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

Prepared for:

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

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

Prepared by:

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

October 2012

Redacted

This page was intentionally left blank.

TABLE OF CONTENTS

Section Page

1.0 INTRODUCTION 1
1.1 Background 1
1.2 Purpose 2
2.0 METHODOLOGY 2
2.1 General Process 2
2.2 Solicitation of Interviews 3
2.3 EPA Interviews 4
2.4 Joint DOE/EPA Interviews 5
2.5 Follow-Up Interviews 6
2.6 Confidentiality 7
3.0 RESULTS 7
3.1 Summary of Results 8
3.2 Interview Highlights 9
4.0 CONCLUSIONS 10

LIST OF FIGURES

Figure 3.1 EPA Interview Results Summary

Figure 3.2 DOE/EPA Joint Interview Results Summary

LIST OF APPENDICES

Appendix A EPA Interview Script/Questions

Appendix B Sample Aerial Photograph Annotation

Appendix C DOE/EPA Joint Interview Script/Questions

Appendix D EPA Interview Summaries

Appendix E DOE/EPA Joint Interview Summaries

This page was intentionally left blank.

LIST OF ACRONYMS AND ABBREVIATIONS

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

Redacted

This page was intentionally left blank.

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

1.0 INTRODUCTION

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

1.1 Background

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

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

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

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

Redacted

1.2 Purpose

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

2.0 METHODOLOGY

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

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

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

2.1 General Process

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

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

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

2.2 Solicitation of Interviews

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

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

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

2.3 EPA Interviews

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

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

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

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

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

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

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

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

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

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

2.4 Joint DOE/EPA Interviews

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

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

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

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

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

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

2.5 Follow-Up Interviews

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

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

2.6 Confidentiality

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

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

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

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

3.0 RESULTS

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

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

3.1 Summary of Results

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

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

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

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

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

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

3.2 Interview Highlights

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

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

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

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

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

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

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

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

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

4.0 CONCLUSIONS

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

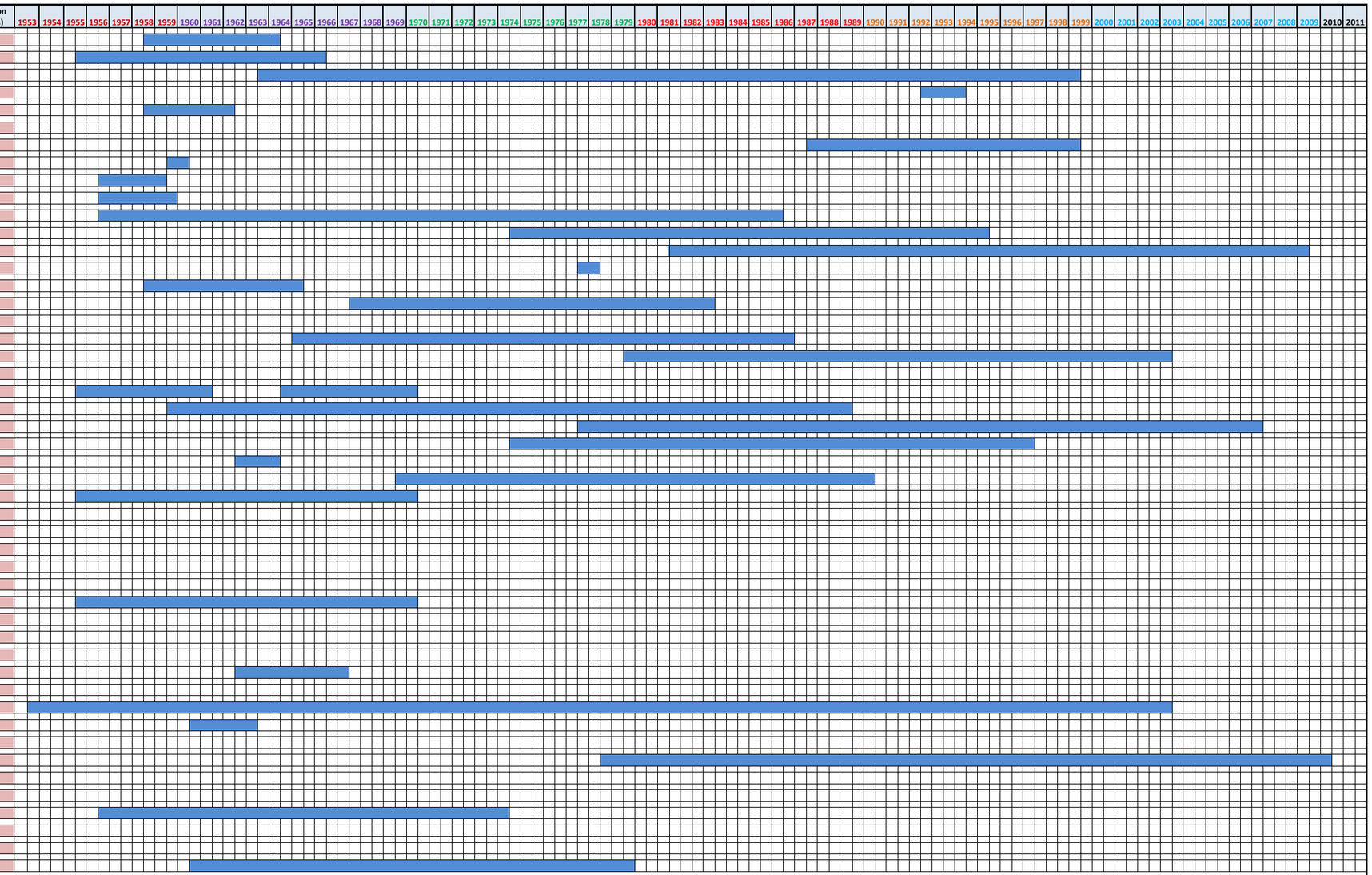
Generally, both interviewees and interviewers appreciated the interview process. Interviewees often mentioned the exciting nature of the work that was going on at SSFL historically and the sense of pride they had in their work. Interviewers were able to glean relevant information for characterization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

This page intentionally left blank.

Figures

This page was intentionally left blank.

Interviewee Number	Job Title	R/A Material Handled	Subarea	Start Year	End Year	Duration (years)
1	Reactor Operator	Y	N/A	1958	1964	5*
2	Instrumentation Engineer	N	6	1955	1966	11*
3	Operations Engineer	Y	5D, 6, 7, 8	1963	1999	36
4	Supervisor	Y	N/A	1992	1994	2*
5	Responsible Engineer	Y	5D	1958	1962	4
6	Health Physicst	Y	5A, 5B, 5C, 5D, 6, 7	1962	N/A	N/A
7	Quality Engineer	N	7	1987	1999	12*
8	Mechanic	Y	6	1959	1960	1
9	Health Physicist	Y	5A, 6	1956	1959	3*
10	Electrical Technician	N	6	1956	1959	2.5
11	Inspector	N/A	5B, 5C	1956	1986	30
12	Construction Inspector	N	5B	1974	1995	21
13	Environmental Technician	Y	5A, 5B, 5C, 5D, 6, 7, 8	1981	2009	28
14	Health Physics Technician	Y	5D, 6, 7	1977	1978	1
15	Laboratory Technician	Y	7	1958	1965	7
16	Reactor Inspector	Y	5A, 5B, 5C, 6, 7, 8	1967	1983	16
17	Concrete Worker	N/A	6	1980	1980	N/A
18	Unknown	N/A	N/A	1965	1986	22*
19	Mechanic	Y	5A, 8	1979	2003	24
20	Hiker	N/A	N/A	N/A	N/A	N/A
21	Senior Engineer	Y	5B, 6	1955	1970	12*
22	Engineer	Y	5B, 6	1959	1989	30*
23	Research Mechanic	Y	5D	1977	2007	30
24	Supervisor	N	5B, 5C, 8	1974	1997	23
25	Chief Engineer	N	N/A	1962	1964	2*
26	Quality Assurance Engineer	N	5B, 5C	1969	1990	21
27	Electrical Technician	N	N/A	1955	1970	15
28	Purchase Agent	Y	N/A	N/A	N/A	20*
29	Unknown	N	N/A	N/A	N/A	N/A
30	Unknown	N	N/A	N/A	N/A	N/A
31	Bulldozer Operator	N	N/A	N/A	N/A	N/A
32	Unknown	N/A	N/A	N/A	N/A	N/A
33	Fire & Security	N/A	N/A	1955	1970	15
34	Cement Mason	N/A	N/A	1980s	1980s	N/A
35	Unknown	N/A	N/A	N/A	N/A	N/A
36	Unknown	N/A	N/A	N/A	N/A	N/A
37	Unknown	N/A	N/A	1962	1967	5*
38	Rocket Engine Testing	N	N/A	1960s	1960s	N/A
39	Photographer	N	8	1953	2003	50*
40	Lab Technician	N	N/A	1960	1963	3*
41	Mechanic	Y	N/A	1980s	2010	30*
42	Machinist	N	N/A	1978	2010	32*
43	Unknown	N	N/A	N/A	N/A	N/A
44	Unknown	N	N/A	N/A	N/A	N/A
45	Accountant	N	N/A	1956	1974	18*
46	Unknown	N	N/A	N/A	N/A	N/A
47	Unknown	N	N/A	N/A	N/A	N/A
48	Engineer	N	N/A	1960s	1970s	20*



