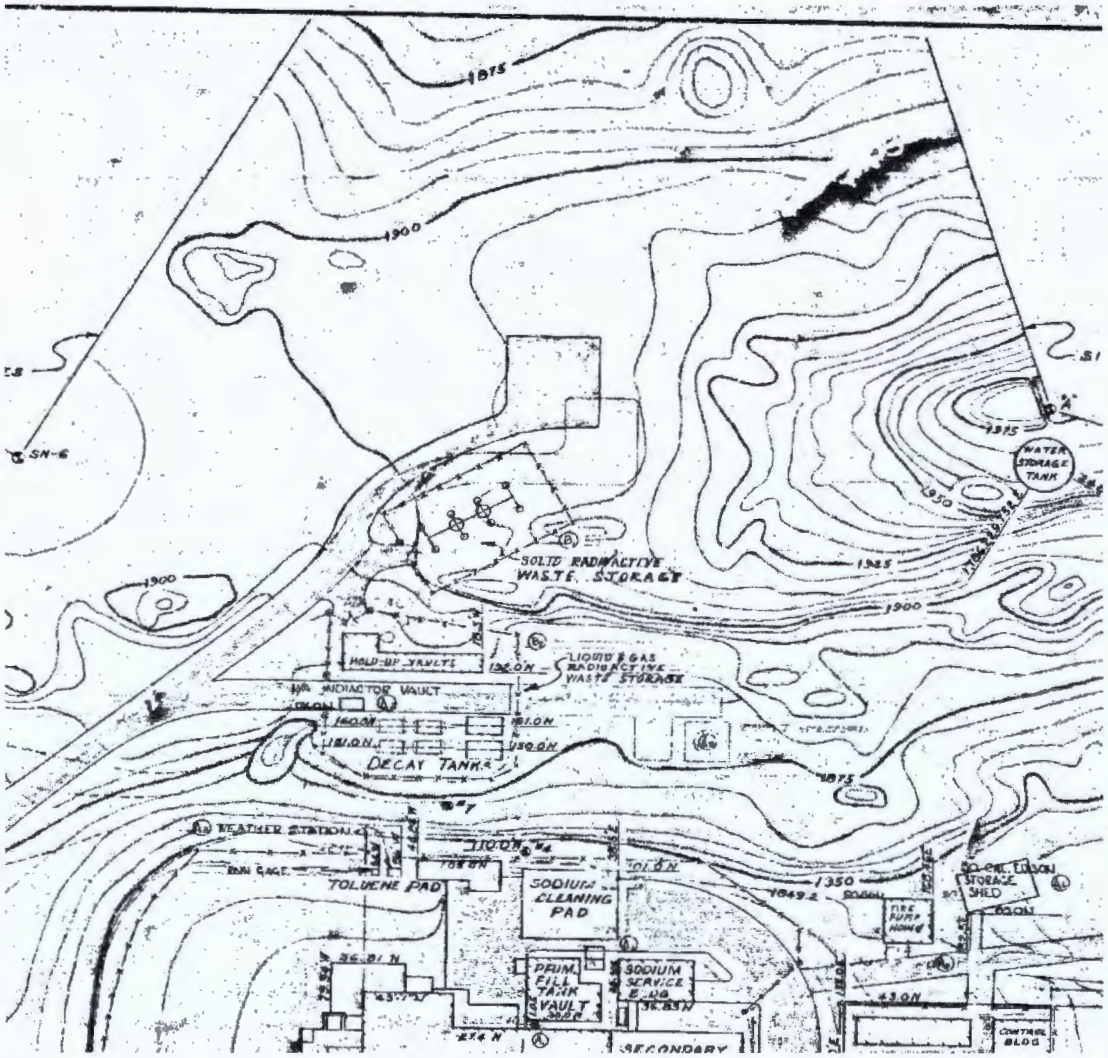
U.S. EPA Region 9

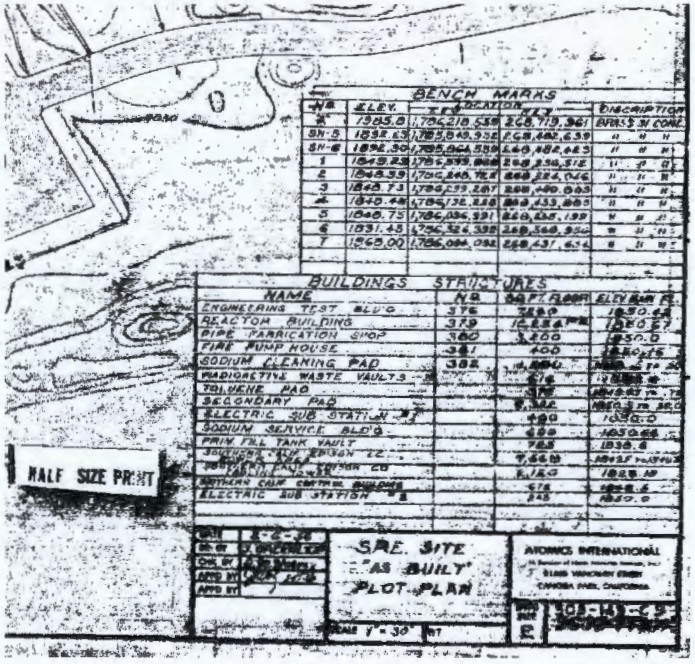
Figure 2.1.9a
Building 4505,
Site 4714
Site Photograph

Y:/Santa_Susana/EP9038/TM/HSA_6 (2-1-10a)Bldg4653AP.cdr
Project:EP9038
Revised: 10/27/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.10a
Building 4653
Site Photograph





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Revised: 04/25/2011 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.10b
Building 4653
Plot Plan

Y:/Santa_Susana/EP9038/TM/HSA_6 (2-1-10c)bldg4653TR.cdr
Project:EP9038
Revised: 05/23/11 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.10c
Building 4653
Tank Removal
1977

Y:/Santa_Susana/EP9038/TM/HSA_6 (2-1-11a)bldg4163AP.cdr
Project:EP9038
Revised: 04/08/2011 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.11a
Building 4163, 4183, 4184, 4185, 4684
Site Photograph

Y:/Santa_Susana/EP9038/TM/HSA_6 (2-1-12a)Bldg4686AP.cdr
Project:EP9038
Revised: 10/27/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.12a
Site 4686
Site Photograph

Y:/Santa_Susana/EP9038/TM/HSA_6 (2-1-13a)Bldg4689AP.cdr
Project:EP9038
Revised: 10/27/2010 TJ
Source: Boeing Company, 2008

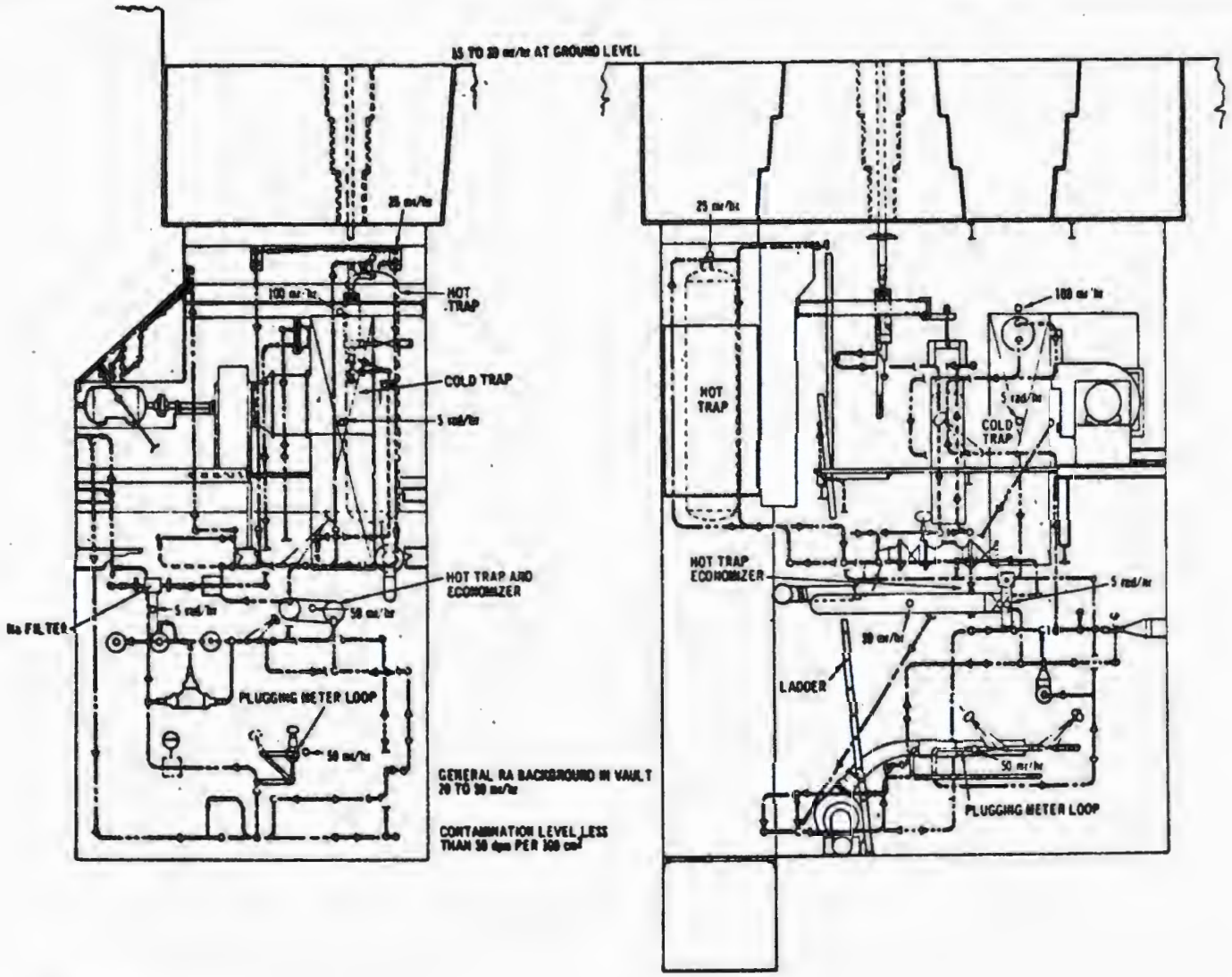
U.S. EPA Region 9

Figure 2.1.13a
Building 4689
Site Photograph

Y:/Santa_Susana/EP9038/TM/HSA_6 (2-1-14a)bldg4143AP.cdr
Project:EP9038
Revised: 04/08/2011 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.14a
Building 4143, 4153, 4695
Site Photograph



5-14-68

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Project:EP9038
Revised: 07/22/10 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Cold Trap Vault

Figure 2.1.14b
Building 4695
Elevation Views

Y:/Santa_Susana/EP9038/TM/HSA_6 (2-1-14c)bldg4695BD.cdr
Project:EP9038
Revised: 05/11/11 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.14c
Building 4695
Below-ground
Demolition
1978

Redacted

Y:/Santa_Susana/EP9038/TM/HSA_6 (2-1-15a)WT4703AP.cdr
Project:EP9038
Revised: 10/27/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.15a
Site 4703
Site Photograph

Y:/Santa_Susana/EP9038/TM/HSA_6 (2-1-16a)Bldg4505Site4714AP.cdr
Project:EP9038
Revised: 04/08/2011 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.16a
Building 4505,
Site 4714
Site Photograph

Redacted

Y:/Santa_Susana/EP9038/TM/HSA_6 (2-1-17a)Bldg4723AP.cdr
Project:EP9038
Revised: 10/27/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.17a
Site 4723
Site Photograph

Y:/Santa_Susana/EP9038/TM/HSA_6 (2-1-18a)Bldg4724AP.cdr
Project:EP9038
Revised: 10/27/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.18a
Building 4724
Site Photograph

Y:/Santa_Susana/EP9038/TM/HSA_6 (2-1-19a)Site4733_4743AP.cdr
Project:EP9038
Revised: 10/20/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.19a
Site 4733, 4743
Site Photograph

Y:/Santa_Susana/EP9038/TM/HSA_6 (2-1-20a)Site4733_4743AP.cdr
Project:EP9038
Revised: 04/08/2011 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.20a
Site 4733, 4743
Site Photograph

Y:/Santa_Susana/EP9038/TM/HSA_6 (2-1-21a)Bldg4753AP.cdr
Project:EP9038
Revised: 10/27/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

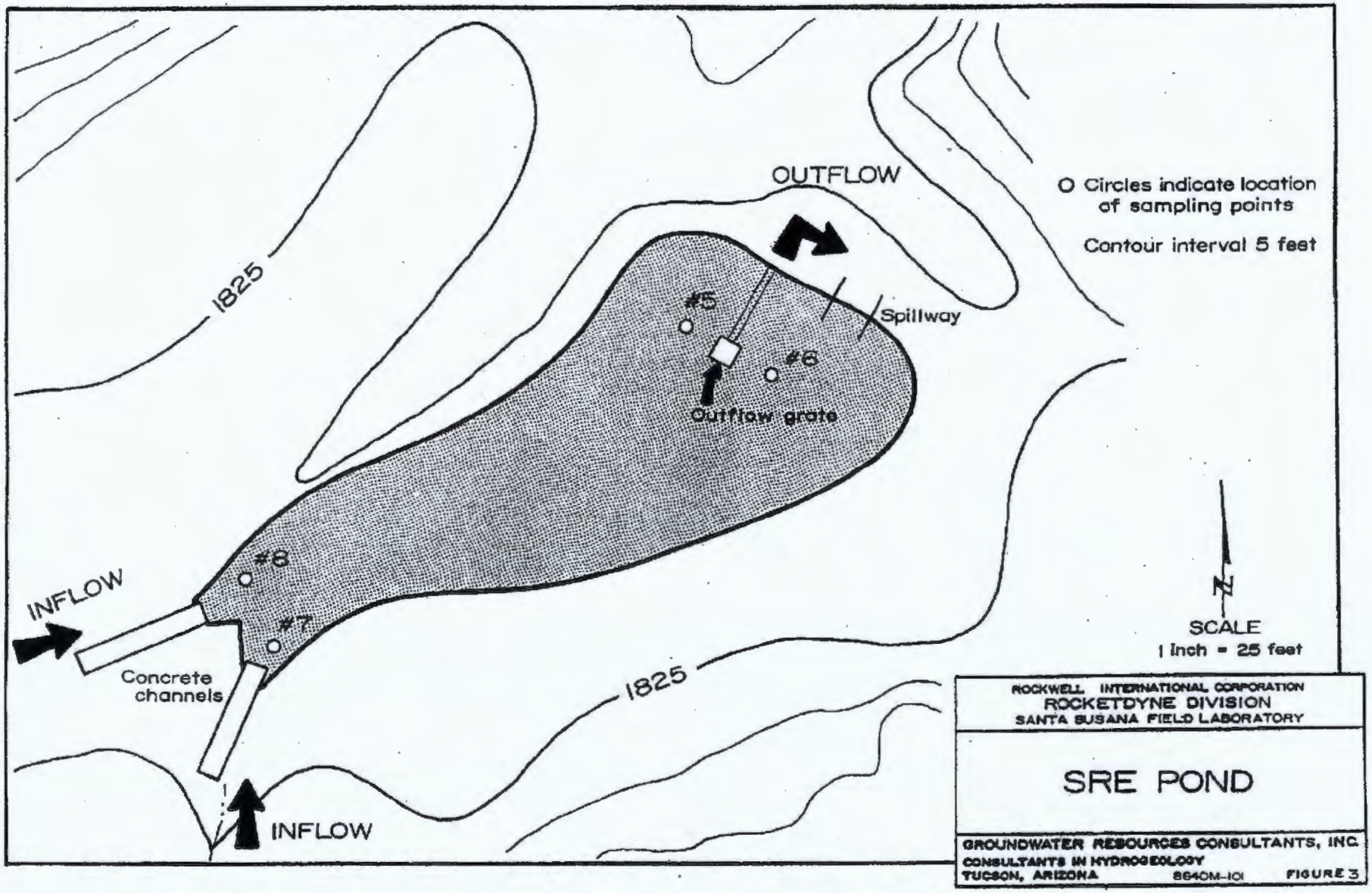
Figure 2.1.21a
Building 4753
Site Photograph

Y:/Santa_Susana/EP9038/TM/HSA_6 (2-1-22a)Pond4773AP.cdr
Project:EP9038
Revised: 10/20/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Sodium Reactor Experiment Pond

Figure 2.1.22a
Site 4773
Site Photograph



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Project:EP9038
Revised: 09/02/10 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Sodium Reactor Experiment Pond

Figure 2.1.22b
Site 4773
Pond

Y:/Santa_Susana/EP9038/TM/HSA_6 (2-1-22c)Site4773AP.cdr
Project:EP9038
Revised: 05/11/11 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.22c
Site 4773
1979 Photograph