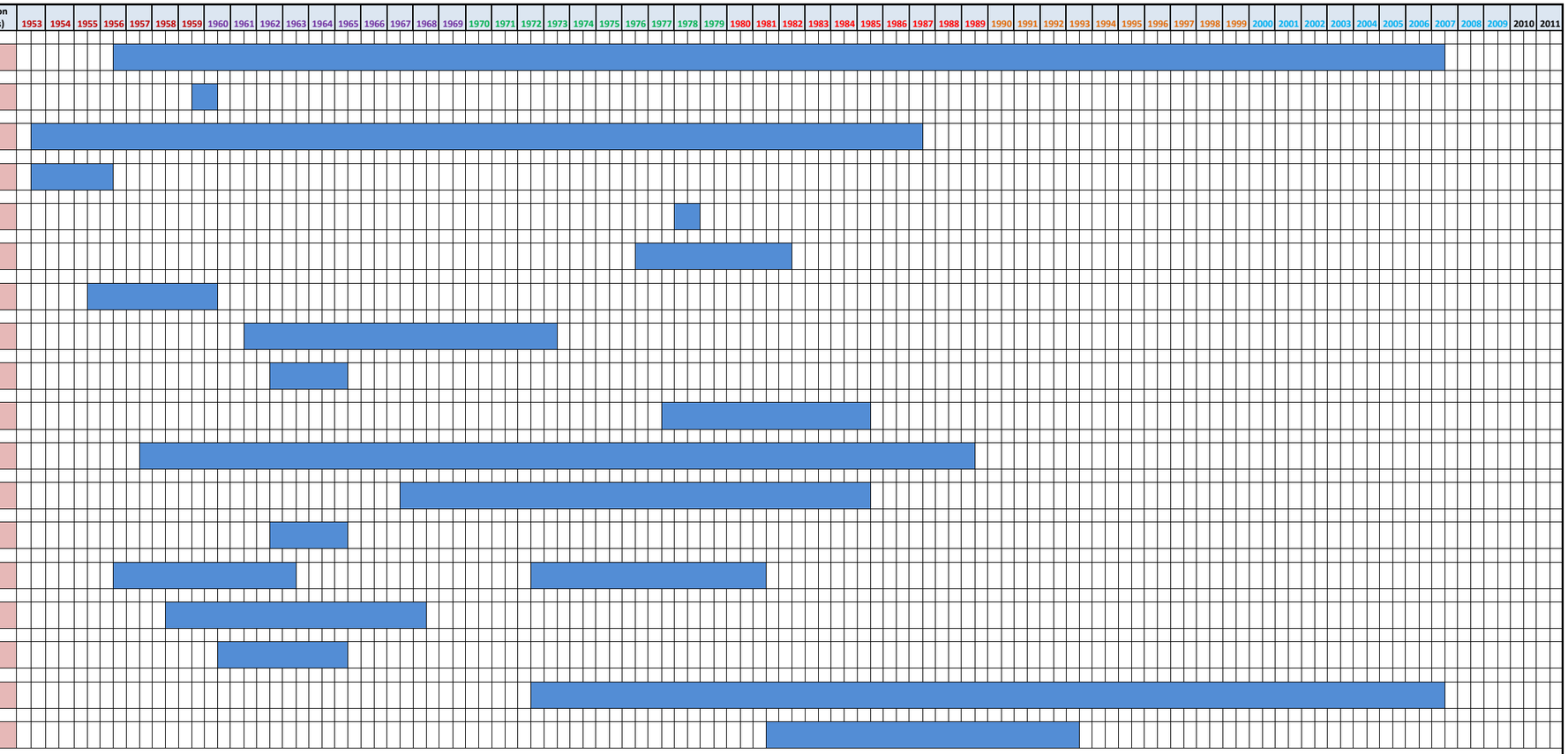
Notes:

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

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

Redacted

Interviewee Number	Job Title	R/A Material Handled	Subarea	Start Year	End Year	Duration (years)
8	Project Administrator	Y	5B, 6	1956	2007	51*
31	Electronics Technician	Y	N/A	1959	1960	1
34	Engineer	N	N/A	1953	1987	34
57	Technician	N	8	1953	1956	3
58	Mechanic	N	N/A	1978	1978	1
78	Mechanic	Y	5A, 8	1976	1982	6
80	Development Engineer	N	N/A	1955	1960	5
107	Engineer/Physicist	Y	7	1961	1973	12
125	Technician	Y	5D	1962	1965	3
154	Instrumentation Engineer	N	8	1977	1985	8
254	Mechanic/Engineer	Y	5D, 6, 7, 8	1957	1989	32
255	Reactor Inspector/Photog	Y	5A, 5D, 7	1967	1985	18
287	Engineer	Y	8	1962	1965	3
296	Design Engineer	Y	6	1956	1981	16**
300	Engineer/Physicist/Super	Y	6, 8	1958	1968	10
245	Physicist***	Y	N/A	1960	1965	5
250	Mechanic/Engineer***	Y	N/A	1972	2007	35
264	Physician***	Y	N/A	1981	1993	12



Notes:

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

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

*** These interviews have not yet been approved.

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

Appendix A

EPA Interview Script/Questions

Redacted

This page was intentionally left blank.

Former Employee Screening Call Script

Telephone Screening Script

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

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

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

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

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

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

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

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

   c) Did you ever wear a dosimetry badge?

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

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

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

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

-- End of Script --

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

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

EPA Former Employee Interview Questions

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

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

Additional questions to gather more detailed information.

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

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

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

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

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

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

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

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

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

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

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

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

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

Closing questions

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

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

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

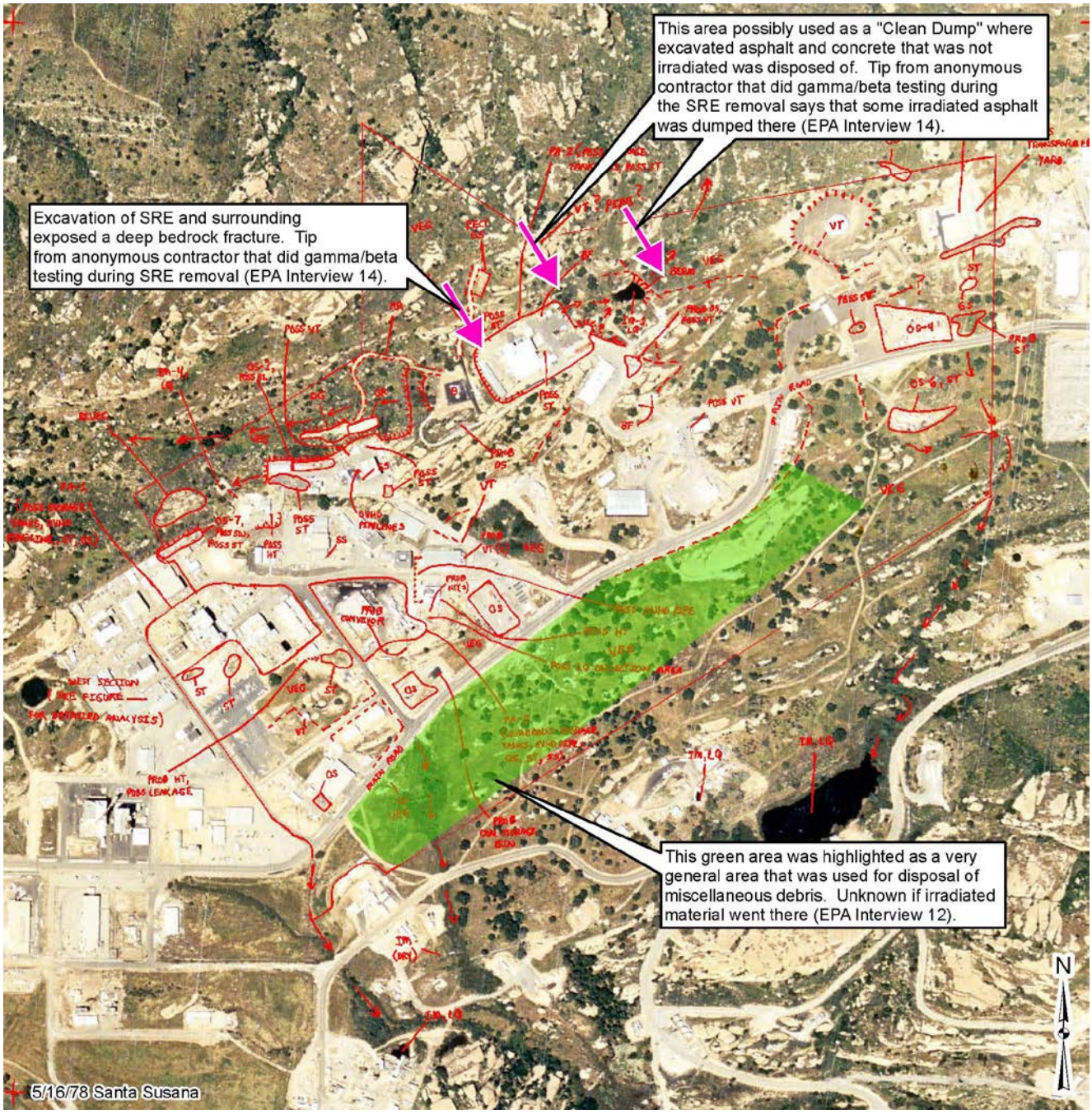
Appendix B

Sample Aerial Photograph Annotation

Redacted

This page was intentionally left blank.

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



Redacted

This page was intentionally left blank.

Appendix C

DOE/EPA Joint Interview Script/Questions

Redacted

This page was intentionally left blank.

Former Employee Screening Call Script

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

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

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

Telephone Screening Script

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

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

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

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

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

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

3) What was your job title or titles?

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

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

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

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

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

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

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

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

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

Which would you prefer?

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

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

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

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

[If not, record concern briefly.]

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

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

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

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

Is this address correct?

[Read aloud, correct as appropriate.]

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

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

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

-- End of Script --

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

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

Preparation for each Interview

Take the following to each interview

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

Questions and Answers

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

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

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

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

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

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

Interview Script

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

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

In addition, this interview will help us:

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

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

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

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

Yes No (circle one)

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

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

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

Start of Interview

Interviewee Name and Affiliation: _____

Interview Date, Time, and Location: _____

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

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

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

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

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

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

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

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

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

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

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

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

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

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

13. How did you document what you did?

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

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

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

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

    a. The sodium burn pit

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

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

    d. The old conservation yard (junk yard)

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

    Tell us more about that.

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

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

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

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

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

This page was intentionally left blank.

The Boeing Company
Santa Susana Field Laboratory
5800 Woolsey Canyon Road
Canoga Park, CA 91304-1148

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

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

Re: Environmental Impact Study at Santa Susana Field Laboratory

Dear Mr. Schassburger:

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

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

Sincerely,

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

Peter Rosenbloom, Counsel
Labor & Employment
The Boeing Company

cc: Stephanie Jennings, DOE, SSFL

Redacted

This page was intentionally left blank.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Appendix D

EPA Interview Summaries

Redacted

This page was intentionally left blank.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 3/16/2010

Interviewee(s): 1

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

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

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

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

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

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

I am not aware of the disposal practices at SSFL.

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

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

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

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

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

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

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

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

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

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

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

This page was intentionally left blank.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 3/16/2010

Interviewee(s): 2

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 3/16/2010

Interviewee(s): 3

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

This page was intentionally left blank.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 3/17/2010

Interviewee(s): 4

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

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

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

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

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

This page was intentionally left blank.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 8/23/2010

Interviewee(s): 5

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

This page was intentionally left blank.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 2/10/2010

Interviewee(s): 6

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

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

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

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

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

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

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

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

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

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

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

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

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

This page was intentionally left blank.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 8/31/2010

Interviewee(s): 7

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 6/07/2011

Interviewee(s): 8

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 12/01/2009

Interviewee(s): 9

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

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

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

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

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

Unless there was some contract I'm totally unaware of, none of AI's facilities were used by other contractors. My basic function there was in Health Physics and also Radiation Engineering. I was doing radiation shielding, radiation transport, and all that kind of stuff. Nuclear engineering kind of things. I think my job title was Research Engineer or Radiation Engineer. I think I was in the Health Physics Department first and then I got into the Radiation Engineering Department. Health physics was more or less a service at the time. I had been fairly educated at Berkeley so I had a background in nuclear physics. Health physics is now a big deal. They have a journal and I've published many research articles in it. Basically a health physicist's goal in life is to protect people from radiation and to make sure they don't get over-exposed. They have rules and procedures set up to minimize radiation like wearing film badges, ionization chambers, little pencil things you can look through. The health physicist's function was to make sure operationally that radiation was a safe thing. He would collect and process the film badges and keep records exposures. At the time the AEC had come up with some rules that you can't have more than so much dose per year, so much dose per quarter, etc. The Emergency Exposure Dose (EED), which was one time in a lifetime. They were a very professional organization. There were some good people there.

There was also the National Committee for Radiation Protection (NCRP). That organization made rules, did research, and did all sorts of publication. They were part of the federal government and funded. I've got all sorts of books, pamphlets and guides that have been written. Radiation protection was a huge thing and it is today.

Health physicists followed rules created by the AEC, NCRP, and International Committee of Radiation Protection (ICRP). The AEC and NCRP were national organizations, but the ICRP is worldwide. The ICRP does research, radiobiology, radiation exposure, they do everything. It's a big organization that looks for cancers among other work.

Health physicists at SSFL did monitor waste removal and disposal. The thing that I was involved in was getting hot material like stainless steel that had been irradiated at the bottom of the reactor. It's a big thing; it looks like a bullet on the bottom that guides the fuel elements into the core of the SRE. When you pull them up they're hot with a lot of radiation coming off. They had to make sure you're not getting too exposed and work with it too much. What I used to do is design 50-gallon drums to put radioactive material into. I can sketch it here. It's a 50-gallon drum like this and it's got a pipe in the center, a real pipe that goes down and you pour concrete all around it and put your radioactive material in there depending on how hot it is. This is your 50-gallon drum that I used to design and work around and watched guys put the stuff in and load these onto a truck. Then the truck went to Port Hueneme. There was a huge number of

these things and we took everybody's waste – all the hospital's waste and various people who had radioactive material tracers. They paid AI or somebody to do this. This was called a 50-gallon drum waste disposal. I supervised a lot of design so you had enough shielding so that the dose on the outside does not exceed a certain limit.

The pipes used in the drums are usually steel, but could be cast iron as well. The designs were usually very simple and depended on how hot the material was. I used to do calculations to figure out the best design. I would get the dose on the surface and that was it. I continued with this container. You take all these containers once you accumulate them and they were being loaded in either Santa Susana or Van Owen. I don't remember how they got transported around. I used to supervise these things being loaded at a reasonable distance away. When you accumulated hundreds of barrels, you trucked them down to Point Hueneme. They were going to be dumped into the ocean.

The radioactive material was dumped off of the Farallon Islands. You had to make damn sure that the dumping ground was 1,000 fathoms or more – 6,000 feet. That was the requirement. All you had to do was find that depth. Down here it's off St. Nicolas Island on the other side one of the lone Channel Islands out there. We put these drums on a big barge and you tow them out with this ocean-going tug. I'd be supervising this stuff and the guys would be watching. The drums were all tied on the barge with a rope and you just chopped them and they all rolled off. The boat would be going around distributing this stuff. We were on the ocean going tug most of the time. It was kind of interesting and kind of fun. Some of these barrels would go down and most of them would sink. Some would be floating, either they weren't loaded properly and someone screwed up. We had a gun that we would used to shoot the floating drums until they went down. But that wasn't very often, maybe one time for every 1,000 drums. Those drums probably aren't there anymore. They are probably rusted and gone. It's against federal law now; you can't do any of that anymore. At the time you could. The rule was 6,000 feet or 1,000 fathoms and you could dump. It was kind of an arbitrary thing. Nobody did a lot of studies on it, just an arbitrary number. That's about a mile down.

The radioactive steel thing in the reactor looked like a bullet. It was hanging on the bottom. It's a fuel element guide really that hung down so you could put this into a reactor core hole. You can leave it in there after so much time and pull it up and it was hotter than hell since it was in the core. It got neutron activated. Stainless steel gets very neutron activated. There are a lot of elements in there that get very hot. I don't know what the official name for that steel piece is, but I called it the fuel rod stainless steel bullet guide since it looked like a bullet. It was hotter than hell after having been used in a reactor. I would say the steel bullet was about 2.5 feet long.

I never examined all the stuff that was going in the drums. I was just interested in finding out how many Curies would be deposited in there. I designed the drums for the maximum Curie levels. Many times the waste was just gloves and clothes. We never sorted it out that much. We just put whatever we thought was radioactive in that hole.

I mentioned we also took hospital waste and other people's waste. Any radio-pharmaceuticals people were using like cobalt x-ray stuff. Cobalt-16 was a big thing. UCLA had radio-

pharmaceuticals. Generally those things weren't that hot. The hot stuff was really Santa Susana. I don't know anybody else except these people using cobalt-16. When you wanted to disassemble a unit, I was never involved in that, you always know that all that goes in the shipment of hot stuff coming in. You just take that stuff - the GM tube, the ionization chambers - and see how hot it was and that was it.

There were several experimental facilities like the Kinetic Energy Water Boiler (KEWB) and the Systems for Nuclear Auxiliary Power (SNAP) up on the Hill. Any kind of waste that would come from those facilities was packaged and shipped in drums. I think at the time those things really got going. In earnest, I was gone. I helped design the SNAP environmental test facility. I wrote the hazard report for it, which you had to submit to get a permit to build it.

All this kind of stuff when you ask where else did waste come from, there are hot cells and all kind of facilities that had anything hot (radioactive). There was some experimental stuff down in Van Owen at the AI facility in Canoga Park. They had hot stuff too. I didn't get too much involved in that. Except one time and that was when we loaded what's called… There was a big glass sphere and we were loading this sphere with uranyl sulfate solution and we kept loading this thing until… We were plotting the reactivity as a function of how much source you put in. You put in a source and it would go up and up. We were plotting the loading of uranyl sulfate into this sphere to make it start multiplying. I was involved in that and I think I got a heavy dose from that. There were two guys involved, me and another guy. We were plotting this and showing everybody. It was like a fishbowl. Everybody watching and how wonderful, look at that experiment, we get to see it. That was an interesting thing. It became very radioactive too. It was a multiplying medium. It was going critical and producing fission products. I don't know what they did with it later. I just know I was involved in this plotting.

I don't remember the numbers of the buildings I worked in. This Sodium Reactor Experiment (SRE) building, I think I visited some of the other ones to collect film badges and take smears sometimes. We used to take these little round pieces of paper and smear it and read it to see whether contamination transferred. My work at SRE was health physics and radiation engineering/shielding work.

I don't remember where I was working when I was working with the waste drum loading. I think they would drum waste at the source, but sources came in everywhere before this. It might have been down in the Van Owen area. I remember there were barrels lined up.

As far as accidents or spills go, everyone knew about the SRE melting. That was the big one. I do not remember any others while I was there.

I can't remember a lot about the waste stream generated during my work. I don't know about cleaning liquids. Those things I can't remember. I just draw a blank. I never got involved in dealing with the contaminated clothing.

As for the test smears we would do they were just little pieces of paper. And you'd just take them and put them in a reader to see if you got some contamination/radiation response from the

detector. We took smears all over quite a bit. Generally, you didn't have many problems. I got a lot of these test papers and went down to the Santa Monica Pier during the time they were doing the atmospheric testing and got a higher reading of the upper railings of the Santa Monica Pier than that. That was during the days of open air testing – Russians, Soviets, and we were doing it. I got some interesting stuff. That was my own thing though, that was not part of my job.

I don't recall any stories about other accidents or spills out on the hill other than the SRE. And that was the big deal that made a lot of problems all over – this radioactive sodium from the loops and hard chunks of sodium. Mostly it was just sodium activation, sodium-24, and that would go away very quickly. Sodium-24 had a pretty short half-life. As far as testing for radionuclides on the hill, I would test for the fission products – sodium, cesium-137, strontium-89, strontium-90, and yttrium. Forget sodium, it has a very short half-life. You've got to look at the long half-life, so they've been around for quite a while. I'm not too familiar with all those half-lives. Iron-55 and maybe Iron-56. I can't remember whether these are all radioactive or not, but I think so. Iron-55 I know is. Nickel is a big one too. These basically are the fission products. I'm just getting involved with some guy writing a story for a movie script on terrorism and I'm just getting back involved with that again. If the terrorists try to get a hold of some radioactive material they're going to try and get it from a small reactor or some college like Oregon State and steal it to make a, not a radioactive bomb, but make it dispersive – a dirty bomb.

As far as disposal ponds on the hill, I remember a big pond at the back of the SRE. It was just a big pond that had water in it. We used to take the sodium and throw it in there during lunch time just to watch it explode. Eventually I'm sure it's pure sodium hydroxide because if you throw sodium into that, the reaction and such that you get sodium hydroxide because it combines with water. You get this explosion that's really kind of fun to watch and the smoke because it's an exergonic reaction. We used to throw pieces of sodium in there that we would find laying around, perhaps in back of the SRE. I don't think the sodium we picked up was active. Sodium-24 has a very short half-life. It may have a little bit of activity, so if I got some radiation from it, I don't know. It was more fun doing that than worrying about it.

The sodium in the SRE loop was probably more viscous than water, but I don't know exactly what the viscosity was. The loop was contained. There's a primary loop and I can't remember whether they had two loops or not. I have some drawings. Here's the reactor. Here's the SRE reactor. There are all these fuel elements and that's the core. You had the shielding around it and everything else. Then you had the inlet and the outlet. There was a heat exchanger that exchanged with the water. And a sodium pump to pump the sodium loop here. The sodium loop goes through the reactor. It circulates through the reactor. There's a heat exchanger here that takes heat from this and exchanges with another loop. I can't remember whether this is another sodium loop or not. If it is another sodium loop, then I think it's exchanging with the water loop here. That goes into a turbine that drives a generator. If it's not a sodium loop, it would just be a water loop. I think you had these two loops. This was always radioactive, this wasn't. That's why they were trying to separate them. They were trying to make everything from here on out non-radioactive and make everything here radioactive. This whole thing, the entire thing, would

be in the SRE. The reactor, the loops, everything and the turbines were inside. The turbines generated electricity. They lit up on one of the little towns out there.

Because it was a closed system, the secondary loop would not be contaminated. The only thing that connects to this is the heat exchanger. The heat exchanger is just transferring heat – nothing else. The primary loop is the hot loop. That's really hot. So you had all kind of shielding around it and on the floor. This entire area was down counter-sunk into the lower area of the building. I'm not that much of a nuclear engineer to tell you the replacement requirements, but the fluid in the loop would probably need to be replaced over time. I don't know for sure though. What you would need to know is what the characteristics of the sodium does when it gets hit by a lot of radiation. In the OMRE, the problem there was when you have this organic fluid coming in there, it gets really gunky. It's like tar. Sooner or later, you radiate it and it gets very viscous like molasses so it doesn't flow very well. The OMRE had failed, that experiment they said forget it.