Y:/Santa_Susana/EP9038/TM/HSA_6 (2-1-22d)Site4773PF.cdr
Project:EP9038
Revised: 05/11/11 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.22d
Site 4773
Pond in Foreground

Figure 2.2
Area IV Subarea 6-2
Santa Susana Field Laboratory

U.S. EPA Region 9

4-inch discharge from sump pump

TANK 4731
TANK 4732
Drain
OS
PROB DE
BLDG 4737
UT-28
SUMP
ESG STORAGE YARD
BLDG 4320
POND SITE 4773
LTMM
SUMP PUMP
LEACH FIELD
SEPTIC TANK
EJECTOR
6-IN CIP SEWER LINE
BLDG 4183
PAD 4684
PAD 4505
BLDG 4714
PAD 4723
BLDG 4688
4724
PA
BLDG 4163
BLDG 4143
UT-74
PROB DS
TRENCH
PIT
BLDG 4003
HOT CAVE
5-GAL BOTTLE
SUMP
BLDG 4825
4693
4283
RADIOACTIVE LAUNDRY
4316
4273
RADIOACTIVE LAUNDRY
4763
4063
4783
F Street
Gutter
E Street
G Street
BLDG 4624
ASH PILE
BLDG 4040
BLDG 4014
BLDG 4043
BLDG 4033
BLDG 4053
BLDG 4333
W
SD
SS
G

Legend

- Subarea 6-1 Boundary
- Primary Roads
- Secondary Roads
- Tertiary Roads
- Underground Storage Tank
- Unknown Tank Type
- French Drain Holding Tank
- Sump
- Dry Well
- Tank Footprint
- Above ground Storage Tank
- Demolished Bldg.
- Existing Bldg.
- Parking Lots
- Drainage
- Drainage Ditch
- Interview Line
- Offsite Seeps and Springs
- Onsite Seeps and Springs
- Drain
- Well

B	Building
CA	Cleared Area
CONT	Container
CR	Crates
DB	Debris
DG	Disturbed Ground
DTM	Dark Tone Material
EX	Excavation
FA	Fill Area
GR	Graded
GS	Ground Scar
HT	Horizontal Tank
IM	Impoundment
LTMM	Light Toned Mounded Material
MTMM	Medium Toned Mounded Material
OS	Open Storage
PA	Processing Area
PL	Pipeline
POSS	Possible
PROB	Probable
SS	Smoke Stack
ST	Stain
S-T	Storage Tank
UO	Unidentified Object
UT	Underground Tank
VT	Vertical Tank
WDA	Waste Disposal Area

Aerial Photography Data

- Aerial Photography Features
- Septic Tank
- Leach Field
- Parking Lots

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
- Water (Removed)
- Water (Removed)
- Pipes (Unknown Type)
- Pipes (Unknown Type)
- Gas
- Storm Drain
- Sanitary Sewer
- Water

Surface Water Flow (From Boeing Database, 2008)

N

0 25 50 100
Scale In Feet

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Created: TJansen
Revised: 04/28/2011 TJ
Sorce: Boeing Company, 2008
CIRGIS, 2007

HGL HydroGeoLogic, Inc.

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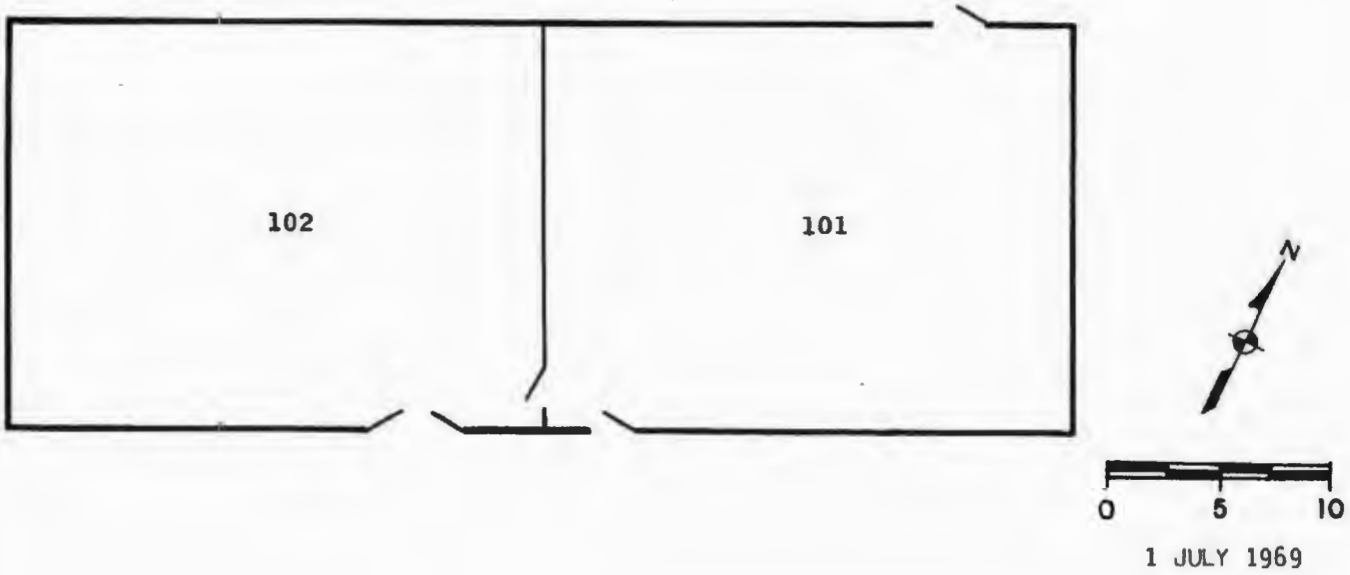
Project:EP9038
Revised: 10/20/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.2.1a
Building 4063
Site Photograph



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Project:EP9038
Revised: 09/02/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Maintenance Service Building

Figure 2.2.1b
Building 4063
Floor Plan

Y:/Santa_Susana/EP9038/TM/HSA_i-(2-2-1c)Bldg4063PP.cdr
Project:EP9038
Revised: 04/08/2011 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.2.1c
Building 4063
Plot Plan

Y:/Santa_Susana/EP9038/TM/HSA_6 (2-2-2a)Bldg44273AP.cdr
Project:EP9038
Revised: 10/27/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.2.2a
Building 4273
Site Photograph

Y:/Santa_Susana/EP9038/TM/HSA_6 (2-2-3a)Bldg4283AP.cdr
Project:EP9038
Revised: 10/27/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.2.3a
Building 4283
Site Photograph

Figure 2.3
Area IV Subarea 6-3
Santa Susana Field Laboratory

U.S. EPA Region 9

Legend

Subarea 6-1 Boundary		B	Building
Primary Roads		CA	Cleared Area
Secondary Roads		CONT	Container
Tertiary Roads		CR	Crates
Underground Storage Tank		DB	Debris
Unknown Tank Type		DG	Disturbed Ground
French Drain Holding Tank		DTM	Dark Tone Material
Sump		EX	Excavation
Dry Well		FA	Fill Area
Tank Footprint		GR	Graded
Above ground Storage Tank		GS	Ground Scar
Demolished Bldg.		HT	Horizontal Tank
Existing Bldg.		IM	Impoundment
Parking Lots		LTMM	Light Toned Mounded Material
Drainage		MTMM	Medium Toned Mounded Material
Drainage Ditch		OS	Open Storage
Interview Line		PA	Processing Area
Offsite Seeps and Springs		PL	Pipeline
Onsite Seeps and Springs		POSS	Possible
Drain		PROB	Probable
Well		SS	Smoke Stack
		ST	Stain
		S-T	Storage Tank
		UO	Unidentified Object
		UT	Underground Tank
		VT	Vertical Tank
		WDA	Waste Disposal Area

Aerial Photography Data

- Aerial Photography Features
- Septic Tank
- Leach Field
- Parking Lots

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
- Water (Removed)
- Water (Removed)
- Pipes (Unknown Type)
- Pipes (Unknown Type)
- Gas
- Storm Drain
- Sanitary Sewer
- Water

Surface Water Flow (From Boeing Database, 2008)

N

0 25 50 100
Scale In Feet

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Created: TJansen
Revised: 04/28/2011 TJ
Sorce: Boeing Company, 2008
CIRGIS, 2007

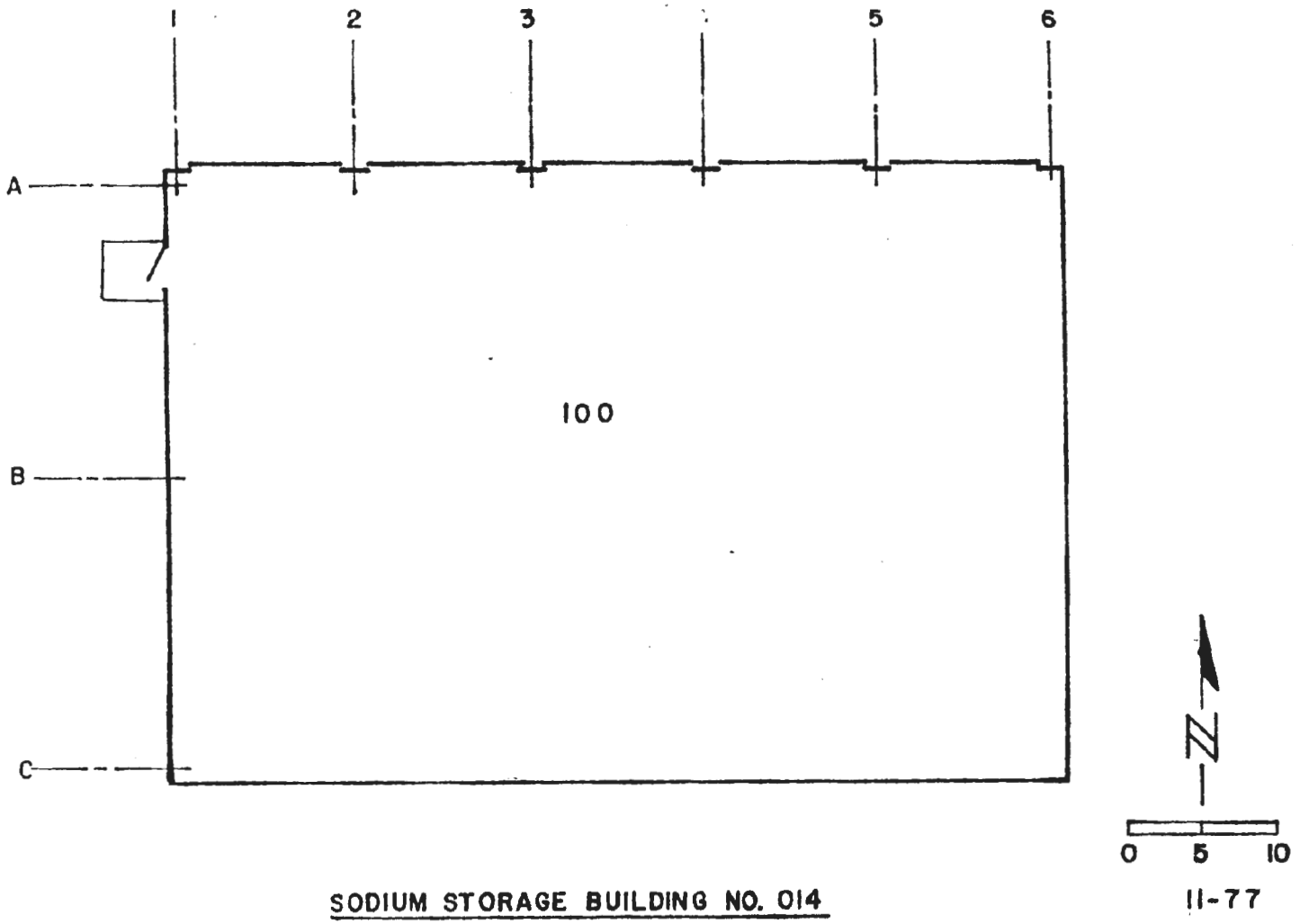
HGL HydroGeoLogic, Inc

Redacted

Y:/Santa_Susana/EP9038/TM/HSA_6 (2-3-1a)Bldg4014AP.cdr
Project:EP9038
Revised: 10/27/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.3.1a
Building 4014, 4053
Site Photograph



SODIUM STORAGE BUILDING NO. 014

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(2-3-1b)bldg4014FP.cdr
Project:EP9038
Revised: 05/11/11 TJ
Source: Boeing Company, 2008

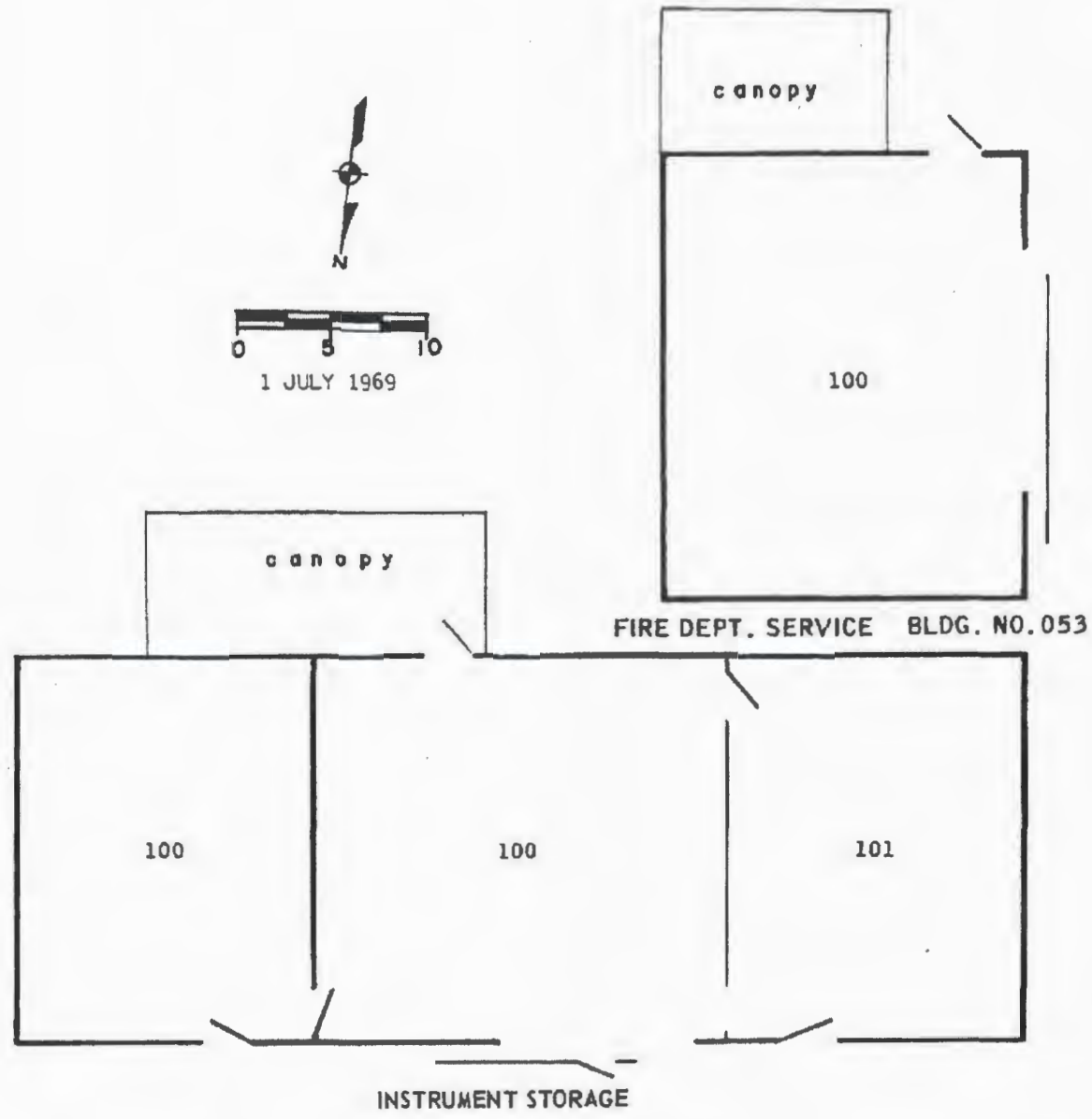
U.S. EPA Region 9

Figure 2.3.1b
Building 4014
Floor Plan

Y:/Santa_Susana/EP9038/TM/HSA_6 (2-3-2a)Bldg4014AP.cdr
Project:EP9038
Revised: 04/08/2011 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.3.2a
Building 4014, 4053
Site Photograph



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Project:EP9038
Revised: 09/01/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