Looking back at the drawing, this is the primary loop here and this is the secondary loop. I'm not sure if there's a tertiary loop here. Maybe it was a sodium turbine, I'm not sure. What you would do was drive the hot sodium in there and maybe vaporize it and turn a loop. In order to do any kind of work (work = pressure times the change in volume) you have to have something change (volume). This change in volume is a change of state like if you had hot water and then reduced the pressure, then you're going to get steam or gas. That gas is going to be able to drive the turbine. It expands. You have to have this expansion in order to make it work because the pressure's constant. The sodium could be contaminated with other radionuclides, but the sodium itself (sodium-24) was also radioactive.

When the core melted down this sodium picked up a lot more stuff than just sodium-24. The activation of sodium-24, you have to get a neutron and it goes into sodium-23 and that goes into sodium-24, which is radioactive and its half-life is really low. You can pick up all kinds of fission products if you get an open leak in here or if it's a meltdown. That whole thing becomes full of everything.

The question is what happens to sodium when it become further irradiated. Does it change the viscosity? The viscosity just went straight to hell on the OMRE. Whether you have to change it or not depends on what the radiation damage is if anything it does to it. Generally something like a liquid or inorganic like sodium doesn't get damaged. If you radiate something like organic, then all these things cross-link. Then you get different bonding and the viscosity goes way up. It changes to gunky tar, so it's no good anymore.

I don't know about any sodium tanks outside of the reactor buildings or waste sodium, unless it was some tests that they did. Maybe they did some side tests or sampled a loop. I'm sure they had facilities to sample loops. I wasn't part of that operation.

I don't really know anybody else you should talk to. I don't know if they're still around. I can't recall anybody I really knew at the SRE. Any of my friends didn't really do much work on the hill. I couldn't identify anybody there.

With regard to document collection, the only thing I produced there were hazard reports for the SNAP environmental test facility and I can get my resume and show you that. In fact, maybe I can download my resume.

[Looking at a 1959 aerial photograph, EPA points out the SRE complex and a drainage pond.]

Maybe that's the pond that we kept throwing sodium into. If it is the only pond near the SRE as you suggest then that's the one we threw sodium into. I know it was in back of the SRE. There might have been a place where I had these radioactive drums. They were probably "down in Santa Susana," we transferred some stuff down there. It was kind of like a sidewalk or road where they had these barrels that we would load. I was checking the outside of them because I designed the shielding for them. I never loaded the stuff, I just designed them.

There's a KEWB facility I think that was over in this area. KEWB and also the SNAP facility. Kinetic Energy Water Boiler, it's an experiment. I used to hang out over there too. I'm sure I picked a few rays over there. And then there was the SNAP Environmental Test Facility (SETF). I showed you that last publication that I did. They wanted to get a permit to operate this facility with SNAP reactors. SNAP reactors stand for Space Nuclear Aerospace Power I think. We launched satellites with radioactive material in it powering the equipment, that's what SNAP's about. They had contracts to build those reactors. One of them was built with sodium and potassium (NaK). They were doing sodium work at the SRE, so naturally they were also the people who worked with the sodium SNAP reactors. We did quite a bit of work for those. Those are the only two facilities, the KEWB and SNAP, I remember other than the SRE. There were probably storage tanks there. I just remember very vaguely the KEWB and SNAP environmental test facility. I don't think at the time they had any radioactive material in the SETF because they had to get a permit. That's the reason why I wrote the hazards report before you could get a permit. I did all kind of calculations on if stuff got loose where does it go in the air? I did those calculations in the surrounding area. That report would have my estimations of what the radioactive material would be and how dangerous it would be if it got loose. That was the requirement to get an operating license to use the facility.

The KEWB facility definitely had radioactive material in it. It was an experimental fission facility to see how much stuff you needed to make things go critical and to get multiplication and chain reactions. Experiments, basically. It definitely had radioactive material in it. I have no idea what the waste stream was. My only function was to go in there and smear around it and see if there was any kind of radioactive material around it, monitor it with the meter and whether there was any stuff around it that was radioactive that could be picked up by people that were working there that were hazardous. I don't recall picking up anything of concern there. I didn't spend a whole lot of time there. I was only there a few times. I don't know, I just remember that facility.

[Looking at the aerial photograph.] Is this the road that separates the Rocketdyne? The rockets are way over here. I remember we watched some of them. I don't know anything about the

ponds you are pointing out. I never hung around this area at all, maybe walked over there a couple times after a rocket firing and that was it.

I spent some time at the SETF and because I was involved in writing the hazard reports. I was involved in the KEWB and going out there and hanging out. That was it. Most of my time was at the SRE. You never got a whole lot of direction. You just did your own thing. I'm sure people with less experience got more direction. I can't remember how much supervision they got, but I knew just as much as those guys. They were older and had been around longer, but I subsequently did a lot of other stuff they never did.

They tried to put a big chill on this SRE. It's a big PR thing. The head of the AEC came out. He threw the switch, the Jacob's ladder. It was a big deal like that. I remember when they had that meltdown. They were scurrying around like rats. I forgot the guy's name that was head of the AEC at the time. It was a big deal. We all sat around. He would throw the switch and they lit up one of the little towns. They were trying to get the job. Sodium and fooling around with those loops, they weren't going to get that. The reactor industry wasn't going to go for sodium reactor experiments. Water is simpler, pressurized water. Shove that into a submarine and beat them out.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 12/11/2009

Interviewee(s): 10

I went to work at the Santa Susana Field Laboratory (SSFL) in August of 1956. I left in December of 1959 to go to the University of California, Los Angeles (UCLA) to work on the reactor there. I have my clock number and the serial number that they gave me if you're interested in that

My original boss, the man who interviewed me, a guy at Van Owen at their office in the valley, was redacted. And he was my boss probably for the first year at least – direct boss – but I never worked at Van Owen. I always worked at Sodium Reactor Experiment (SRE). And when I first went up there my title was a Junior Engineer. I did not have a degree at that time. I took pre-engineering in high school, I had four years of math, and I had physics and chemistry and I went to USC for a year as a civil engineer.

I was 21 when I went to work there. I had a little time in the service after the episode at USC and I had some electronics there. That's probably part of the reason I think he hired me.

My first job because of the electronics background was to supervise the contract electricians who were doing the wiring and particularly the thermocouples. There were thousands and thousands of thermocouples on that particular plant. And I understood about changing the types of wires on thermocouples and they did not. So my job was to supervise all the hook-ups of thermocouples from wherever they set them and make the measurements up to the control room where they were read out.

I've always worked in the SRE building. The whole time I was there I worked in the SRE building. I also trained on that instrumentation, the parts of the instrument I had not been familiar with before. I was familiar with scopes and meters and those kinds of things. The specialized nuclear instrumentation, the people who had the experience, the older guys, were training me on that instrumentation because when the reactor went critical I went on the operation ship. I hated that. It was a week of swing, a week of graveyard days, and then you had a week off. And I was trying to go to school at night and I was married. It was a nightmare for me, so I didn't last maybe 6 or 8 months or maybe a year on doing shift work. And then they moved me into what they called their experimental section because there that's where I was sort of much more valuable to them. A fellow named redacted. He came to Atomics International (AI) and I think he came to SRE was to do a transport function measurement. Transport function measurement is where you put in a system input to the reactor. In this case there was what they call a pile

oscillator and you put on a known sinusoidal wave and then you measure the output of the function of the reactor – the temperature change, the neutron level change and all that. They sent me because of my background at Sanborne, which was in Boston. And then I came back and set up the oscillographs for measuring the outputs of the transport function. I'll show you some pictures of that. They were able to measure the neutron characteristics, the dynamics of the plant, whether it responds, what the frequency response is. Mathematically it gives you a really long large number of things. In fact that was the first time I'd ever seen it and it was probably the first time it was ever applied to a nuclear plant – this mathematical concept. From there we actually when I went to UCLA, we did it on the UCLA reactor. I can show you a couple of pieces. As a matter of fact there's one sitting right there of a used transport function.

These measurements were to figure out the output and characteristics of the reactor, what the frequency response was, how fast it would respond to the control rods. How the delayed neutrons affected where the delayed – I mean the average time of the delayed neutrons, so how much time did you have for them to make these changes before the reactor would respond to those changes. Ramp up and shut down. We did it with sine waves. We had a poison, which absorbed neutrons which went behind a shield that didn't absorb neutrons and ran it down the reactor and as it rotated around, it changed the reactivity so that the reactor power was doing this at whatever frequency we wanted to run that thing. Then from the ion chambers, which were measuring the neutron output and the power output of the reactor, we hooked those up to our oscillographs and then we had an input and an output on the same piece of paper. I could show it to you for the UCLA reactor. I can't show you for this one, they kept them all. They didn't do the mathematical analyses up on the Hill. They took that down to Van Owen. There weren't many computers in those days, so I don't know they must have given it to the mathematicians to do the analyses.

We put the pile oscillator down into the sodium – into the reactor itself. You'll see pictures of the thing operating.

You won't see the ion chambers because they're down in near the core. They're under the big concrete shielding. That particular reactor, in addition to the activity coming from the fissioning of the uranium – the sodium becomes extremely radioactive (sodium-15). So everything that was measuring the actual reactor itself was down underneath and you wouldn't see the chambers.

Compensated Westinghouse, Compensated Chambers – they were this long and maybe about that big around. They had both compensated and uncompensated. The compensated were used to log in the linear power meter. The safety amplifier was used on non-compensated ionization chambers. We used exactly the same ones that they used on the UCLA reactor. I got a spare set when I went back to Oak Ridge [National Laboratory] from that helium reactor that never went critical. They let the university have some of their electronics, so we had an extra set of them to do experimental things with. The people that I worked mostly with were [note a series of contacts was provided and has been redacted for privacy].

This guy [pointing to name on paper] went to General Atomics and he was big in the health physics society. He did some consulting afterward and he was always involved in the reactor

emergency response things. I ran into him all the time there and I've stayed at his house too. I'll think of it, but he… Okay, remember we're talking about the 1950s and this was only the second power reactor in the world as far as I know. So there was a lot of training. They trained us probably a couple of weeks in health physics procedures alone. I had special training in instrumentation because my area/background was in instrumentation and just had to be converted... They even gave us lectures on understanding the reactor itself and what we're dealing with and that aspect. And I did get to operate it on the ship, although I was not an operator. I was the electronics technician on the ship. If something went out I could put new vacuum tubes in. I kept the ink running in the recorders. Anything that was instrumentation-wise that was on the ship that was my job. Because it was back-shift and not a lot to do they put me in a high stool because I couldn't stay awake sometimes. I'd fall off if I went to sleep. They also let me sit and run the reactor on occasion. Even, maybe not to take it critical, but to bring it up to power and stuff like that. Everyone on the ship was supposed to be able to do everyone else's jobs. I think that's a good measure. You know, I don't remember the trainers' names. The health physicist (HP), as soon as I come up with him and I will come up with him because I've known him for all these years.