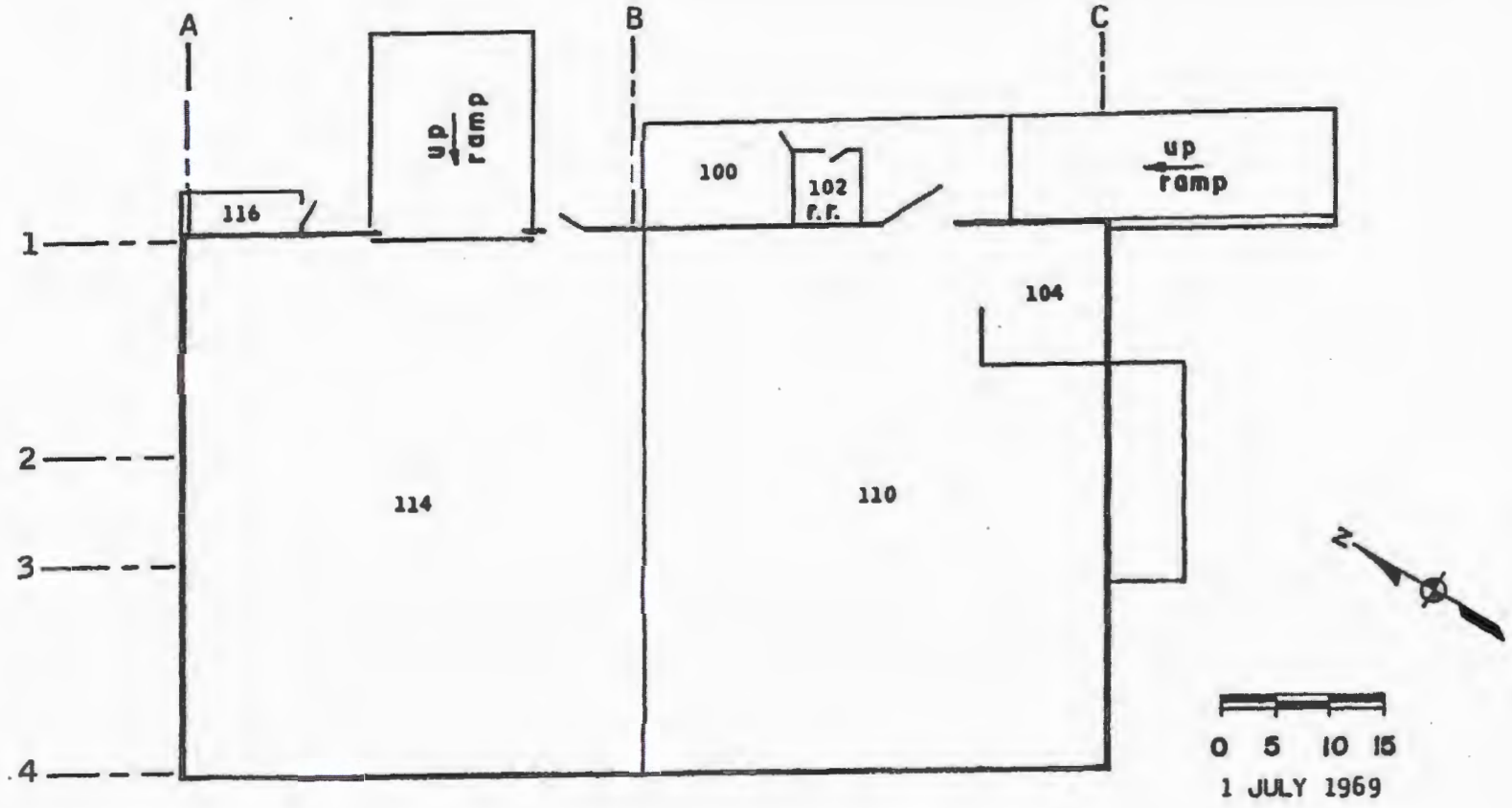
Fire Department and Instrument Storage Buildings

Figure 2.3.2b
Building 4053
Floor Plan

Y:/Santa_Susana/EP9038/TM/HSA_6 (2-3-3a)Bldg4064AP.cdr
Project:EP9038
Revised: 10/20/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.3.3a
Building 4064
Site Photograph



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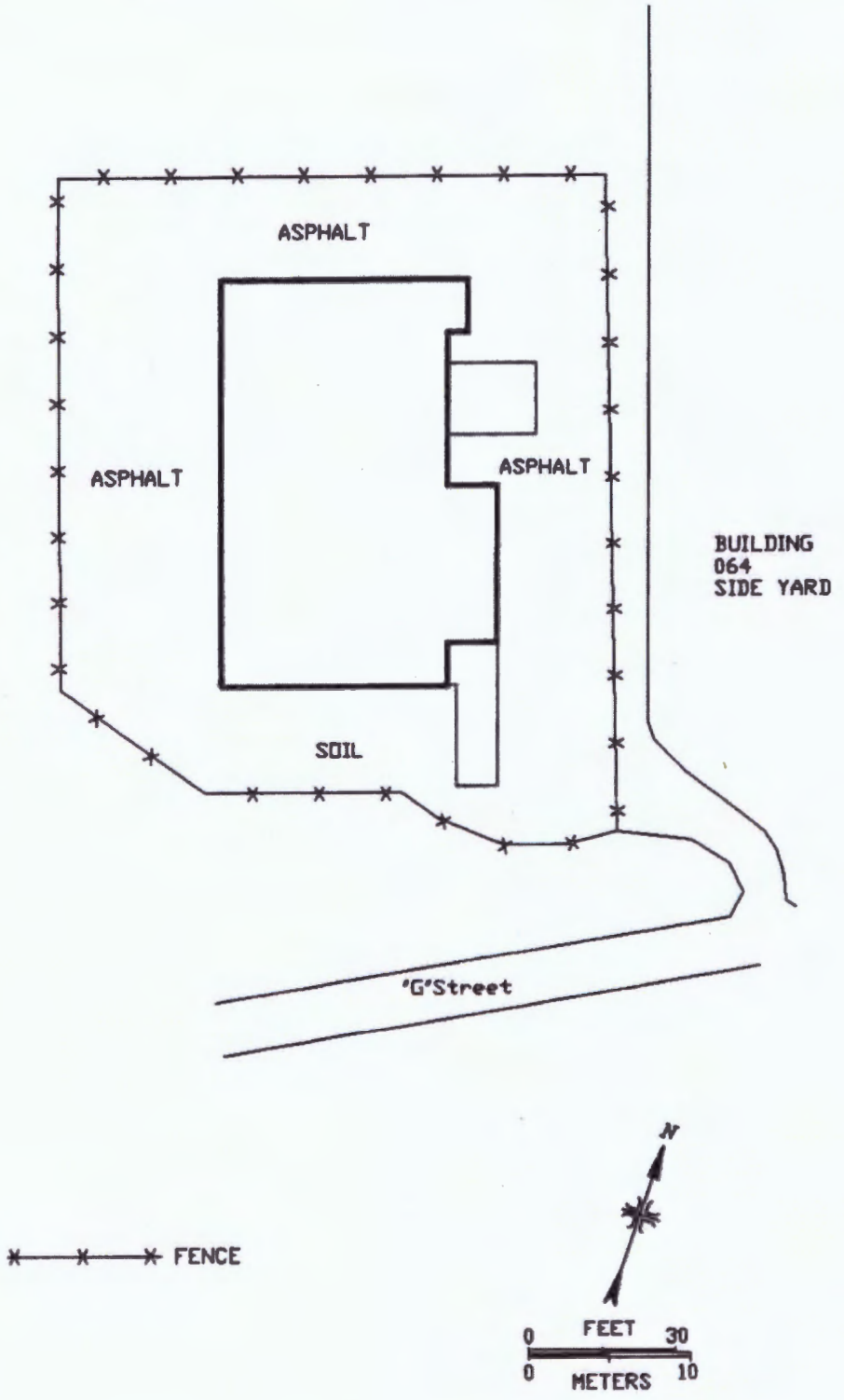
Project:EP9038
Revised: 09/02/10 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Fuel Element Storage Facility

Figure 2.3.3b
Building 4064
Floor Plan



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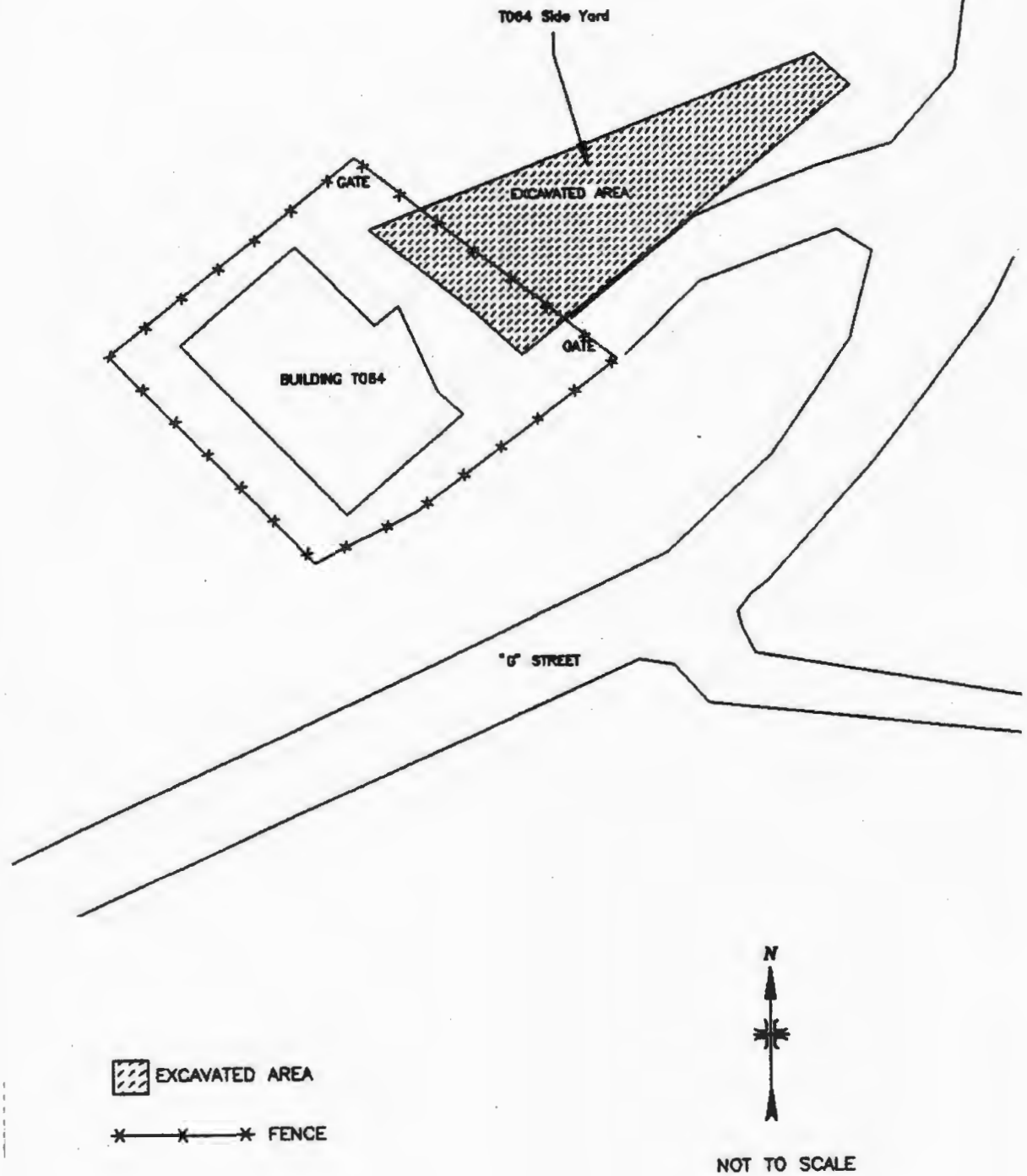
Project:EP9038
Revised: 09/02/2010
Source: Boeing Company, 2008

U.S. EPA Region 9

Fuel Element Storage Facility

Figure 2.3.3c
Building 4064
Fenced Area



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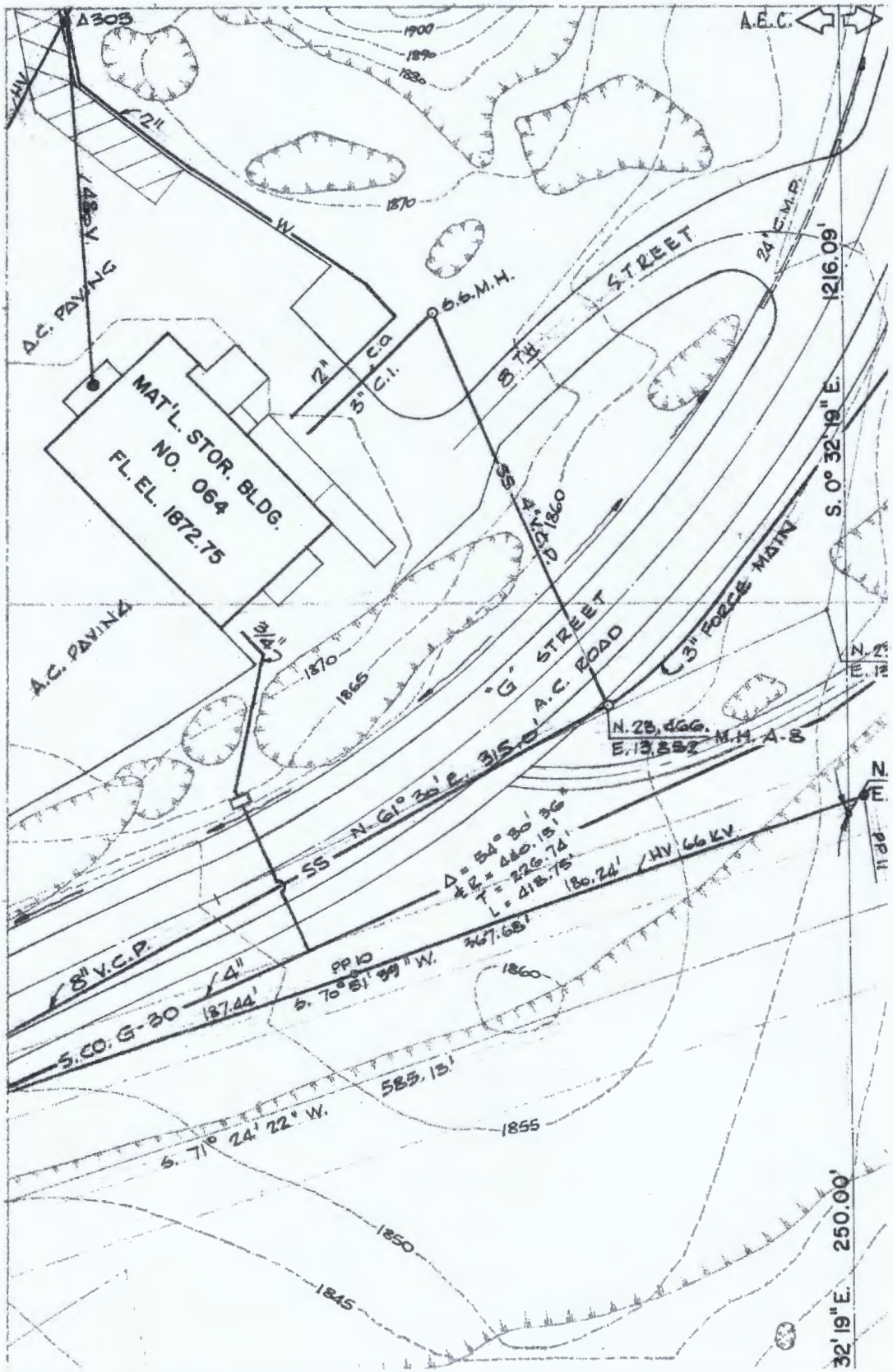
Project: EP9038
Revised: 09/27/2010 TJ
Source: Boeing Compa/ny, 2008