The focus of experiments was to work towards a commercial product. As a matter of fact they were building one at the time. It was being built in Nebraska and it was a sodium reactor. It was a full size. This was one of the five pilot plants. It was a helium cooling reactor. This was across the border. And I'm not sure if it ever went critical. It may have or it may not have. They had two fatal accidents there as we had two fatal accidents. Nothing to do with radiation. All the primary sodium was underneath these huge concrete vaults that were high density concrete and you lift these great big tonnage blocks off because of the sodium radiation. The tubes were thin and the guy just fell of the edge. You fall 15 or so feet before you hit the tubes and it just slices you up like a big cutting… and he died. The one that died at SRE – when you go down there those pits are very hot and the air circulation stopped for a little bit and there's an inner gas filling when the thing is not there so that the sodium doesn't burn when it comes out into the atmosphere. They just passed out from that. One guy passed out and the guard was supposed to be his mentor monitoring him crawled down to get him and of course he went to and there was no one to see them before they died from asphyxiation.

Redacted. He was one of the main HP's up there. Redacted did some of the training, HP training. I was an engineer, I wasn't an HP at that time. He just recently passed away. Last Christmas or before. Not much older than me. When he retired from General Atomics, he went to work for the state of California. By that time I was with the Nuclear Regulatory Commission (NRC) and overseeing the state of California. One of my jobs was to go out with each inspector and he was one of their inspectors so we always made a joke out of that. He had trained me 30 years before and I was supposed to be taking him out training. It was a good laugh for us. We enjoyed that aspect of it. Yes, we had film badges from before the reactor started up. Everybody wore them. They were very conscientious about wearing them. There was hand monitoring as well. People like me did not do the monitoring because if you went down into the pits or anything like that you always had a health physicist to check the thing out before you went down. Or maybe even put extra dosimeters on you depending on what you were going to do and monitor you when you came out or even sometimes go with you. So Frank went with us a few

times. I got used to it. Working in the pits was really hell. It was 140 degrees in the pits and you had to make sure that the air was going so you didn't suffocate from the inert gas. I think the inert gas was probably argon.

My work down in the pits was doing the sensor thing for the endothermal couples. They were tacked onto the piping for instance. If they come loose, I need to go down and spot weld them back on. Or the flow meters – I would go down and see if they got jammed up or not really working. The sensors for the instrumentation were all down in the pits and somebody had to go down and look at these.

Thermocouples you can always leave a little slack and strip back reattach them to the pipe. And you mostly do it with a tack welder. There was not a lot of waste material/waste electronics coming out of that work and the thermocouples are radioactive. Sometimes I pulled the asbestos off myself to do repairs. And it was asbestos, there's no question about that. If you asked most of the people that did this type of work asked, you just wore a piece of paper over your nose because if you wore a hooded thing and you're working in 140 degree temperature you couldn't see and the glass would fog up.

The other thing as long as I was down there, all the pipes had 240 volt heaters and sometimes the wires on the heaters came loose and I would fix those too. And many of the days I got 240 volt shock, but you can live through it. Health wise, the absolute worst thing… and we all had to take turns at it because they don't want you exposed for a long period of time…In the earlier days we used toluene as the pump cooler, not tetralin. And we had a lot of leaks and sometimes the big rotating pumps would seize up on us because the sodium would solidify. And we'd pull the pumps out and take them outside. With a little steam generator and just a face shield and nothing more, we'd take turns steaming the sodium off the pump. That vapor coming off as the sodium was going "boom boom boom." That vapor coming off there would take the mucus right out of your throat as you're breathing that vapor down. Talk about a hazard, that was probably the greatest hazard I was in.

Toluene was a coolant. Not a lubricant. The tetralin was a coolant. The way a shaft is turning and comes through a seal – the way that they made seals for the sodium was that they froze the sodium. Freezing to you means ice, but freezing to sodium is about 200 degrees or 180 degrees. The sodium would come up through and freeze and that would be the seal. The way they made it freeze is by having it circulating a cooling material around where the shaft came through the seal. The cooling material in the beginning there was toluene and then they switched to tetralin. And somehow the tetralin leaked into the sodium is what caused the initial thing. And by the way I was there when - we didn't realize that the tetralin had turned to tar and plugged up one of the channels to the fuel elements or a couple of the channels. The reactor just acted kind of strange. We didn't shut it down, we just kept on running. This is an experiment and we didn't know what was going on down in the core. Even after we did know what was down in the core, we put fuel elements back in it after we pulled those others out and tried it. But officially we didn't go back to power until after I had left. We went back to power several times while I was still there. There were no rules against it remember. We were under the Atomic Energy

Commission (AEC), an AEC reactor those days. The AEC had people out there almost daily to see what was going on.

The pumps that we steam cleaned were not radioactive. It was before we took the reactor critical. And by that time we learned about the tetralin and switched. We didn't have those same kinds of problems with tetralin that we had with the toluene.

Regarding sodium on pumps or pipes that was taken over to a pond a half a mile west of the SRE that was not radioactive sodium that they took over there. It was after the sodium-15 decayed out. If there was extra sodium or sodium leaked out of the system they'd clean it up and dispose of it in that pond, in that waste pond. But that was on Rocketdyne property I think. I don't believe that was on what we considered to be Atomics International fenced in area. I think that was on Rocketdyne. But it was our sodium, no question about it. They did dispose of it there. In terms of the fission products that were released from hot sodium, iodine immediately went into it. The xenon, xenon's an inert gas, so it built up in the top of the core, but it was released. There's no doubt about that. The radioactivity that went in the high bay didn't seem to be infected all that high and we were still walking around the high bay most of the time. The only time that we didn't walk around the high bay was when we put a fuel element in our cleaning facility before we put it in the hot cell. One of the cleaning facilities I guess they didn't get enough inert gas in there and it caused the sodium to explode when they flushed it with water. It blew the element, this is a hot element out of the core, up into the room and the activity there – everyone ran out of the building. The activity there was extremely high. As far as exposure to the people, it was only for seconds and many feet away from it I think.

I was not involved in the decontamination operations at SRE. We used toluene as a decontamination agent at UCLA a lot, but I learned about it up on the hill. You put it on concrete. It actually pulls the moisture out of the concrete and put the stuff in solution. I thought we used that up there too. Maybe I'm remembering from my time at UCLA. I thought I learned about it up there. It was a decontamination agent. It was fairly new at the time.

Going back to the sodium removal from pumps. They wouldn't do that kind of cleaning operation until the sodium-15 had almost completely decayed away. If we had to work in the pits or with anything in the primary loop after some hours of operation, we had to sit there 2 weeks until sodium (sodium was a 15 hour half-life I believe) completely decayed away before we did it. After the fuel melted – the strontium, cesium, and iodine – all of those things go immediately into the sodium, combined with the sodium so they are not free. We had clean up systems. We had filters. Probably ion resin exchangers and we'd run the sodium through that and we could clean out the fission products that were in the sodium by using those filters. If it was solid, the filters would take them out and so we can clean up the primary loop pretty well. I think the primary loop was on a somewhat continuous cleaning cycle during operation, but if we stopped we would increase that. So we'd get the fission products or whatever happened to be in the sodium out of there and that was all in these pits too. The pits may have been external to the building because the one thing that you could do with this reactor is that we had tanks that were big enough that you could put the entire primary loop sodium into a tank outside so that your sodium loop was empty.

Those were underground tanks, they're in big concrete blocks. Huge concrete blocks. The high-density kind. The concrete blocks that they had to lift off of these pits, they were kind of stepped, smaller at the bottom so they're stepped down because of the radiation. We hired a crane operator to lift one of the blocks out. They were trying to tell him this concrete weighed such and such per square foot. And he says look I've done this all my life; don't tell me what to do. And of course he picked the thing up and turned his crane over and probably a half a million dollar crane or more because he just wouldn't listen. He was too smart for all that.

So when the pipes are cleaned out, the fission products are cleaned out and that material would be in the cleanup part of the system, which sometimes was outside. I don't know what happened to it the radioactive waste after it was removed from the system.

With regard to the SRE incident in 1959, it didn't melt down. I think the cladding failed on it. The stainless walls that the pellets were in got hot enough that they weren't getting enough cooling and melted the stainless. My understanding is they did pull one of the elements apart and part of it stuck to the bottom. They eventually got it out of there. When they pull those up keep in mind they had to go through a big tank of sodium. So any volatile stuff is going to go in that sodium as they're pulling it up. Sure there's going to be fission products that come with it. They had two fuel handling machines, both of them heavily shielded. And they pulled the fuel up in there. It'd have been nice if the fuel was all together but that one fuel rod. I think they only pulled one of them apart. I think the other damaged rod came up as a whole fuel rod. It went right up into that machine. Yes you're going to contaminate that machine and you're going to have fission products in it, but they're still contained and they're still contained in the inert atmosphere. They move them over and put them down in the fuel cell [or holding area], but they're still contained. The reactor itself, the vessel – nothing melted. When we finally got that element out we put another new element down in the hole. Got the hole cleaned out so the sodium would flow through and start up the reactor again. We couldn't have done that if we had a Three Mile Island.

We had air monitors in the high bay, control room and outside that were continuously monitoring the air and recording it on chart. They had particulate filters in them as well as looking at gases and they had recorders. That was part of my job too. They had recorders in, so we saw an elevated amount of radiation, but not elevated to the point where we couldn't walk in there.

No, I don't know anything about offices getting contaminated and files being taken outside. The high bay itself was under negative pressure compared to other offices in the buildings and the control room so that any airborne contamination would come into the high bay and go up the stack. It would not flow the other way. I've never heard of an incident – and there were multiple fans, so a power failure on any reactor – we had a battery room, generators. I worked on this system too. They turned continuously, there were motor generators that turned continuously and kept the batteries on flow. You wouldn't lose one cycle. If the entire power shut down the line going into the place or going out of the place, the batteries would turn the generator as a motor, the same thing it does on my Prius, turn the generator as a motor and you wouldn't even lose one cycle of AC. They would stay on long enough for the diesel generator, which is a 100 kilowatt (kW) diesel generator. It wouldn't be one cycle off from the switching over so that you never

lost power for anything. You never lost power for your fans, to your instrumentation to the reactor room, to your control rods, to your pumps. If you were in a situation like that, you didn't demand – you were in shutdown position if that system came on. You wouldn't be running your major pumps, but you can run your minor pumps. That reactor, the beauty of sodium is the heat transfer coefficient is so high that if the whole thing solidified, it still would not melt down. It would carry the heat out to the heat exchanger and either blow it to atmosphere or send it to the generator which made steam and water – I mean steam and electricity. The sodium occasionally in some of the secondary system – the primary system was all under the concrete blocks so the secondary system is the one that shipped the heat over to the pipes.