U.S. EPA Region 9

Fuel Element Storage Facility

Figure 2.3.3d
Building 4064
Side Yard



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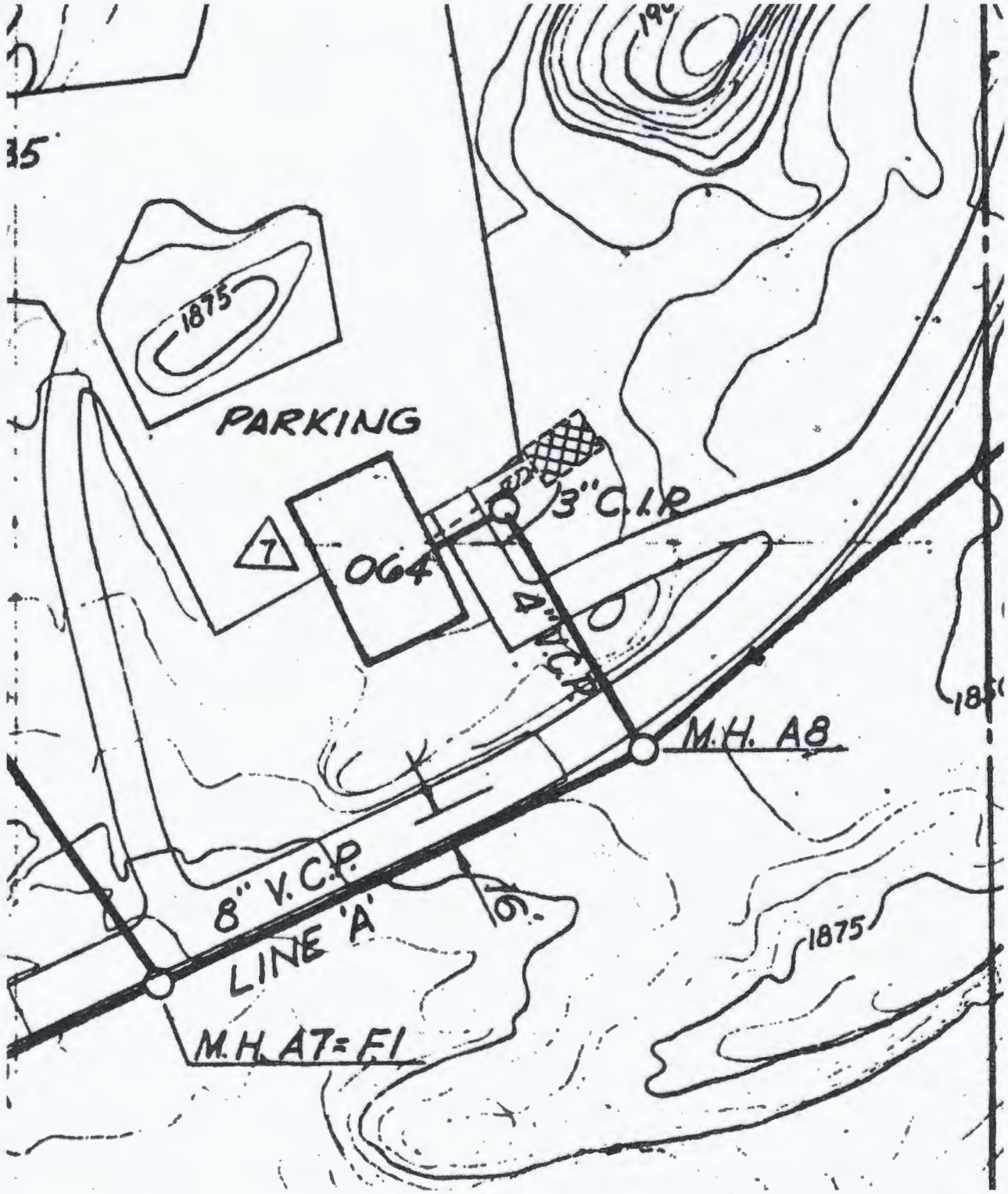
Project:EP9038
Revised: 04/08/2011 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.3.3e
Building 4064
Plot Plan



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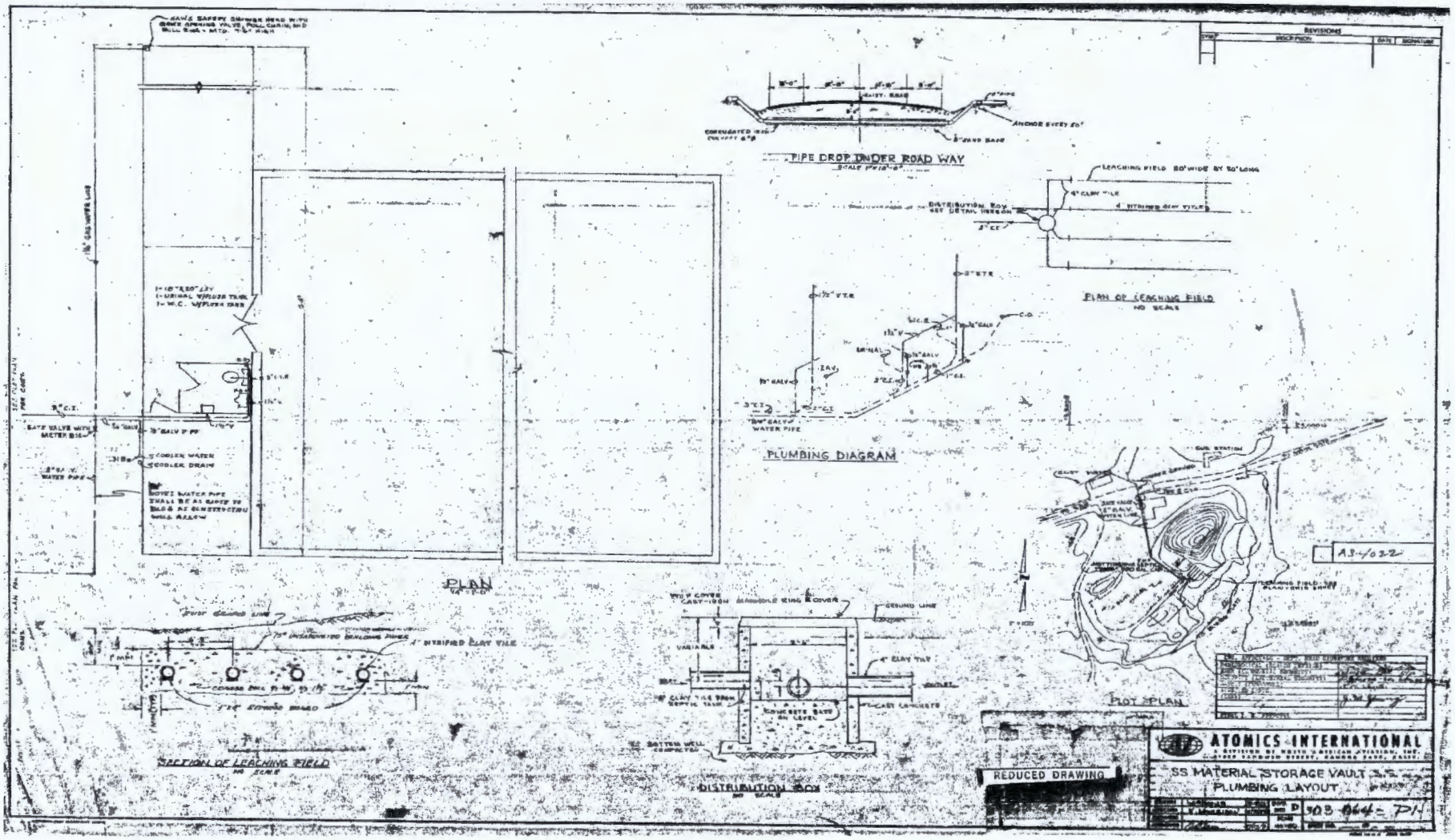
Revised: 04/08/2011 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.3.3f
Building 4064
Sewage System



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Project:EP9038
Revised: 04/08/2011 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.3.3g
Building 4064
Plumbing Layout

Redacted

Y:/Santa_Susana/EP9038/TM/HSA_6 (2-3-4a)Site4513AP.cdr
Project:EP9038
Revised: 10/27/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.3.4a
Parking Lot 4513
Site Photograph

Historical Site Assessment
Final Technical Memorandum - HSA-6

Figure 2.4
Area IV Subarea 6-4
Santa Susana Field Laboratory

U.S. EPA Region 9

Legend

- Subarea 6-1 Boundary
- Primary Roads
- Secondary Roads
- Tertiary Roads
- Underground Storage Tank
- Unknown Tank Type
- French Drain Holding Tank
- Sump
- Dry Well
- Tank Footprint
- Above ground Storage Tank
- Demolished Bldg.
- Existing Bldg.
- Parking Lots
- Drainage
- Drainage Ditch
- Interview Line
- Offsite Seeps and Springs
- Onsite Seeps and Springs
- Drain
- Well

Aerial Photography Data

- Aerial Photography Features
- Septic Tank
- Leach Field
- Parking Lots

Surface Water

- Intermittent Stream
- Permanent Stream
- Surface Water
- Lined Channel
- French Drain
- Drainage
- Leach Field
- Septic System

B	Building
CA	Cleared Area
CONT	Container
CR	Crates
DB	Debris
DG	Disturbed Ground
DTM	Dark Tone Material
EX	Excavation
FA	Fill Area
GR	Graded
GS	Ground Scar
HT	Horizontal Tank
IM	Impoundment
LTMM	Light Toned Mounded Material
MTMM	Medium Toned Mounded Material
OS	Open Storage
PA	Processing Area
PL	Pipeline
POSS	Possible
PROB	Probable
SS	Smoke Stack
ST	Stain
S-T	Storage Tank
UO	Unidentified Object
UT	Underground Tank
VT	Vertical Tank
WDA	Waste Disposal Area

Utilities

- Channel
- Drain
- Drain
- Drainage Divide
- Gutter
- Tank
- Tank
- Vault
- Well
- Water (Removed)
- Water (Removed)
- Pipes (Unknown Type)
- Pipes (Unknown Type)
- Gas
- Storm Drain
- Sanitary Sewer
- Water

Surface Water Flow (From Boeing Database, 2008)

0 25 50 100
Scale In Feet

N

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Project: EP9038
Created: TJansen
Revised: 04/28/2011 TJ
Sorce: Boeing Company, 2008
CIRGIS, 2007

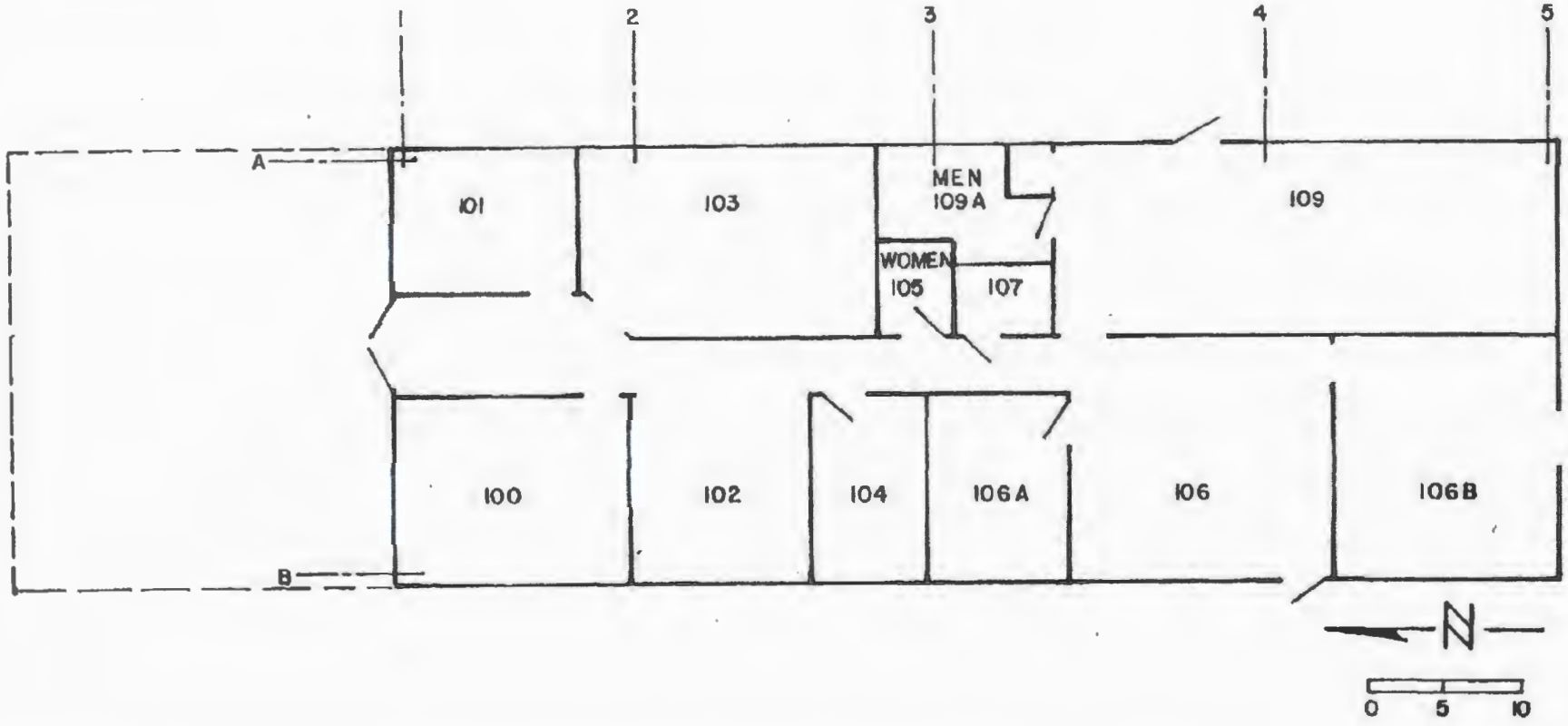
HGL HydroGeoLogic, Inc.

Redacted

Y:/Santa_Susana/EP9038/TM/HSA_6 (2-4-1a)Bldg4040AP.cdr
Project:EP9038
Revised: 10/20/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.4.1a
Building 4040
Site Photograph



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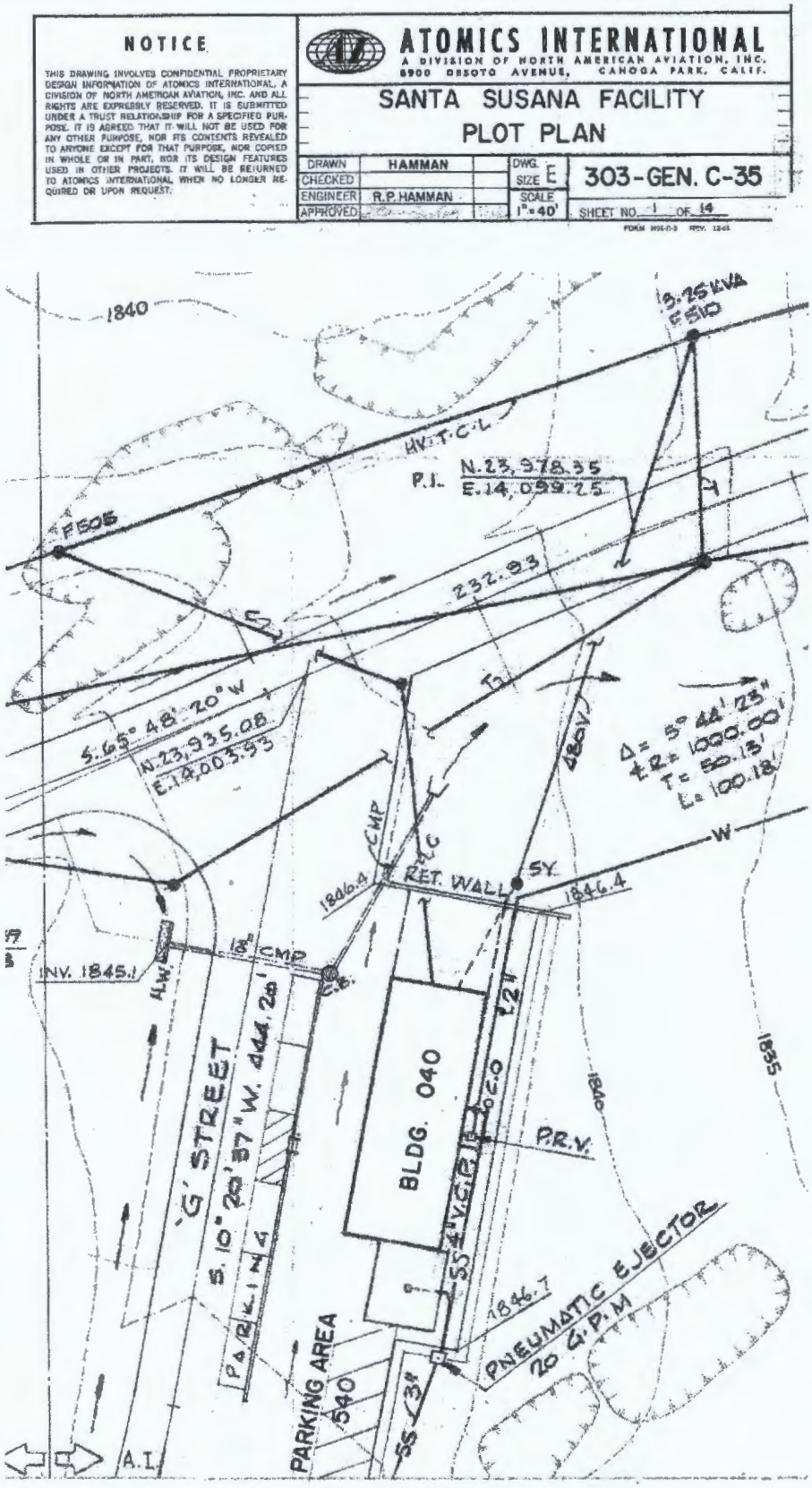
Project:EP9038
Revised: 09/02/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Contaminated Medical/Storage Facility

Figure 2.4.1b
Building 4040
Floor Plan



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(2-4-1c)Bldg4040PP.cdr
Project:EP9038
Revised: 04/08/2011 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.4.1c
Building 4040
Plot Plan

Redacted

Y:/Santa_Susana/EP9038/TM/HSA_6 (2-4-2a)Bldg4114AP.cdr
Project:EP9038
Revised: 10/20/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.4.2a
Building 4114
Site Photograph

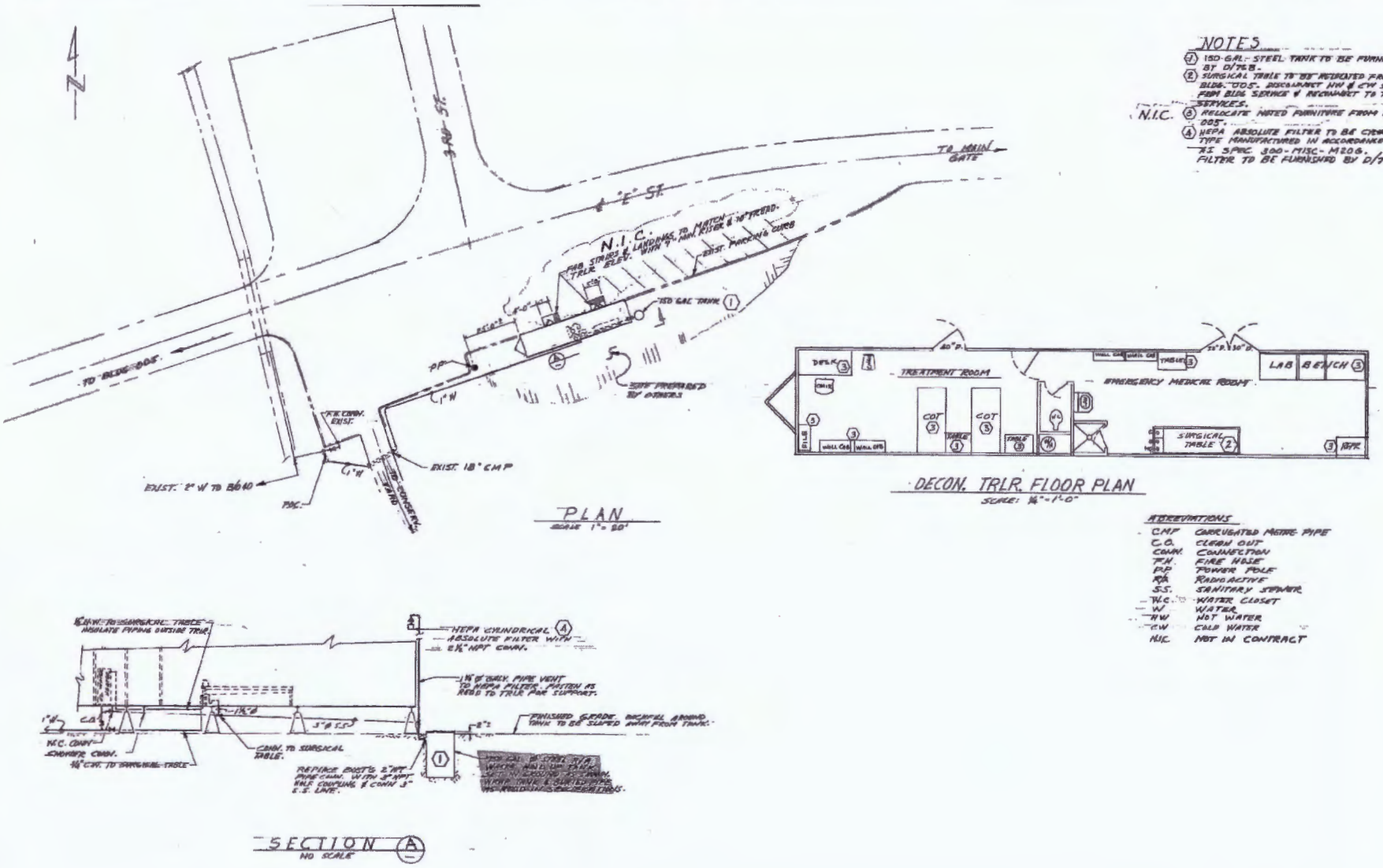

Figure Not to Scale

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Redacted

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Project:EP9038
Revised: 10/27/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.4.3a
Parking Lot 4511
Site Photograph

Y:/Santa_Susana/EP9038/TM/HSA_6 (2-4-4a)Site4540AP.cdr
Project:EP9038
Revised: 10/27/2010 TJ
Source: Boeing Company, 2008

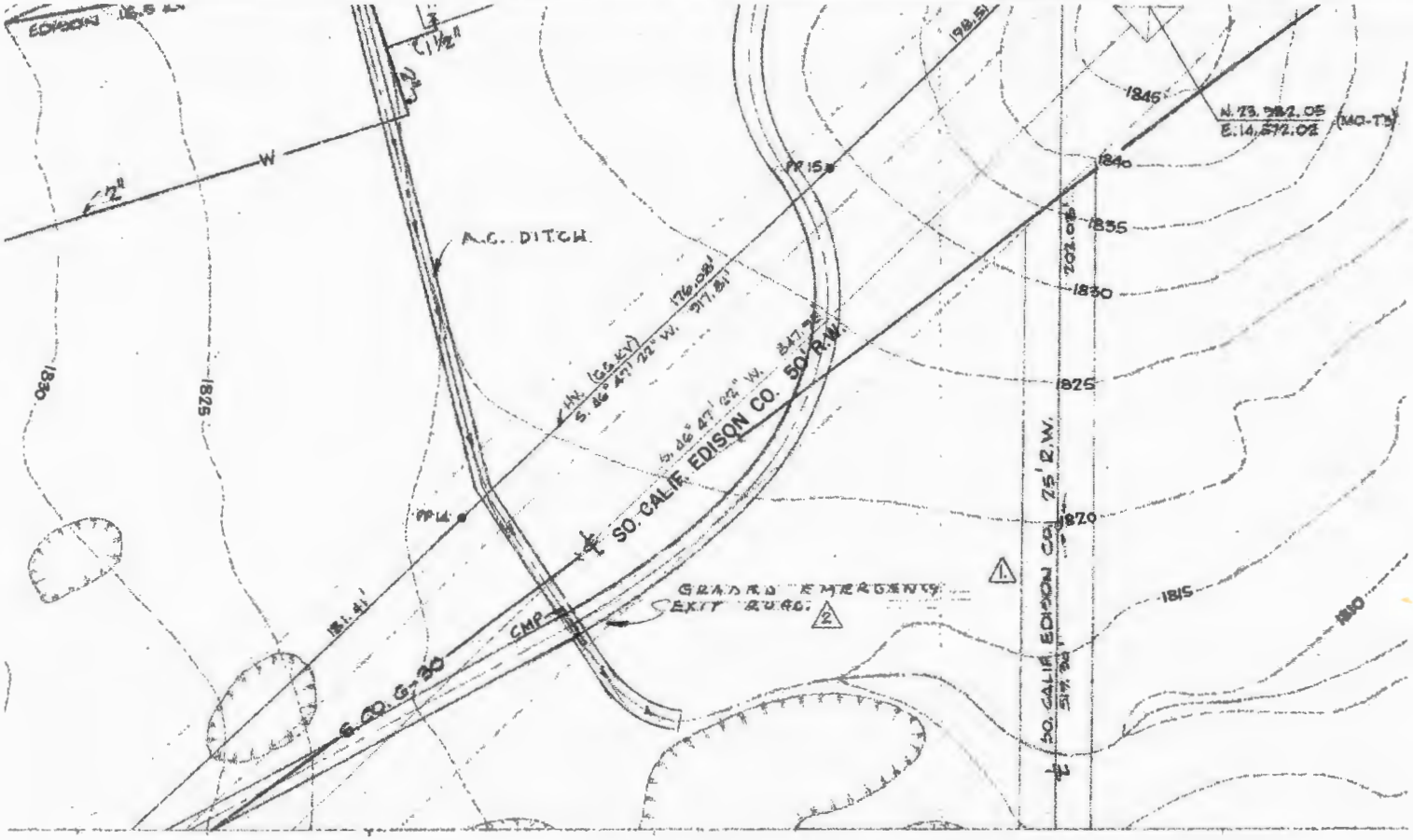
U.S. EPA Region 9

Figure 2.4.4a
Parking Lot 4540
Site Photograph

Y:/Santa_Susana/EP9038/TM/HSA_6 (2-4-5a)Site4583AP.cdr
Project:EP9038
Revised: 10/27/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.4.5a
Site 4583-New
Site Photograph



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8900 DESOTO AVENUE, CANOGA PARK, CALIF.

SANTA SUSANA FACILITY
PLOT PLAN

DRAWN	HAMMAN	DWG. SIZE E	303-GEN. C-35
CHECKED			
ENGINEER	R.P. HAMMAN	SCALE 1"=40'	
APPROVED			SHEET NO. 1 OF 14

FORM MM-83 REV. 1261

Y:/Santa_Susana/EP9038/TM/HSA_6 (2-4-5b)BldgSite4583PP.cdr
Project:EP9038
Revised: 04/08/2011 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.4.5b
Site 4583-New Plot Plan

Figure 2.5
Area IV Subarea 6-5
Santa Susana Field Laboratory

U.S. EPA Region 9

Legend

Subarea 6-1 Boundary	
Primary Roads	
Secondary Roads	
Tertiary Roads	
Underground Storage Tank	
Unknown Tank Type	
French Drain Holding Tank	
Sump	
Dry Well	
Tank Footprint	
Above ground Storage Tank	
Demolished Bldg.	
Existing Bldg.	
Parking Lots	
Drainage	
Drainage Ditch	
Interview Line	
Offsite Seeps and Springs	
Onsite Seeps and Springs	
Drain	
Well	

B	Building
CA	Cleared Area
CONT	Container
CR	Crates
DB	Debris
DG	Disturbed Ground
DTM	Dark Tone Material
EX	Excavation
FA	Fill Area
GR	Graded
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HT	Horizontal Tank
IM	Impoundment
LTMM	Light Toned Mounded Material
MTMM	Medium Toned Mounded Material
OS	Open Storage
PA	Processing Area
PL	Pipeline
POSS	Possible
PROB	Probable
SS	Smoke Stack
ST	Stain
S-T	Storage Tank
UO	Unidentified Object
UT	Underground Tank
VT	Vertical Tank
WDA	Waste Disposal Area

Aerial Photography Data

- Aerial Photography Features
- Septic Tank
- Leach Field
- Parking Lots

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
- Water (Removed)
- Water (Removed)
- Pipes (Unknown Type)
- Pipes (Unknown Type)
- Gas
- Storm Drain
- Sanitary Sewer
- Water

Surface Water Flow (From Boeing Database, 2008)

N

0 25 50 100
Scale In Feet

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Project: EP9038
Created: TJansen
Revised: 04/28/2011 TJ
Sorce: Boeing Company, 2008
CIRGIS, 2007

HGL HydroGeoLogic, Inc.

Redacted

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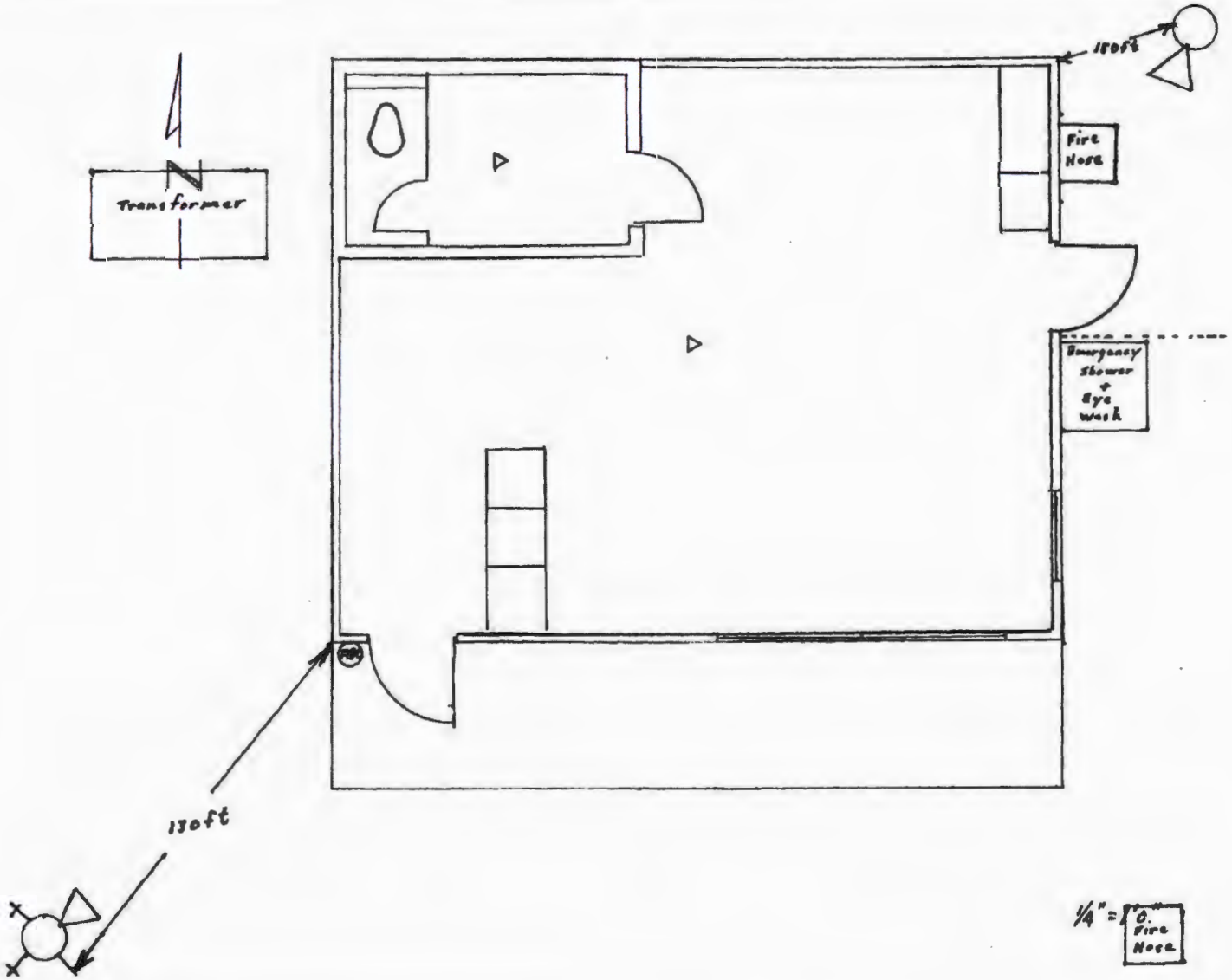
Project:EP9038
Revised: 10/20/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.5.1a
Building 4320
Site Photograph

Figure Not to Scale



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Project:EP9038
Revised: 09/02/10 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Fuel Oil Control/Pump Building

Figure 2.5.1b
Building 4320
Floor Plan

Y:/Santa_Susana/EP9038/TM/HSA_6 (2-5-2a)Site4583AP.cdr
Project:EP9038
Revised: 10/27/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.5.2a
Site 4583-Old
Site Photograph

Y:/Santa_Susana/EP9038/TM/HSA_6 (2-5-2b)Site4583HP.cdr
Project:EP9038
Revised: 0530/2011 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.5.2b
Site 4583-Old
Historical Photograph
1963