We didn't have World War III. Between Christmas and New Year's on a midnight shift when it was raining cats and dogs all of a sudden we hear this "boom boom." We go running outside and the whole sky was lit up. One of the seals on a sodium loop had broken – so the 1,200 degree sodium was shooting out into the rain. It was exciting. It was the most exciting thing I saw out there.

As far as the activists at the site go, I know redacted personally. I've sat at a bar and had a beer with him. I'll tell you exactly what he told me. He said, "I'm making a living on this. I'm going to become somebody famous on this. I don't have to have the right idea. All I have to do is convince the right people." That was when he was trying to shut down the UCLA reactor.

With regard to the allegation on the SRE is that there was an unmonitored release of radioactivity because it exceeded the equipment at the time, there may have been. First of all I don't disagree about the probability there was a release and we may not have known how much, but I can guess. It was inert gas and it was released out of the stacks so the people who worked there were not exposed to it. It was a Santa Ana weather condition at the time that this happened, so it all went out to sea. If you look at the population density of the path of it in those years, you don't look at the population density of the path of it today, it was maybe the little strip of land in Malibu, the sand, there were houses, but between there and the ocean that's about the only place there was any population whatsoever. By the time it got there, I'm sure the concentration was insignificant. And yes I've heard a million theories. But you're talking about being shot up a stack at a high velocity. The stack was way above the roof of this thing, which is about three stories up.

As far as releases, it would be xenon gas. No iodine as far as I know. The hot sodium becomes sodium-iodine instantaneously. You're not going to release iodine, strontium, and cesium. What you're going to release is xenon because xenon is an inert gas. Once it's out in the environment, the concentration is way down.

Argon has no body uptake. Xenon has no body uptake. So the only radioactive exposure you'd get is when you breathe it in and out and the time it's in your body, in your lungs. It doesn't stay in your body whatsoever. So the exposure still would have been fairly low even though the concentration at the point of release would have been very high.

Moorpark is the town we isolated and gave it nuclear power for a month. It was the first city in the world to exist on nuclear power independently. We even beat the reactor in Pennsylvania (Shippingport) that was the first reactor online, we were second.

With regard to the SRE and steam cleaning the pumps and the underground storage tanks, there was a cement pad on the north, big double doors, and that's where we took the pumps and did it right on that cement pad. The tank that we're talking about that holds the primary sodium was just to the east, right up against the building, and east of that pad.

As far as Area IV went. They had some little reactors. The operators and including myself – I am not an operator. I had 20 years of senior operator license at UCLA, so I've been through the program. I taught the program a long time myself. There were some NaK experiments going on in some of those buildings too. A combination of sodium and potassium, it melts at a much lower temperature than sodium did. The sodium melted at such a high temperature that was one of our problems, keeping everything to heat to that sodium would stay liquid.

Working there you also meet people from Rocketdyne. They had some pretty serious chemicals over there that are hazardous too. In reading, redacted has kind of just pushed those things all together and made it one. He doesn't distinguish those chemicals from what is going on in the nuclear plant. He makes it one big issue. There may be this pond you're talking about. Yes, groundwater from this pond soaked into the ground. That would be chemical problems. I don't think anything radiological. I think we took sodium that was radioactive.

Regarding finding cesium and strontium in a 1980s excavation of the pond, that's fission products. Oh, let me tell you something. I was also responsible for monitoring the UCLA reactor. I do wipes on the campus because people are concerned about releases onto the campus. One day I wiped and I got cesium and strontium. There's no other reactor could be putting this out. When the Chinese did their bomb testing, a lot of it drifted here to the U.S. Fairly high levels, levels that we would require decontamination if it were on the streets at Westwood. On other streets, I would just wipe it down and I would consider it to be decontamination.

I do think you can analyze the material and know whether it was from weapons or from a reactor.

With regard to what happened to the primary loop sodium from SRE, it would be hell of a lot of truckloads if it were sent to Hanford. When I first got there, there was no sodium on site at all. We're talking about dozens of 18-wheelers with 55-gallon drums of sodium on them. We had a special place where we would put the drum and put heaters around it and put asbestos around it. It would heat the drum up and run it into the system. The sodium was packed in drums. I was there when they opened them. It was solid though. I don't remember any oil being used to pack the sodium. It was just an inert gas that was used. You set the drum upright and you put your fittings on it with the valves and everything in the upright position. The room was very dry and then you'd set the drum up here and you wrap it with the heaters and asbestos. You start heating it up and you got to a certain temperature. You open the valve and you had to have a vent at the

other end. We did have it hooked up to a cylinder of argon to push it out. We'd flow the sodium out and into the main tank for when we're going to fill the reactor.

With regard to filtering the sodium in the primary loops, it's just like water on a reactor whether it's a submarine or the UCLA plant we had filters and mix bed ionizers. You could drink the water that ran through the core. It was a lot cleaner than the water you got out of your tap. What do you do with the filters? You shipped them as radioactive waste normally, but there was very seldom much stuff in them.

Once they decided the end the experiment, they probably put the sodium back in 55-gallon drums would be my guess. I never got to the pond [sodium burn pit], but I knew we had one and that when we had contaminated, dirty or leaked sodium we'd scrape it up and put it into something to take it over to the pond and dispose of it. I thought the pond might have had a liner.

Looking at an aerial photograph of the site I can point out some little reactors. There was the L-77, which they were going to sell to schools. There was one more. And then there was the organic moderator. I don't know if that was a zero power reactor or if they got that far or not because one of the companies in the east did build an organic moderator reactor. We were going to go that route, but they beat us to it. It never progressed. The sodium pump cleaning would be right about here on the map. The pit that I'm talking about that has a tank for the core reactor sodium would have been right here.

There were some pits outside that were pretty deep, maybe 20-30 feet down. The hot cells were in a building, which was underneath the building in this corner. They all had drains and they had to drain somewhere into a tank. I think that stuff was on this side. I remember I had to suit up to go down in one of those holes one day to do some fix on instrumentation. There was concern about contamination. I had to climb down a rope ladder with booties and gloves and totally covered up with a face mask and all. No harness, not in those days. I know there are pits along there. They're quite deep.

What were they finding in the soil? At what concentrations? Why don't they put a fence around the whole thing and walk away? The level of contamination where somebody lives and particularly if they also farm versus the level of contamination where you would have a day-use thing is different. The cleanup levels you are at are almost down to the level where we're talking about background radiation from other things. You have to find background levels beyond 50 years ago? We're getting close to 50 years on this reactor.

Let me show you some pictures. One of these is the input to the transport function and then it goes through the reactor and then one of these is the output. This is the first use of Sandborne equipment, primarily electroencephalogram (EEG) and electrocardiogram (EKG) machines. The first use in an industrial setting, especially in nuclear. That's the control room. They had a little room for experimental material. This is the reactor console right here. This is the engine behind from the sodium reactor. Here are pictures of the console. That's me, they set up an external

thing so I could go down and make measurements in that area. Here are pictures that are mostly taken shooting down the Hill from behind.

This concrete thing here, that's where the primary sodium tank was located, was emptied, was reacted, was running and it was full and when they'd work on the reactor they'd pump the sodium back into this tank right here. This pad right here is where we cleaned the sodium pumps. We had a portable crane and we shipped them from internal crane to portable crane and come out here and shoot them with hot steam. The stuff would blow.

On the base of the pump if the toluene was not efficient and the pump would seize and the sodium would solidify. We had no way of getting that off of there. So we'd bring it out here and shoot it with water.

It's sodium from the primary loop before the reactor started. We did a lot of testing. I was there for most of the construction. We did a lot of testing of the pumps. At first we didn't completely understand sodium being used in this fashion before. This is totally new engineering. This thing right here is where we put the drums to melt the sodium that came up in the trucks. This is the secondary loop where the heated sodium from the pit. The heat was transferred from the secondary. There's a heat exchanger in here. If we needed to get rid of the heat because of a shutdown or something and the power plant couldn't take it – this is the steam power plant – then it would go out of the heat exchanger right there. The secondary pumps are in this area. The primary pumps are underneath the concrete and the sides. Did you know about the steam generator? They were worried about 1,200 degree sodium and water. There was a layer of mercury between the water jackets and the sodium and what happened to that mercury I have no idea. We're not talking about a small quantity of mercury here, we're talking about maybe a few hundred gallons. I do know that there was mercury in there, so if the pipe corroded through the sodium would either go into the mercury or water corroded through it would go into the mercury. The sodium wouldn't go directly into the…I just don't know the volume of mercury.

The heat exchanger I heard had mercury in it. It had to be a unique one. The first submarine was the Nautilus. The second submarine started out to be a sodium cooled reactor, but the guy who headed that program, Admiral Rickover, was really scared of the sodium underwater. So he had them pull that whole system out and put a water system in. We got the steam generator up here and plugged that as the secondary steam generator, which did not have the mercury transfer in it. I think that was used towards the end, too. Two conversions from the sodium to the steam to turn the turbine. That's redacted. He and I worked close together, he was another technician. This was on the reactor floor. This is the pile oscillator and it has a shaft that goes right down to the reactor core. These are control rods. This is our oscillator. This is the motor for it and the sinusoidal input – we got the input information on the top. The right angle shaft goes down into the core of the reactor. It spins around on itself. That's how we create the sine waves of the power. Here I am at the end of the oscillator. We have the Sandbornes set up. This is the power supply to the chambers that we're using. These are the Sandbornes to look at the output/input of the information that was going on. They didn't like us out there in the reactor core. So they moved us into that room – you saw that other picture. You can't really see the vertical shaft down to the core.

We built it in the shops. You're right this whole system us custom made and we built one similar to the UCLA reactor.

You couldn't call up a company and say send me a pile oscillator. There's no such thing, so we had to build it. This is the paper coming out. I think this is a four-channel, so we had a lot more information coming from that. This is redacted, he's out on the floor. They didn't want us on the floor while the reactor was running at full power. We did transport function at full power. I gave lectures on the Sandbornes. This is the trip report from sending me back from Sandborne. This is a procedure for the hot trap and this is one of the traps of the sodium reactor, you're cleaning up the primary sodium and how to do that and operate it. The ship supervisor was redacted and I worked for him at this particular time when I was on the ship.

26th of June 1957. This is a long time ago. This is the head of the experimental unit personnel. I told you I don't get along all too well on the ship. So they moved me over to the experimental unit. This is where we started doing the oscillator test and things like that. I still did a lot of instrumental repair. That was primary job. [Review of people in experimental unit who were in the photographs].