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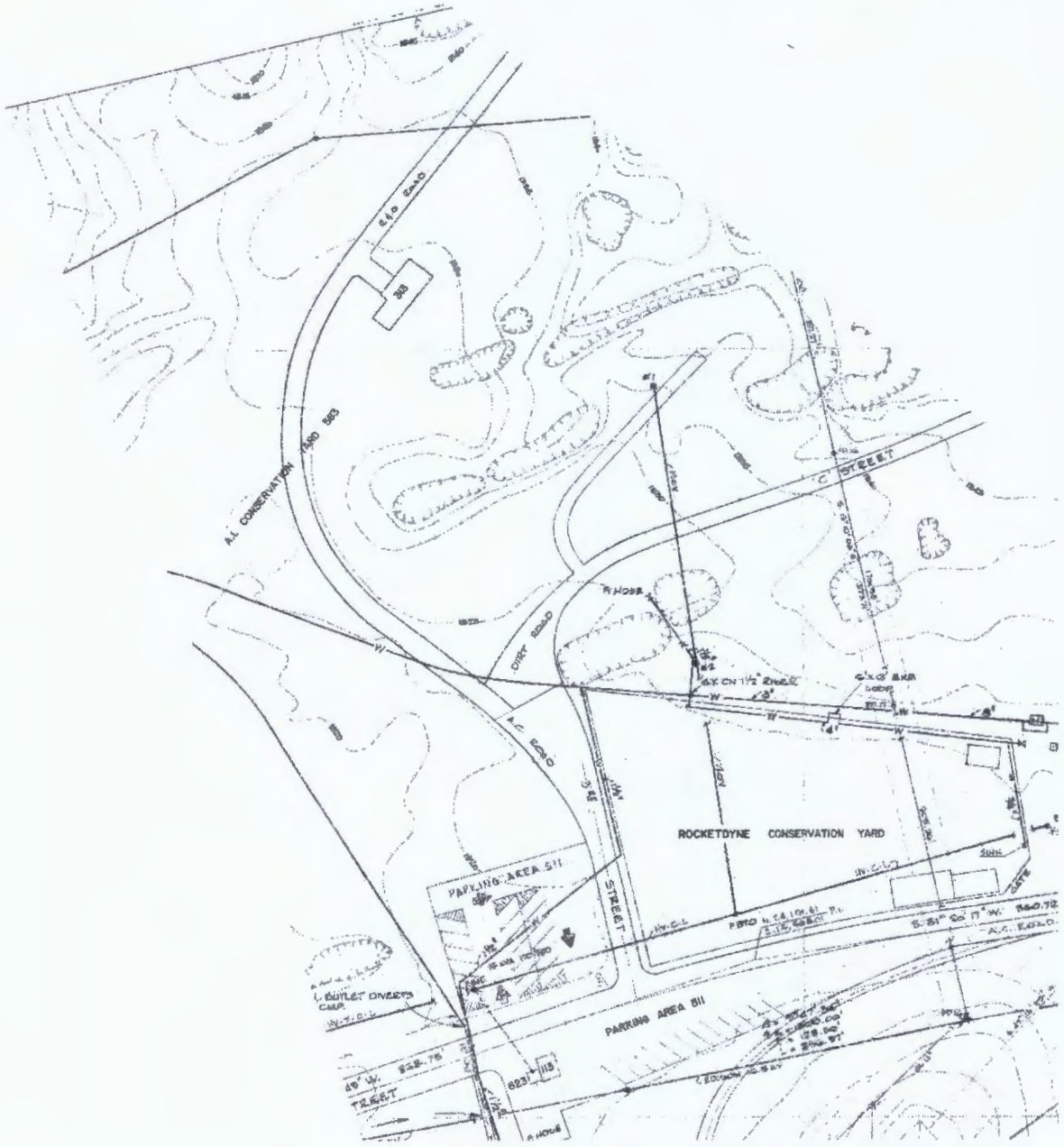
SANTA SUSANA FACILITY
PLOT PLAN

DRAWN	HAMMAN	DWG. SIZE E	303-GEN. C-35
CHECKED			
ENGINEER	R.P. HAMMAN	SCALE 1"=40'	
APPROVED			SHEET NO. 1 OF 14

FORM NSI-7-3 REV. 1961



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Project:EP9038
Revised: 04/08/2011 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

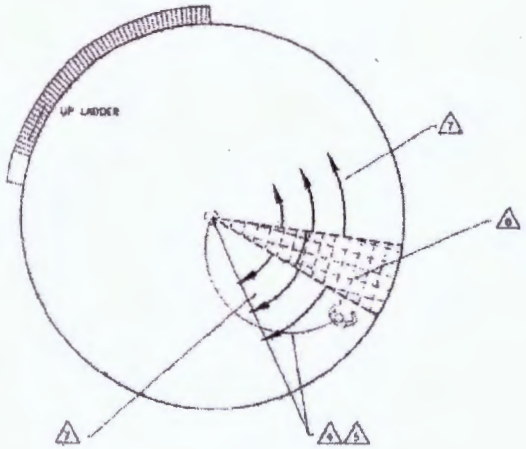
Figure 2.5.2c
Site 4583-Old
Plot Plan

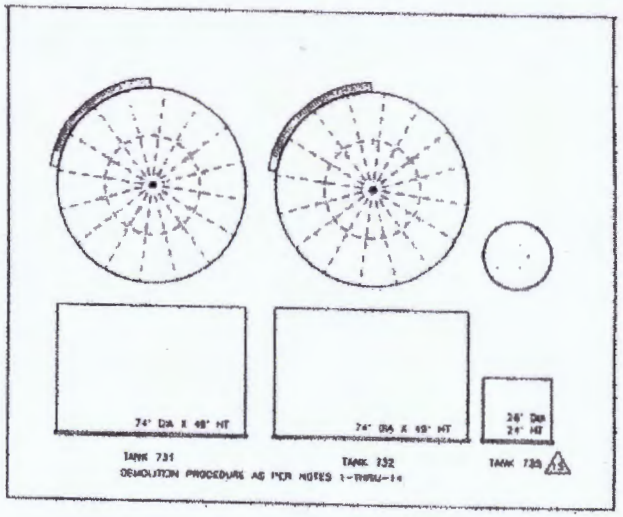
Y:/Santa_Susana/EP9038/TM/HSA_6 (2-5-3a)Site4731AP.cdr
Project:EP9038
Revised: 10/27/2010 TJ
Source: Boeing Company, 2008

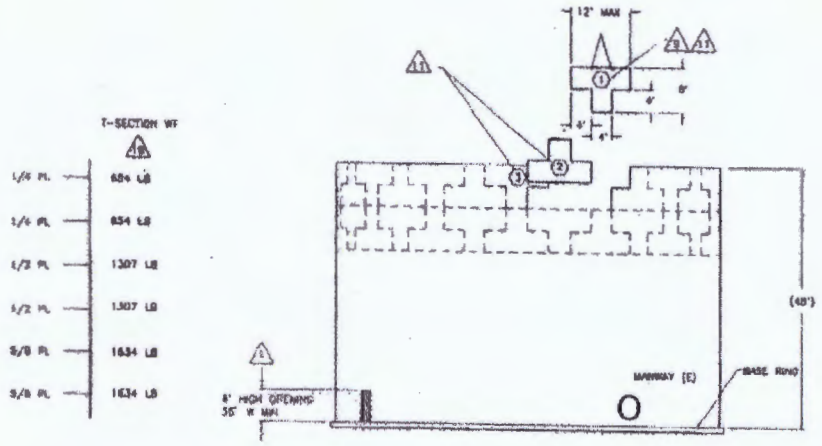
U.S. EPA Region 9

Figure 2.5.3a
Site 4731
Site Photograph

Figure Not to Scale







16 PLATE THICKNESS ESTIMATED AND DENOTE TYPICAL TANK PLATE THICKNESSES.
15 TANK 135 DEMOLITION: CUT INTO LARGE PIECES AT DISCRETION OF CONTRACTOR
14 STEP #10 LIFT TANK BOTTOM AND INSPECT FOR PRESENCE OF HARMFUL AND/OR DANGEROUS VAPORS BEFORE CUTTING.
13 STEP #9 REMOVE ALL SCRAP AND DEBRIS FROM TANK BOTTOM.
12 STEP #8: FABRICATE LIFT BRACKETS ALONG EDGE OF TANK BOTTOM.
11 NUMBER INDICATES SEQUENCED PLATE REMOVAL FOR DRAWING PURPOSES ONLY
10 REPEAT FOR NEXT LEVEL, THEN FOR NEXT.
9 REMOVE T-SHAPED SECTIONS AS SHOWN CLOCKWISE STARTING AT UPPERMOST TANK RING
8 STEP #7 REMOVE VERTICAL BULKHEAD PLATES AS PER DETAIL.
7 CONTINUE TANK ROOF DEMOLITION, REMOVING 30° SECTORS IN ALTERNATE SEQUENCE FROM FIRST CUT. ALL ROOF WORK SHALL PROCEED FROM POINTS FURTHEST FROM LADDER TOWARD LADDER.
6 STEP #6 REMOVE TANK ROOF AREA, APPROX. 30° SECTOR, IN 3-FT SECTIONS, STARTING AT ROOF EDGE, WORKING TOWARD CENTER.
5 STEP #5 SECURE OPERATOR(S) TO SHACKLE
4 STEP #4: ATTACH 3-1/2" SHACKLE FROM WINCH TO SECURE MINIMUM 5/8" NYLON ROPE OR "SAFETY LINE".
3 STEP #3 INSURE TANK BOTTOM IS CLEAR FOR TANK EGRESS.
2 STEP #2 POST FIRE WATCH AT BOTH OPENINGS AS NEED FOR FLAME CUTTING OPERATIONS
1 STEP #1 REMOVE TWO (2 EA) BOTTOM SECTIONS AS FOLLOWS:
90-DEGREES TO TANK MANWAY
180-DEGREES APART

DEMOLITION NOTES: UNLESS OTHERWISE SPECIFIED

Y:/Santa_Susana/EP9038/TM/HSA_6 (2-5-3b)bldg4731DD.cdr
Project:EP9038
Revised: 09/02/10 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Fuel Oil Storage Tank

Figure 2.5.3b
Site 4731
Demolition Details

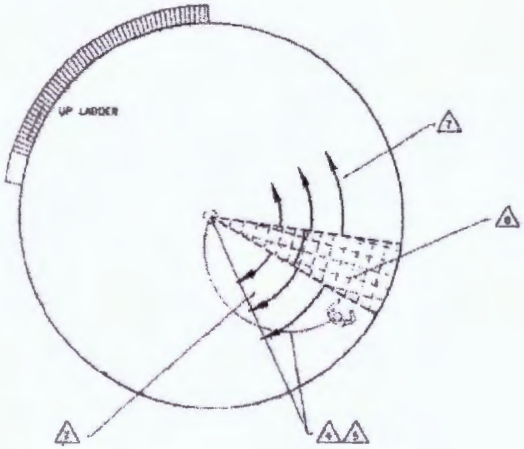
Redacted

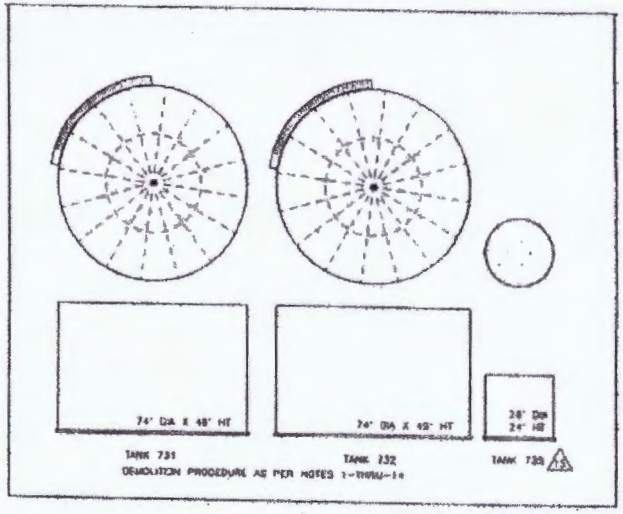
Y:/Santa_Susana/EP9038/TM/HSA_6 (2-5-4a)Site4732AP.cdr
Project:EP9038
Revised: 10/27/2010 TJ
Source: Boeing Company, 2008

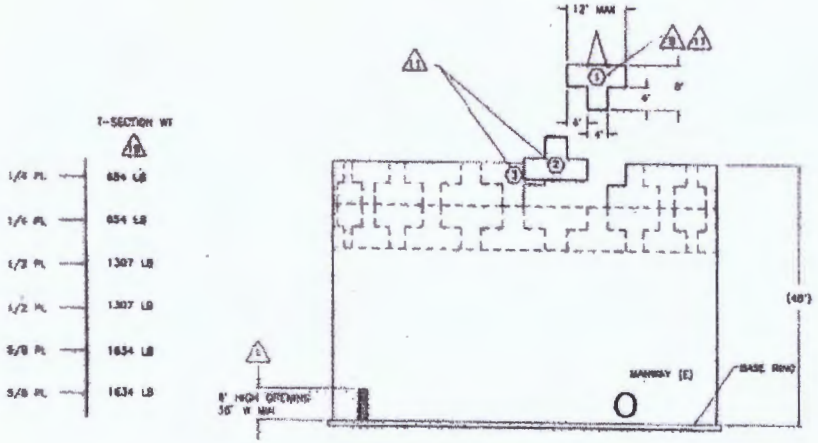
U.S. EPA Region 9

Figure 2.5.4a
Site 4732
Site Photograph

Figure Not to Scale







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180-DEGREES APART

DEMOLITION NOTES: UNLESS OTHERWISE SPECIFIED

Y:/Santa_Susana/EP9038/TM/HSA_6 (2-5-4b)bldg4732DD.cdr
Project:EP9038
Revised: 04/08/2011 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Fuel Oil Storage Tank

Figure 2.5.4b
Building 4732
Demolition Details

RESPONSE TO COMMENTS

Response to Comments on Draft HSA-6 Technical Memoranda Issued on June 3, 2011
Historical Site Assessment, Santa Susana Field Laboratory Site
Area IV Radiological Study, Ventura County, California

Item	Comment	Response
1	*General Comment:* Group 6 HSA1.6 methodology- it is indicated that 760 documents and photographs were reviewed in the writing of HSA group 6 technical memorandum. For Boeing/DOE's full day presentation of the SRE with a panel of experts, it was stated that those experts were provided 80 documents to review in order to make their assessment. There is concern that different representations of the SRE impacts are being made because different levels of information were made available to those experts versus the experts asked to assess the historical data for EPA for investigative purposes with site remediation as an objective. For this reason, I believe the HGL team should be given those same 80 documents provided to the Boeing hired experts. Otherwise, a continued misunderstanding of events that transpired will occur. It would be beneficial for the EPA team to be given the opportunity to review those same documents since very different conclusions were offered to the public through this event, versus the technical review being done by the regulating agency responsible for investigating the radiological contamination remaining at the site today.	EPA received and reviewed the 80 documents mentioned in this comment, together with a large number of additional documents.
2	*General Comment:* *Placement of Outfall 4* Please note that the historical constructed drainage from the SRE complex down to the SRE pond below is specifically missed by the current location of outfall 4 [intended to monitor water quality coming from the SRE complex]. This has been discussed repeatedly in site visits and I ask that the request to properly place outfall 4 be submitted by EPA to DOE and Boeing who answers for responsibility for this area for regional water board issues (related to the NPDES permit).	EPA's role is to characterize the radiological contamination in Area IV. The NPDES role, about which the commentor requests, is not within EPA's investigation scope.

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3	*General comment:* *What was the initial levels found?* In 2001, Boeing conducted soil sampling at the former SRE site in areas planned for excavation due to high mercury levels. Boeing found no elevated radiation levels in these areas, but found elevated radiation levels in two locations in a drainage ditch northeast of the former Building 4143 site. Following excavation, confirmation sampling determined that Cs-137 levels were below Boeing's cleanup levels of 9.2 pCi/g.[3] This emphasizes my concern about the drainage ditches constructed to focus effluent runoff and the fact that outfall 4 misses this drainage and thereby potentially misses important monitoring needs to protect the public below.	EPA's role is to characterize the radiological contamination in Area IV. The NPDES role, about which the commentor requests, is not within EPA's investigation scope. The comment is noted but no changes will be made to the HSA.
4	*Building 4003 Drainage* *Building 4003 drainage pathways page 23* Please adjust the record to reflect the current owner of the neighboring property as the American Jewish University aka Brandeis Bardin Institute. Since the tarp currently covering part of the SRE complex due to mercury and tritium contamination issues, please inform us as to how the tarp will be disposed of when removed to complete the investigation? The reason for my concern is because we have observed during previous site visits that the stored contaminated water held in the baker tanks at SRE, is sometimes released back onto the tarp for the purpose of evaporation of contaminated water (as a method of disposing of the contaminated water). It would seem that the water evaporated and the associated contaminants remain on the tarp which is an absorbent felt material. The results of these activities are potential contaminant accumulation of concentration levels making the tarp itself a potential mechanism to spread the problem during rain events that subsequently occur. John Pace- interview 207 on page 34-41.	Agree. A parenthetical note will be added after the term "Brandeis-Bardin Institute" as follows: (now known as the American Jewish University). The disposition of the SRE tarp is not within the scope of this investigation. The comment is noted but no changes will be made to the HSA.

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5	*The comment below refers to SRE Incidents for Incidents related to Building 4003 (A0438) and Building 4143 (A0274, A0393, A0394, and A0510).* These incidents showing release of mixed fission products indicate many exposures to employees.	Comment noted.
6	*The comment below refers to SRE Incidents for Incidents related to Building 4143 (A0460, A0305, and A0373).* Since this report is missing, what is the source of the information provided? How many of these "reports" were missing within the review?	The information presented in the Building 4143 Incident Summary Table was taken directly from the incident database provided by Boeing. The note "incident report missing" indicates that, according to Boeing, the actual incident report listed in the database index is not available. Of the 42 incident reports for Building 4143, two were missing: Nos. A0460 and A0373.
7	*Pg. 61- Bulleted incident under heading "Incidents after the July 12, 1959 Major Incident"-* This seems like a very serious incident. Was this a fatality? How many fatality accidents occurred at the site according to the review? Isn't there more information about this incident?	The description of the June 13, 1962, incident regarding an operator being engulfed in fire during the transfer of core heaters was taken directly from the Boeing incident database index description. From EPA's review, no fatalities were found to have occurred at the SRE during or after its operation.
8	*The comment below refers to SRE Incidents for Incidents related to Building 4143...* *A0030-* Did asphalt have to be replaced/removed? *A0493-* I believe this was the pit below that John Pace described during the removal of the fuel rods following the July 1959 incident. *A0371-*The number of incidents involving employee contamination through inhalation of particulates potentially indicates a wider release to the surrounding environment.	Incident Report No. A0030 does not indicate that the asphalt was replaced or removed; merely that it was decontaminated to a maximum 0.7 mrad/h using a floor scrubber and vacuum. Incident No. A0493: Comment noted. Incident Report No. A0371: Comment noted.
9	*The comment below refers to SRE Incidents for Incidents related to Building 4143...* *A0321 and A0059-* The incident described by John Pace as contaminating the office, mezzanine and viewing area indicates the potential loss of records kept. Has this been confirmed as a reason why so many log books are missing?	Comment Noted. Boeing has not provided an explanation for the missing log books.

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10	*Pg. 53, third paragraph*– This issue of lacking transparency to report to the public seems consistent throughout the years of operation which included many incidents and many fires which were not disclosed to the surrounding and potentially affected public. In particular, the neighboring properties.	Comment noted.
11	*Pg. 48, third paragraph* Very high readings seemed common place and depicts a lack of understanding of the hazard to workers. Safety incidents where workers refused to wear proper respiratory gear reflects a lack of safety training.	Comment noted.
12	*Table 2.1, Damaged Fuel Elements*– Damaged Fuel Elements.	Comment noted. Commentor presented Table 2.1 from TM.

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13	*P. 55–* • *Reactivity changes in power run 14 were also attributable to the presence of tetralin decomposition products in the reactor. The reactivity loss of 1.2 percent during the first four days of run 14 was caused by sodium entering the R-10 and R-42 moderator cans likely caused by abnormal temperature conditions in the core. The reactivity increase of 0.3 percent, which produced an excursion to about 70 percent full power, was likely the result of sodium expulsion from several fuel channels in quick succession. The general conclusion of the 1961 SRE Fuel Element Damage report is that "no important change in [the SRE's] physical condition [has occurred] as a result of the fuel element damage to the first core.* • *Following removal of the fuel elements, inspection of the core began. The radiation level at the bottom of the loading face shield was measured at 43 rad/h. The fuel slugs and cladding fragments remaining in the core were picked up by articulated grapples, canned, and then stored with other damaged fuel. Removal of damaged moderator cans showed that sodium had leaked into cans R-10 and R-42. Later sodium leak checks found cans R-32, R-44, and R-45 also contained leaks. A total of 16 cans were replaced. As a result of the fuel cladding failures during power run 14, an estimated 5,000 to 10,000 Ci of fission products were released to the primary coolant system. AI's initial fission product analysis of the SRE primary sodium is shown in Table 2.2 below.* Is this the conclusion shared by EPA?	EPA has not made an independent estimate of releases of fission products to the primary coolant system. This is outside the scope of work for this project.
14	*Pg. 56, Table 2.2* Does this not indicate release from core?	EPA believes that the activity values presented in Table 2.2 indicate releases from the reactor core.
15	*Pg. 57, Incidents after the July 12, 1959 Major Incident, comment related to incident for date September 10, 1959–* This incident conflicts with information that they went back to work two weeks later.	EPA assumes that this comment refers to John Pace's statement that Building 4143 was "off limits" for 2 weeks. EPA has been unable to independently confirm this statement.

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16	*Pg. 57, Incidents after the July 12, 1959 Major Incident, comment related to incident for date November 21, 1959* How long were the areas tagged after the July major incident?	EPA has found no additional information about this.
17	*Pg. 57, Incidents after the July 12, 1959 Major Incident, comment related to incidents for dates December 7, 1959, December 18, 1959, April 11, 1960, and May 15, 1960* More red-tagged areas following Major incident of July 1959.	Comment noted.
18	*Pg. 57, Incidents after the July 12, 1959 Major Incident, comment related to incidents for dates May 25, 1960, June 2, 1960, and June 9, 1960* How long did the fuel rod removal process take?	Table 2.1, a summary of events prepared on November 15, 1959, indicates that fuel rod removal commenced on about July 26, 1959 and continued until November 1959.
19	*Incident of raising shield on transloader–* As described by John Pace, this incident does not appear to be included. It resulted in contamination of the high-bay area, where the area was tagged and restricted for several weeks before being able to return to work.	EPA has not found documents or other interviewees to independently confirm this incident. An explanatory footnote will be added to document Mr. Pace's recollection.
20	*Pg. 57, Incidents after the July 12, 1959 Major Incident, comment related to incident for date December 15, 1960* Sandblasting hotspots was done without respirator according to worker interviews conducted by cleanuprockeydyne.org	Comment noted.
21	*Pg. 59, comment related to incident for date November 4, 1961* Additional incidents indicating lacking training about hazards related to work	Comment noted.
22	*Pg. 61, Incidents relating to July 30, 1962 and October 20, 1962* The number of incidents involving over exposure to employees is truly disturbing and also indicates the ease of which releases did occur.	Comment noted.

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23	*Pg. 61, Incident relating to March 19, 1964* Could this be where the Cesium anomaly was found?	This is possibly the location of the Cs-137 anomaly.
24	*Pg. 79, Incident relating to January 29, 1962* Red tagged areas indicate substantial release to the environment	Comment noted.
25	*Pg. 62*– Is the precise location of this incident known at this time? (location of pipes and lines from as-built drawings and employee interviews?) It is greatly appreciated that EPA pressed on for the information contained in the 104e letters of requests for information such as diagrams and photographs.	The exact location is not completely known, however, judging from the description of vessel names and line locations and comparing that to facility drawings, it has been possible to define the general location of the incident which gamma scan results and soil sampling will help confirm.
26	*Pg. 63*– This indicates purposeful movement of contaminants from Area IV to Area II	Comment noted.
27	*Pg. 75*– Drainage pathways confirm contaminant migration to Area II by design	Comment noted.
28	*Pg. 63, incident relating to June 15, 1964* According to John Pace, the service pit was often found to be extremely contaminated. What was the hazard/health risk presented to employees that exhibited nose smear results such as this one?	A nasal smear is a common radiation protection technique used to evaluate worker exposure to airborne radiological contamination or to evaluate the effectiveness of respirator protection. However, there is insufficient information to determine whether a health hazard actually occurred based on this particular incident. Commenter should direct question to the appropriate public health agency.
29	*Pg. 63, incident relating to June 17, 1964* What was the hazard/health risk presented to employees that exhibited nose smear results such as this one?	The hazard being evaluated is exposure to airborne radiological contamination. However, there is insufficient information to determine whether a health hazard actually occurred based on this particular incident.

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30	*Pg. 64, incident relating to June 21, 1964*– Service Pit and lacking hazard training concerns.	Comment noted.
31	*Pg. 64, incident relating to September 18, 1964* This is indicative of the dangerous nature of this work and the fact that full appreciation of the hazards they could encounter, were not fully understood or considered.	Comment noted.
32	*Pg. 68, incident relating to August 10, 1977* 1977 incidents at SRE continued? Where was this water storage pit located? What were the subsequent soil sampling results?	The water storage pit was located near the reactor core, but documents do not indicate its precise location. The incident report indicates that soil sampled outside the east wall of the SRE was found to be contaminated up to 1,300 pCi/g.
33	*Pg. 68*– This incident in 1977 reflects my concern that the location of currently existing monitoring wells may not tell the full story. It is appreciated that EPA has added to the monitoring program wells to get a more complete picture.	Comment noted.
34	*Pg. 69, relating to text "In early 1967, the AEC approved a plan for the deactivation of the SRE..."*– How many years did SRE decommissioning and demolition take?	The decon & decommissioning of the SRE was conducted in phases between 1967 and 1999. In 1967 and 1968, AI removed the reactor core elements and drained the coolants for a stored-in-place configuration. Decommissioning began in 1974 and was completed in 1979 with the objective of removing all significant radioactivity and releasing the facility for unrestricted use. In the 1970s, Rockwell removed all vessels and underground structures, but retained the SRE building superstructure to provide containment for airborne contamination. In 1999, Boeing demolished the building.

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35	*Pg. 70, relating to text "In October 1969, ..."*– It is known that groundwater seeped in and out of the cells at several of the reactor facilities including SRE and SNAP and was the reason Building 56 was not built. What is the estimate for leakage of this contamination INTO the groundwater, and how is it being investigated (as far as location of sampling?)	An estimate of leakage which may have occurred over forty years ago would be highly uncertain and is beyond the scope of the soil radiological study. Radiological contamination that enters groundwater and potentially contaminates soil adjacent to the outside deep building walls at these locations could be investigated during the placement of deep boreholes. During this effort, it would be possible to collect soil samples from the depth interval coinciding with the "smeared" zone of contamination that may be caused by the seasonal fluctuation of the groundwater table. The soil sample depth interval of collection may also coincide with elevated down-hole gamma measurements. The objective of the radiological study is to identify the presence of radioactivity in soil above harmful levels and to the extent reasonable determine its extent.
36	*Pg. 71, relating to text "In December 1976,..." and "In June 1977, ..."* What was the final disposition of the 55,000 pounds of SRE primary sodium (in 158 drums)?	EPA assumes the SRE primary sodium was shipped to Hanford for storage as indicated in Rockwell's June 7, 1977, letter to ERDA.
37	*Pg. 71, relating to text "In February 1979, ..."*– Is this consistent with the location of tritium found at SRE?	This appears to be consistent with the location of tritium found at the SRE.
38	*Pg. 71, relating to text "Between November 1979 and September 1982, ..."* Where can the actual sampling results and excavation remedial reports for this be found?	Sampling results are presented in Argonne National Laboratory, *Post Remedial Action Survey Report for the Sodium Reactor Experiment (SRE) Facility, Santa Susana Field Laboratories, Rockwell International, Ventura County, California*, DOE-EV-0005-46, ANL-OHS/HP-84-101, February 1984, pp. 17-65. A rough outline of the excavation area is presented in Figure 19 of this report although no dimensions are provided.

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39	*Final comment -* Of primary concern is the exclusion of areas due to existing buildings and slabs. I reiterate my request to move forward with building removal so that these areas can be included in the investigation while funding exists to do so. In particular, the decision to not remove buildings is not articulated in the Conti decision and there can be interpreted to mean that demolitions necessary to complete a comprehensive EIS should be undertaken so that these areas can properly be investigated as that is the crux of the Judge's decision (2007)	Comment noted.
40	Sampling plan for Subarea 6. I am curious why the previous findings of cesium that were provided by Boeing are not included in map 1? They are the result of previous radiological Investigations and have several high findings ranging from several hundred to several thousand pCi/g and resulted in several interim measure cleanups from 1963 to 1997. Please advise.	Response from Craig Cooper of EPA regarding radiological contamination in Building 4064 area: *This email [is] in response to your email to me of July 1 (attached below) concerning previous findings of past cesium contamination that were provided by Boeing that may not have been fully addressed in EPA's Soil Sample Plan Addendum for Subarea 6.* *Based on subsequent emails with you, of particular interest is Building 64, the Fuel Element Storage Facility. As described in EPA's HSA Tech Memo for Subarea 6, the fenced-in side-yard (covers 4500 sq ft) located to the east of the Building 64 exclusion fence was used for storing recoverable uranium scrap and miscellaneous radioactive wastes. On occasion, transportation casks that contained used nuclear fuel were also stored in this area but inside the building exclusion fence. EPA's HSA Subarea 6 Tech Memo summarizes the information from an incident report dated November 1963 that describes the finding in February 1963 about an area of about 700 sq feet in an area east of the SS Vault exclusion fence that was contaminated with mixed fission products and a maximum radiation field measurement of 700 mrad/h was recorded as well. The activity in a single soil sample collected in February 1963 was measured to be 8,340 pCi/g gross beta-gamma. After EPA's re-review of building drawings, it was learned that the term "SS Vault" refers to the main Building 64 structure itself since its construction displays vault-like features for safeguarding of special source material hence, the term "SS" was also used. This November 1963 incident report describes the removal of 2365 gallons of*

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		contaminated soil in two separate events that were sent to the RMHF. Post excavation surveys recorded the radiation field as 0.5 mrad/h. The information in this incident report does not precisely locate the area of contamination nor does it identify the source or date of the release other than to say that it likely was due to a leak of contaminated water contained inside a shipping cask that was staged in this area in mid-1962 pending shipment to an off-site location. As you have correctly pointed out, there have been no less than six radiological surveys of this area and that on the opposite side of G Street and an equal number of soil removals between the period 1988 - 1999. A survey in 1988 identified an area of elevated radioactivity where Cs-137 was measured at a maximum of 2,700 pCi/g in an area east of the exclusion fence but further east than the 1963 finding. *In response to your July 1 email, EPA re-evaluated our current soil sampling plan for Subarea 6 to determine if the sample locations adequately address this past spill area at Building 64. We determined that the four existing sample locations and one sediment drainage sample in EPA's soil sampling plan for Subarea 6 plus the addition of two more additional soil sample locations (samples 321 and 322) downgradient and on both sides of the drainage ditch would adequately characterize any residual contamination left behind. All seven of these soil samples locations are surface/subsurface samples and therefore we now have 14 soil samples within and immediately downgradient of the areas of known highest historical rad concentrations. Attached to this email is a map from EPA's Soil Sample Plan for Subarea 6 with the two additional soil sample locations hand-written onto that map. In addition, we propose moving sample location 243 to the southeast to help verify whether radiological contamination has migrated in the downgradient direction and towards the New Conservation Yard.* *Round 1 soil sampling in Subarea 6 has recently begun and will continue for the next several weeks. Also, for purposes of completeness, EPA's final HSA document will include additional information described in this email and contain all available references about the subject past spill at Building 64 that was not fully described in EPA's HSA Tech Memo on Subarea 6.*

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41	In regards to Section 2.1.1, Building 4003, Engineering Test Building (ETB), in a recent radiological survey performed by the Environmental Protection Agency (EPA) elevated isotopes were discovered along the length of a pipeline that went from the ETB to the KEWB (Kinetics Experiment Water Boiler) Reactor. Based on government maps, the location of the KEWB is the actual starting point of the Los Angeles River (LAR). These headwaters exit the SSFL via Bell Creek, in addition, this reporting areas pipeline of effluent from the Sodium Reactor Experiment (SRE) was delivered to the Silvernale pond outside of AREA IV into another portion of the LAR watershed.	Soil samples have been collected along the pipeline that runs between the ETB and the KEWB as part of the Subarea 6 and Subarea 5A investigations. Soil samples have also been collected along the former transfer pipeline that carried water from the SRE pond to the Silvernale pond as part of the Subarea 6 investigation. Surface water and sediment samples have been collected from the drainages in Area IV and the NBZ as part of the over-all Area IV Radiological Study. Additional surface water and sediment samples are scheduled to be collected from drainages and retention ponds within Areas II and III, this fall.
42	The majority of HSA 6 of the Santa Susana Field Laboratory (SSFL) Area IV surface drainage of the SSFL drains into the Simi Valley side onto the property of the American Jewish University's Brandeis-Bardin Campus. With the amount of documented accidents in this reporting area, it is important that a proper characterization and subsequent cleanup is performed.	The majority of Subarea 6 drains south into the Silvernale pond. The majority of the area around the SRE drains north towards Simi Valley Brandeis. Sediment and drainage samples have been collected from this drainage as part of the Radiological Soil Investigation of Area IV and NBZ. Also, soil samples will be collected during Round 1 sampling from the SRE pond bottom and downgradient.
43	Section 2.1.1, Building 4003 Area, Engineering Test Building (ETB), there are labeled facilities as "Unknown", just East of the asphalt areas of Building 4003, to ensure a proper characterization the footprint of these buildings and their surroundings, extra sampling collected at various depths is needed. Due to the fact that there were Radioactive Waste Sinks, the area of the 2700 - gallon septic tank and it's connected 600 linear foot leach field need to be located and sampled. When reading HSA 6, words like, "Grossly Contaminated with mixed fission products" within the surfaces of the Hot Cave raises some concerns and these areas should be investigated in more detail.	Over a dozen sample locations were identified in the FSP Addendum with the sole objective of investigating potential contamination resulting from leaks from this septic tank and associated lines.
44	Section 2.1.1, Building 4003 Area, Below is a photo of the decommissioning activities and the stockpiled areas of debris, including the debris in the SRE area should be noted.	These photos were used to help identify locations for soil sample placement that are described in the FSP Addendum for Subarea 6.