[Looking at UCLA reactor photographs] That's the UCLA reactor console. When I went to UCLA we were brand new too. There were just three of us. I worked under redacted as a technician, but I quickly got promoted to assistant supervisor. After three years he resigned and went someplace else and I got his job.

I'm not sure that it's helpful for you. Because I went to UCLA, I saw my radiation records and I never got more than 100 milliroentgens (mR) at any time. You get more than that when you take a CT scan these days. I was there when it melted down probably on the ship because we didn't know it melted down. All we knew was some of the instruments – in fact they had me take that recorder off and put a signal in to make sure that recorder is working right. We don't believe that recorder's in. That the kind of thing I was doing when they were trying to figure out what was going on with the reactor. Yes the fuel did heat up because it wasn't getting coolant from the sodium, which was blocked because the tetralin turned to tar at the bottom and it melted through the cladding. I don't call that a meltdown, a cladding failure. We were an experiment after all. There were no other sodium reactors in the world at that time. There were a lot of good things about sodium. Like I said, you couldn't have the problem you had with pressurized water reactors like they had at Three Mile Island because if sodium even solidified it would carry the decay heat away from the reactor and cool down by itself. We could blow it out the air blast heat exchanger we had outside. There were a lot of good things. The other thing is when we were producing electricity for Moorpark, our temperature of our sodium was 1,200 degrees so we were 40 percent efficient. Even the best water reactors today are only 30-35 percent efficient so we were more efficient than any of them because we could carry a higher temperature. When you get water at that temperature, you're talking about 2,200 pounds per square inch and you've got a lot of problems to deal with. We're talking about with the sodium reactor that's atmospheric pressure.

The whole idea of research reactor is you put things in to be irradiated or manufactured, so we had a lot of handling things that came in and out of the reactor. Up there it would be only if something failed and they had to take it out of the primary loop and repair it. If it was failed beyond repair, they'd put something new in. That would be contaminated. They let it sit around until most of the radioactivity decayed away. It was primarily – I was wrong, it was sodium-24 that had a15 hour half-life. They let it sit around along as they could and it was primarily decayed away. You didn't see a lot of fission products because on that particular reactor the sodium picked up most of the fission products. In the release of the fission products when the fuel melted, it went into the cover gas, which was argon, and it would mix with fairly high concentrations of xenon. They didn't want a lot of pressure on top of the reactor core. They want enough to force the sodium down, so they would release it up the stack. During normal operations, the cladding didn't leak.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 2009

Interviewee(s): 11

I was hired in 1956, and from 1956 to 1974, I worked as a mechanic for North American Aviation. Then it became Rockwell and later Rocketdyne. Our office was down in Canoga Park, but I worked up on the Hill all of those years. I worked in alpha area, bravo area, coco area, delta area and Component Test Labs (CTL) 1, 2, 3, 4, and 5. They had three shifts in that area or two shifts rather. They didn't believe in three shifts, so they had the guy working 10 hours a day over in Rocketdyne. All we were doing up there was testing rocket engines for space. We had big water buckets, bigger than this house, where the flame will come out and then shoot out this way. I can't really say. Everything was fine up there. I worked different shifts there for a while. I was a mechanic. Then I went into inspection.

From 1974 to 1986, I was at the Energy Technology Engineering Center (ETEC). As an inspector at ETEC, I checked on everything there and made sure they were running all the tests. I had to do a leak check with a machine up there, checking on any of the nuclear stuff for any type of leakage. I inspected everything they had there for testing radiation. One place there we had to go down in the basement, I don't know how many steps, and check for leakage on any of the nuclear stuff down there. I inspected all of ETEC for any type of leakage all around.

We buried a lot of stuff. There at ETEC. I was an inspector up there at the time. We only had the one shift. We didn't have a second shift or third shift. Evidently they felt there that the guys would be better off learning all this stuff on the one shift because there were sometimes when I'd working Saturdays and Sundays and we'd have to talk all kinds of samples. What they ever did with them, I don't know. I can't answer that.

We didn't have to wear any sort of hazmat suits at the time. I had to wear a mask/respirator and a hard hat all the time. I can't remember if I wore a dosimeter or film badge. I don't think so. It was all new to them. We were just getting into it.

My job as an inspector involved checking for leakages and pipes. We had a leak detect machine we'd run in there and put in liquid nitrogen or hydrogen and check all the piping and fitting for leakage. I tested sodium, helium, hydrogen, nitrogen pipes, and liquid oxygen pipes. We had to be careful of liquid oxygen because that did the most damage. I didn't work in any one building more than another, we just had to go to one building one day and another building another day. We'd get a call and the supervisor would say, "Go up there and you've got to check for leakage in there."

I can't remember any accidents of spills. If it happened, we never paid much attention to it if you follow me. Oh we got a slight leak going there. We'll just get a shovel and bury it. You know what I mean? That's about all we did. We didn't know too much about it at the time. As far as what we buried it would be leakage from the type of testing we were doing. It's been so darn long now I've forgot a lot of it. The mechanic would bury it. We made sure to bury it out in the ground or something like that. At that time, they didn't know what to do with it either. It would be small volumes, smaller than a bucket or drum. That would happen maybe once a week, maybe once every two weeks or something. They were pretty careful about pipe connections and stuff like that to make sure they weren't leaking.

The mechanics would just dig a hole, 1.5 or 2 feet below the surface and deposit stuff. They took it over to one area out there. Don't ask me where it is or where it was then, I don't know.

Nobody could believe my serial number. I was hired on with North American before the war, out in Inglewood. They were looking for workers, so I went to work. I said all right and I got in. They had the draft, but I enlisted in the Navy. My number was three digits and when I'd go through security at the gate they wouldn't believe it. I said that's the number. They had to call down to Inglewood, "This is the man's name, what's his serial number?" They couldn't believe it. Everybody else had five or six digits in their numbers. So then when I hired in with Rocketdyne in 1956 I had the same serial number and nobody would believe it. When you went through the gate, you'd have to give the serial number. I told the guards this and that. No it can't be. Call Inglewood, call Canoga Park. Oh okay, you're in. Those days it was a gated community. Guards at the gate. I don't know how it is now. If they still have guards at the gate.

I might have handled radioactive materials, but I can't recall really. It was so new to us then that we didn't know.

I didn't do any work with the removal of drums or waste because I was an inspector and all the drums were taken off by a company of fork lifts and moved someplace.

The mechanics that worked there may be able to help with more information. I can't remember where they are or who they are. One guy right now, he lives up in Tehachapi. My nephew was working at ETEC. He spent quite a time over there in radiation. He was a mechanic. My son was over there, but Rocketdyne sent him down to Canoga Park and he worked on Canoga Park. He was a manager down there in college.

I couldn't tell you what my nephew did because he's still working there. Forty years he's done with them. He works out of the other side of Palmdale and all that stuff that's up in there. He put in 40 years and he retired and they said no we want you to keep going. So they said you will be a "job shop" and if they want a job up here in Palmdale, he'll go over there. He lives out in Tehachapi and he goes to various jobs up in the desert.

The mechanics would take the piping apart, repair it, put it all back to together, and we'd all go inspect it for leakage when we did the test.

The mechanics worked out of the building. I don't remember all the building numbers, but they'd have all their equipment in a building and work out of it. They'd be working at the building that had the piping problem. This was in the days before all the computers came out. They would work in the different areas that needed repairs. And we were able to drive our vehicles up in there. We'd drive in being to the main office and if I had to go out on the job, I'd take my vehicle out to a certain building.

We had an area up there where they dumped a lot of that stuff, but don't ask me where it was. It was kind of on the side of the hill. They had to dig it out and bury this stuff. To tell you the truth, then, we never paid any attention to it. They said okay we have to bury that stuff over there. Whatever came out of the piping if there was a leak was buried. I think pick-up trucks came in there if there were ever large things needed to be disposed. I never paid much attention to it.

If I were to try and guess where the mechanics and people would bring the small volumes of waste for disposal it would be in Area IV someplace, but I can't say where. I think they were called Maintenance and Maintenance would come down and pick it up. The barrels and stuff. They may have called Maintenance for small volumes as well. Being in inspection, I had nothing to do with it.

I can't remember anyone's name in Maintenance off hand. I could tell you guys from Rocketdyne side, engineers. They were test-hand engineers. We did the firing of the rocket engines. We had a great big piece of granite material and we did a lot of inspection on that for leveling. Most of his work was inspections of materials coming in. We had this great big granite plate that was all leveled out and we had to check it for leveling. It was a regular great big piece of granite. It was all leveled. Shipped that from Italy.

Building 59. That's an awful familiar number. They had a reactor in there. I worked at all of the buildings. We had to do a leak check down there and go over there. When you quit working you forget. Those buildings were familiar. Small Component Test Loop (SCTL), Sodium Component Test Installation (SCTI). I was in both of them quite a bit. Being an inspector, they had all the mechanics in there doing all the work and we'd get a call to have a leak check or putting this and that together. We had paperwork to buy it all off. I don't know where that paper work ever went. It went someplace. It was paperwork of what you've done. Kept in folders. They'd have it all down – inspected this, inspected that. Then we'd have to sign off on it.

This page was intentionally left blank.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: _____

Interviewee(s): 12

I was a construction inspector also known as a labor 17 inspector and began working at the Santa Susana Field Laboratory (SSFL) in November 1974 and retired in 1995. I worked throughout Area IV for Atomics International, Rocketdyne, and then Boeing. I worked throughout Area IV, including at the Liquid Metal Engineering Center (LMEC), which then became the Energy Technology Engineering Center (ETEC).

I have worked to build new buildings from the excavation up, including piping systems and refurbished existing structures. I have worked on sodium piping, steam pipes, and power plant systems. I inspected aboveground storage tanks and underground storage tanks. As an inspector, I did a little bit of everything including non-destructive testing. Some tests, for example, were to ensure the quality of concrete and required breaking apart the concrete in labs, whereas other structural integrity tests were done by x-ray using cobalt-60 and/or radium-192. Most tests were related to sodium pipes and steam generator pumps. I also worked on excavation water pumping. I wore a dosimeter and/or film badge when working in "hot" areas or potentially hot areas. All film badges were collected every 3 months. I never worked on any detail that required use of the borrow pit located on the south hill, but I am aware of that borrow pit. Excavated soil and broken concrete would be dumped along the border between Area IV and Area III, near main road. Some construction crews would also dump concrete and rebar, such as the concrete floor from the Sodium Component Test Installation (SCTI) removal (Building 356), in "that small pond."

I think the safety procedures were very good at SSFL.

Fuels were fabricated in Buildings 20 and 25. Most reactor buildings had been dismantled before my time at SSFL, with the exception of the SRE. Building 12 was where my radiographic testing lab was located and prior to that it was a "power source for NASA."

All of the liquid waste I am aware of, such as dowanol and other non-radioactive liquids, may have been reused, but were eventually drummed and "taken away." I do not know where the waste was ultimately taken to.