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45	Section 2.1.1, Building 4003, page 20 of HSA 6 it states "Sewer lines exterior to building 4003, which remained in place [after a May 1983 unrestricted use determination released the facility] were considered to be potentially contaminated" Why was it released as Unrestricted Use? This area needs more attention to help protect the Health & Safety of the surrounding communities. Looking at page 21 of HSA 6 "July 2000, Boeing excavated, removed and surveyed for radiological contamination the drainage lines, septic tank and each field", what was the extent of the removal? Does any portion remain to this day? These questions need to be taken into consideration. In regards to Incident Report AO202 (Incoming shipment of Radioactive parts without labels or authorization November 9 of 1989 - Building 3 in the Rocketdyne "Plummer" facility located at 21415 Plummer), this facility is an example of offsite contamination due to practices related to the Santa Susana Field Laboratory and should be part of this investigation along with the ESG at Vertical Test Stand II in the SSFL AREA I "Bowl".	Argonne National Laboratory recommended that Building 4003 be released for unrestricted use in May 1983 except for the sewer lines. The DOE San Francisco Operations Office released Building 4003 for unrestricted use on July 23, 1985. Over ten sample locations are identified in the FSP Addendum for Subarea 6 to investigate the locations of these lines, septic tank, and associated leach field. EPA will remove Incident Report No. A0202 from the Final HSA Report as the incident relates to an offsite facility, which is outside the scope of work for this project.
46	Section 2.5.2, Site 4583 – Old Area [Below Photo] or Energy Systems Group (ESG) Salvage Yard. This photo can be used to locate potential contamination due to the storage of debris and drums that could have impacted the soil and/or groundwater. Please use this photo during the Sampling and Analysis plan for potential sampling locations as the recent findings - 27 Pico curries per gram in soil of Cesium-137 is a potential health threat below.	This photo and others were used to help identify sample locations in this area and over the entire Old Conservation Yard.
47	Section 2.1.2, Site 4041- Sodium Reactor Experiment - Component Storage Facility have recent discoveries of potential (Gamma Radiation Anomaly) GRAY's as they were pointed out 3 years earlier by Atomics International's Reactor Trainee, John Pace to EPA's Gregg Dempsey as a location where during the decontamination of the SRE, "Hot" office and cleaning equipment were placed in this area. Another issue that was raised by Mr. Pace was described as the Inert Gas System on the North side of the SRE was actually radioactive and this location should be looked into.	The north side of the SRE includes over 15 sample locations to characterize these areas.

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48	The Boeing Co. comments provided by Phil Rutherford states that within the Administrative Order on Consent (AOC) signed by the DOE, that MARSSIM DCGL's are no longer valid should be explained to the stakeholders at the next meeting.	Based on the AOC, EPA's current scope is to characterize the radiological nature and extent at the Site. Consistent with MARSSIM guidance, EPA has made initial classifications and these are presented in each HSA Tech Memo. In accordance with the AOC/AIP agreement, EPA would expect the post-cleanup confirmatory approach to be consistent. DCGLs will be removed from the HSA Tech Memos and will be replaced with the BTV and MDC values.
49	In closing, this draft should not have conclusions of "None Specifically Identified" in the areas of Potential Radiological Contaminants of Concern.	The term "None Specifically Identified" has not been used in this TM nor will it be used in the Final HSA Report.
50	*Page iv*- Change "demolition" to "decommission" Change "MW/d" to "MWd" Change "Megawatts per day" to "Megawatt days"	EPA will make these changes in the Final HSA Report.
51	*Page 3 and Page 11*- The whole concept of classifying areas into Class 1, 2 or 3 based on a MARSSIM DCGLw is no longer valid, since the AOC defines the DCGLw as zero. Thus, Class 2 (< DCGLw or < 0) and Class 3 (small fraction of DCGLw or small fraction of zero) are meaningless concepts. EPA has correctly redefined its classification policy based on a high (Class 1), medium (Class 2) or low (Class 3) potential for contamination based on its various lines of inquiry listed on page 11. However, EPA should stop referring to the MARSSIM definition of the classes based on numerical DCGLws.	Agreed per comment 48.
52	*Page 7*- Change January 11, 2010 to January 11, 2011	EPA will make this change in the Final HSA Report.

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53	*Page 188-* Include the following in the list of radiological investigations. Refer to the DHS release of the Old Conservation Yard in 1995 http://www.etec.energy.gov/library/D&D_page/ocy-dhsrel.pdf Refer to the MARSSIM survey of 4583 by Cabrera Services in 2006. http://www.etec.energy.gov/library/D&D_page/07-1002.00_Boeing_SSFL_Area_IV_FSSR_FINAL.pdf Refer to the MARSSIM survey of 4583 by ORISE in 2008 http://www.etec.energy.gov/library/D&D_page/0453-SR-01-0_Final.pdf	EPA will include the three listed radiological investigations in the Final HSA Report.
54	*Page 214–* Change the author of Tritium Production and Release to Groundwater at SSFL, from P. D. Rutherford to R. J. Tuttle. Rutherford was an approver not the author. Also please make changes elsewhere where the report is cited.	EPA will make these changes in the Final HSA Report.
55	*Pg. 44, Incident Summary Report, Building 4143, Referencing Incident A0315, 6/4/1959–* On the Wash Cell Explosion. I have knowledge of it happening. It did not happen on my shift. Talking with those who were there first hand said it was very scary. At a latter date we had to wash fuel rods and we were very worried it may do the same. We were washing off sodium and tetralin.	Comment noted.
56	*Pg. 46–* This was me and my supervisor. I had not been working very long at AI. I started in Jan 1959 on probation for two months. March is my official date.	Comment noted.

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57	*Pg. 50–* I was working on these days form Jul 12th - Jul 26th 1959. Commentor also stated "Note: I was there on July 14th when the high bay increased to 14,000 cpm	Comment noted.
58	*Pg. 51–* We had many scrams between the 15th through 26 of July	Comment noted.
59	*Pg. 53–* Note: this is when we broke off the first fuel rod, and it got jammed in the fuel transporter. The lead safety shield was accidently lifted up and contaminated the whole building. You can see it states that a considerable amount of radiation exposure in the building. This is when building was off limits for two weeks, and the office furniture went out in junk pile. The modified moderator handling cask was then put to work to remove the last remaining fuel rod. I do not know where the information came from that there were 19 fuel elements remaining. All fuel rods and broken fuel rod ends were out by first week of Sep. The last of August into September, we worked on removing the two broken fuel rod ends with a Cherry Picker by hand. Both 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. While we were working without proper equipment; the company decided to build equipment to pull all the small pieces of fuel rods out of the reactor core. That is what you see in the SRE Recover Film. In the meantime, 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.	Comment noted.

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60	*Pg. 53–* By this date the large equipment was brought in to remove the small pieces of fuel rod. 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.	Comment noted.
61	*Pg. 53, referencing damaged fuel element R-10* We found only damaged fuel rods, not broken in two.	Comment noted. Table 2.1 presents AI's summary of events as of November 15, 1959. An explanatory footnote will be added to document the commenter's recollection.
62	*Pg. 54, referencing damaged fuel element R-55* We found only damaged fuel rods, not broken in two.	Comment noted. Table 2.1 presents AI's summary of events as of November 15, 1959. An explanatory footnote will be added to document the commenter's recollection.
63	*Pg. 54, referencing damaged fuel element R-68* We found only damaged fuel rods, not broken in two.	Comment noted. Table 2.1 presents AI's summary of events as of November 15, 1959. An explanatory footnote will be added to document the commenter's recollection.
64	*Pg. 54, referencing damaged fuel element R-12* Note: broke off when pulling out of the reactor core and contaminated the whole building. The lead safety shield was lifted up by the operator by accident and contaminated the whole SRE building. It was not transferred to the storage cell, because we could not remove it from the fuel transfer cask.	Comment noted. Table 2.1 presents AI's summary of events as of November 15, 1959. An explanatory footnote will be added to document the commenter's recollection.
65	*Pg. 54, referencing damaged fuel element R-21* This is not correct; it was never placed in the hot cell. Not Correct; 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.	Comment noted. Table 2.1 presents AI's summary of events as of November 15, 1959. An explanatory footnote will be added to document the commenter's recollection.

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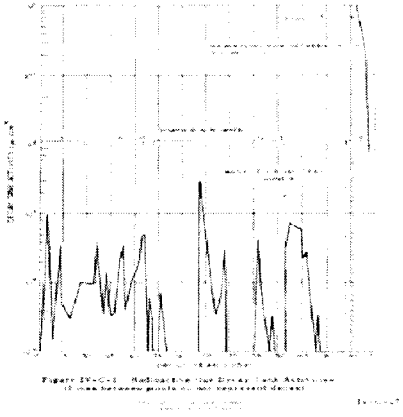
66	*Pg. 54, referencing damaged fuel element R-23* This is not correct; all fuel rods were out of the reactor core by the first part Sep. The last two were pulled out with a Cherry Picker. All incorrect information.	Comment noted. Table 2.1 presents AI's summary of events as of November 15, 1959. An explanatory footnote will be added to document the commenter's recollection.
67	*Pg. 54, referencing damaged fuel element R-69* No fuel rods were withdrawn in October; they were already removed.	Comment noted. Table 2.1 presents AI's summary of events as of November 15, 1959. An explanatory footnote will be added to document the commenter's recollection.
68	*Pg. 54, referencing damaged fuel element R-24* I think this is when we tried to pull 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.	Comment noted. Table 2.1 presents AI's summary of events as of November 15, 1959. An explanatory footnote will be added to document the commenter's recollection.
69	*Pg. 54, referencing damaged fuel element R-76* Notice they have no date. 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.	Comment noted. Table 2.1 presents AI's summary of events as of November 15, 1959. An explanatory footnote will be added to document the commenter's recollection.
70	Page 29, Section 2.1.3. Building Features. It should be noted that the former SRE building was designed to vent radioactive cover gas to the outside atmosphere during SCRAMs and other emergency situations. It is quite logic to conclude that the filters at the SRE air vents quite likely overloaded or were bypassed during the events of 1959 and other SCRAM events.	Agreed. EPA will carefully consider this issue and how to best describe the uncertainty concerning atmospheric venting at SRE and the possibility of filter effectiveness throughout the events of 1959.
71	Section 2.1.3. The general tone of this section is written in a manner that assumes no significant fission gas or particulates were released during the 1959 Major Accident. This conclusion should be reconsidered since it is indeed quite likely such releases occurred or at a minimum there is no evidence that such significant releases did not occur.	Agreed. EPA will carefully consider this issue and how to best describe the uncertainty concerning atmospheric venting at SRE

Item	Comment	Response
72	Section 2.1.3. Page 52. The text of the TM minimized documented offscale measurements when core cover gas was too hot to measure. These offscale readings occurred in the sodium coolant tank, decay tank, and Hi Bay. Please review and incorporate the following references concerning offscale readings at SRE in 1959. These references should be incorporated into the final HSA. Off-Scale Radiation Readings: 1. Core Cover Gas Sample Too High to Be Measured Quantitatively during accident; samples taken thereafter are subsequent to the highly radioactive cover gas had already been purged to external tanks and vented to atmosphere. Hart, NAA-SR-6890 p. p. 13 2. Gaseous Decay Tank Readings Off-scale: "That such an extremely high concentration did in fact exist is borne out by the off-scale readings of decay tank activity (see Figure IV-C-I)." (emphasis added) p. IV-C-15 NAA-SR-4488. Figure IV-C-I from this report (see below) must be included in EPA's final HSA report. 	Agreed. In the final HSA, EPA will review and incorporate important information from the two references and Table IV-C-I as appropriate.

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73	Section 2.1.3. Page 33. The first, second and fourth bullets on this page concerning former workers interviews present statements that are based on second or third hand accounts or opinion of individuals that were not present during the major accident of 1959. These interviews should not be allowed in the HSA.	Noted. With respect to former workers interviews, EPA took the position not to judge or modify any former worker statements.
74	Section 2.1.3. Page 48 and Page 57. Call the series of events in 1959 a "major incident" is NOT appropriate or accurate. At a minimum, these events at SRE in 1959 should be called a "Major Accident – Fuel Melting Event".	Agreed. EPA will reconsider the use of the terms "incident" versus "accident" to describe the evens of 1959. EPA does agree with the use of the term "Fuel Melting Event".
75	Section 2.1.3. Page 51. The Bottom Paragraph concerning the events on July 15, 1959 should be modified to include the likely events that Xe and other fission products were vented. Alternatively, Xe should be removed since its simply unknown what was in that radioactive gas.	Agreed. EPA will reconsider how to describe the possible scope of fission products that was vented to the air at SRE and modify the text in the final HSA as appropriate.
76	Section 2.1.3. Page 56. Table 2.2. I have many concerns about EPA's use of this table. The column concerning Fraction of Inventory Released is based on filtered air data that was collected weeks after the 1959 Major Accident ended. The basis of Table 2.2 is incomplete and baised low concerning potential fraction of inventory released. The sentence immediately after Table 2.2. concerning Xe and Kr releases was collected on September 14, 1959 which was two months after the Major Accident ended.	Agreed. EPA will reconsider the use of Table 2.2 and modify the text in the final HSA as appropriate.

Item	Comment	Response
77	Please consider the following finding in the Hart. NAA-SR-6890 report: (a) *Primary coolant too radioactive to be measured until about a week after shutdown; by that time, much radioactivity had been filtered out by the cold traps.* Hart NAA-SR-6890 p. 10 (b) *Exhaust from the high bay area is not vented to the stack but rather to a separate outlet located on top of the high bay area. The high bay exhaust is passed through CWS filters only when potentially hazardous operations are in progress within the reactor building, e. g., during reactor operation or fuel handling. The original design of the gaseous waste handling system. incorporated radiationlevel-actuated by-pass valves in the line leading from. each source of gaseous activity to the storage tanks. In this way, automatically and depending on the activity level, the gas would be vented either to the stack or to the storage tanks. This system was later modified, because of malfunction, and a manually operated bypass was placed in the reactor control room. The second instance [of elevated radiation readings] occurred on July 15 at 0600; this time the stack activity rose sharply to 7 x 10-5 μC/Cm. The activity level continued intermittently high until about 1100 on July 15. No explanation can be offered for this second occurrence unless it is assumed that the storage tank bypass switch had inadvertently been placed in the bypass position. If this were in fact the case, the activity concentrations in the cover gas were certainly sufficient magnitude to cause the high stack effluent activities noted.* p. IV-C- 24-25 (c) *Radioiodine value in coolant samples low compared to other radionuclides on a volatility basis, suggesting iodine escaped to the core cover gas, vented, and potentially released to environment" Hart, p. 20*	Agreed. EPA will reconsider the use of Table 2.2 and modify the text in the final HSA as appropriate.

Item	Comment	Response
	AEC conclusions about the accident: (6) The circumstances which eventually led to this accident began as early as spring, 1958, when the first Tetralin leak occurred. A second leak occurred in Run 8 on November 29, 1958, and problems continued until July 24, 1959. During that time so many difficulties were encountered that, at least in retrospect, it is quite clear that the reactor should have been shut down and the problems solved properly. Continuing to run in the face of a known Tetralin leak, repeated scrams, equipment failures, rising radioactivity releases, and unexplained transient effects is difficult to justify. Such emphasis on continued operation can and often does have serious effects on safety and can create an atmosphere leading to serious accidents. It is dangerous, as well as being false economy, to run a reactor that clearly is not functioning as it was designed to function. In the long run, reactor economics as well as reactor safety will demand adequate continuing maintenance at all times, and this will include early shutdown and proper action whenever there is the least doubt concerning the situation. Management can and must establish this sort of attitude. Thompson and Beckerley, The Technology of Nuclear Reactor Safety, p. 644-645	