I would collect solids that accumulated in the cold traps, which were the lowest portion of sodium piping. The steam pipes I worked on were as high as 2,000 pounds per square inch and one way we would test for pin holes would be to slowly move a broom in front of the pipes and

if the broom suddenly burst into flames, we knew we had found a leak. Most “mini-fires” from sodium pipes were contained by the operational crews before the fire crews would arrive. The firemen were not well trained in sodium fires. Security and fire protection were one and the same and the firemen were armed.

All film badges and dosimeters were tracked by, and assigned by, the Health and Safety Department. All spent badges were sent to them every 3 months.

It was common knowledge that “stuff” was dumped into the Sodium Burn Pit. A cache of mercury was found in the pit once. That lake in Area III (that was drained to) was used for washing out the flame buckets at the Rocket stands.

An area next to Building 59 was excavated for a new building, but then the plan was abandoned and the pit filled with groundwater that was subsequently contaminated with radioactive liquids released from Building 59. I learned this second hand though, so I don’t have any other details on that, but I can point out Building 59 and the pit on the aerial photograph. There was a dumping ground near the pit as well. Construction maintenance personnel would dump along the two roads next to the pit area. It was common to see dark stains in this area.

A bermed area located along the boundary of Area IV was used as a small arms shooting range. I can point this out on the aerial photograph. To my knowledge there was no indication of dumping here.

I assisted in the construction of drainage ports in the concrete foundations of buildings that would redirect groundwater trying to seep into deep foundations to an interior trench that would then be pumped out of the buildings.

The only release I know of first hand was an alcohol spill (dowanol). I had heard there may have been a radiological release in the 1960s during the construction of a reactor for satellites, and then the previously mentioned leakage from Building 59 to the pit occurred in the late 1980s and1990s.

I can indicate on the aerial photograph you provided a general area that was used for the disposal of miscellaneous debris. It was this general area along the southeastern side of G Street. I don’t know if any irradiated material was ever disposed in the area.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 2009

Interviewee(s): 13

I worked for Rockwell/Boeing in all areas of the Santa Susana Field Laboratory (SSFL). I was an Environmental Technician for 28 years from 1981 to 2009. In that position, I was in charge of the hazardous waste yard area and later testing standards.

There are some areas of potential areas of concern I want the Environmental Protection Agency (EPA) to know about for its sampling effort. I can point out a number of these areas on aerial photographs.

Pits 1 and 2 near southern portion of SSFL. This is the "million dollar hole." I think these pits are from the years 1990 and 1991. They are "sodium burn pits" and among the various things that may have been put there, the sodium reactor experiment (SRE) primary sodium loops were found in these pits. I think there is Channel 2 archived footage of pits 1 & 2.

Up near the fire hydrant "NaK Bombs" were disposed of (cylinders of sodium potassium).

Building 204 (or possibly 209) was a maintenance building. Barrels of waste oil were stored here that were used to suppress dust on all the roads. The roads would be sprayed with oil to keep the dust down. In the 1960s, at least one time that I know of, a barrel of waste oil was determined to be "hot" with radioactivity and it had been used on the roads. That waste oil may have come from Building 26.

There was a large fire in November 2005 and I was assigned to sample ash from the fire all over the hill, including outfall 3 and its leach field and holding pond. There may have been some "hot" readings of samples, but I can't remember any details. I can point out the general area where I sampled on the aerial photograph.

Building 65 was a lab that I remember a certain scientist did "weird stuff" and worked with sodium and potassium.

There were two, small concrete-lined pits about 6 feet by 10 feet deep for rinsing sodium parts. I can't remember where the pits were located, but they were open pits. I remember dowanol (non flammable alcohol) was used for rinsing sodium parts.

Building 10 had high groundwater hits. This building may still be “hot” and that no one was allowed in during the 1980s and 1990s.

I also recall Building 5 or Building 30 being posted as “hot.” I can’t remember which, it may be that Building 30 was next to Building 5 or an AI warehouse, but one of those buildings “had something small in it that was cleaned up quietly.”

I can point out the missing uranium slug area on the aerial photograph and an area where grid lines were laid for a radiation survey. I do not know why a survey was done in this area though.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: November 2009

Interviewee(s): 14

I was a contract health physics technician from 1977 and 1978. I worked 1 year for Chem Nuclear Systems, Inc., a contractor to Rockwell, and then was hired on for the sodium reactor experiment (SRE) decommissioning. I also worked one third of the year at the Radioactive Materials Disposal Facility (RMDF) and also worked at the Nuclear Facilities Development Facilities (NMDF).

My job was to survey materials and surfaces, such as parking lot pavement and building walls and floors, prior to the material being removed and sent off-site for disposal. Sampling included swipe tests, air sampling, surface contamination (walls and floors) and dosimeter surveys. I can provide names of people who may have more information related to these activities.

Using a "GM2 Device" I would survey the asphalt parking lot surrounding the SRE for gamma and beta radiation and mark any areas with readings for removal. They would chip out the "hot" areas and remove the asphalt to a separate area. After the "chip out" of the contaminated areas and a resurvey of the parking lot, the excavated dirt, rock, and asphalt were put in a "clean dump area" on the hill. I would also double check the "clean dump area" where all clean removal debris was stockpiled. One time I found some of the "hot" parking lot asphalt mixed in with the clean debris. I was told that some of the asphalt was contaminated due to "spills" and that after each spill, it would be paved over. From the looks of the asphalt, it appeared that at least three spills occurred because there were three distinct layers of asphalt. As far as I know, the lower levels of asphalt were not surveyed. Up to 10 millirems per hour (mrem/hr) was detected in asphalt, soil and rock.

Excavation of the parking lot and under the SRE went down 10 to 20 feet below ground surface. Excavation went to bedrock and then they began chipping and removing bedrock that was "hot." They tried to dig down far enough to see the end of a crack in the bedrock that was "hot," but finally had to stop. I can indicate this area on your aerial photograph.

The bedrock was first sampled by cores then a removal plan was devised. I do not have any concerns with the soil and rock that was dug up. I think it was all sent offsite to a proper facility.

I do not know how radioactive water was spilled to the parking lot, but I figure it to have been hundreds of gallons. My main concern is that "hot asphalt" may have been mixed in with the

clean dump area at SSFL. There could be 10 or so areas within the dump area that are hot. I will point out the possible "clean dump area" on your aerial photograph for reference. The "hot" asphalt could be between 1.5 and 10 mrem/hr. I would look for pieces of it in layers, probably less than 3 feet in diameter. [EPA's aerial photograph depicting the dump area was passed on to sampling team.]

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 11/10/2009

Interviewee(s): 15

I started working on the hill for Atomics International (AI) in 1958 when I was about 28 years old. I worked there for 7 years and then moved to the DeSoto facility and then a few months later I went to the Downey facility to work under a National Aeronautics and Space Administration (NASA) supervisor of North American Aviation (NAA). AI was a division of NAA. I started as a laboratory technician and did that for about 1.5 years and then I became a radiation disposal facility supervisor at the radioactive disposal facility. As a lab tech I worked in a small lab south of the sodium reactor experiment (SRE). My duties included fabricating and refinement of nuclear materials (uranium carbide, plutonium, and beryllium) and annealing and hydrating uranium isotope test pellets. Waste from the lab consisted of dust and chunks from machining operations. I am not aware of any tritium waste.

Oil was used in sodium containers as well as argon to prevent sodium reactions with the atmosphere.

I had good interactions with the health physicists during my work.

The radioactive materials disposal facility had underground storage in the high bay building for irradiated fuel. I can indicate that location on your aerial photograph. I don't think this fuel was protected. I had a supervisor that heated uranium carbide in a cement mixer in a shed at the radioactive disposal facility to dispose of it. I can indicate that on your aerial photograph as well. When I worked at this facility there was some high level waste material there. We always knew what and where the waste was coming from. All of that information was logged, but I don't know where those documents are now. The records were all sent to the Atomic Energy Commission (AEC). If you look for these documents at AEC, I would recommend using keywords searches such as "unusable" and "unrecyclable" at AEC.

I don't know any details about any onsite waste disposal. I know low-level waste was sometime concreted or fixed in place. There were reactor grade materials buried on a plot of ground near the hot cell [EPA notes this area is now excavated.]

There was also lab equipment (pressure vessels) and parts storage on the ground across from the gate. These parts might have been hot.

This page was intentionally left blank.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 11/23/2009

Interviewee(s): 16

I worked on the Hill from 1967 to 1983 as an atomic reactor inspector. I worked in the Quality Assurance Division. My job involved testing components for reactors, mostly fast breeder reactors. I would x-ray components using cobalt or iridium in a 350 kilovolt (kV) x-ray machine. I remember spent fuel rod storage in the floor of either Building 27 or Building 22, I can't remember. As an inspector, the main building I took care of was Building 32, which contained sodium test loops. I would use a "pill" of cobalt or iridium mostly. The iridium pills were about 1 centimeter diameter. They were kept in a depleted uranium "pig." The "pig" holds the pill until it is used. Iridium had a 75 day half-life, so when the pill would get depleted we would a new one. The switch was made safely and depleted pills were reclaimed.

I knew someone, who is now deceased, who worked in the Sanitation and Radiation Laboratory (SRL). He had lots of stories. One story I heard from him that occurred before my time was when an "SRL tank" that collected radioactive liquid overflowed into an adjacent gully. It was cleaned up with spoons. The tank may have been underground on the side of a hill; I have no idea where this was exactly.

I recall a lake near Building 27, which housed a photo lab I used to use. The photo lab appeared to have been plumbed to the lake instead of the sewer. I used to take a lot of pictures. I used black and white and also color film and used typical developer chemicals. I don't recall any radioactive materials ever being stored in Building 27. Prior to being a photo lab, Building 27 was used as a shaker building to test equipment by physically shaking it. I do not know of any other buildings that were similarly plumbed.

Building 20 was a lab where they reclaimed spent fuels. I had been in there for testing leaks and bolt testing. I tested bolts that that had radioactive material in them designed to keep space instrumentation warm. "Bolt work" was done in a glove box. I don't recall any spills there during my time.

I was on the hill when the 3-foot tall reactor was placed in a vessel/tank in Building 59. The concrete vault the reactor was placed in was 40 to 50 feet deep and required sump pumps to keep it dry since groundwater was only about 20 feet below ground. I guess the pumped water went to the sewer or possibly to a lake, but that water would have been groundwater and not radioactive.

I can point out some of the building uses for buildings I remember:

Building 22 had fuel storage
Building 32 had a radioactive “unit” in vessel
Building 10 had reactor
There was a small reactor building north of Building 13 and four vertical pipe structures (indicating the steam turbine from Sodium Component Test Installation (SCTI)) were built right over that building’s foundation.

I don’t have any knowledge of dry wells. I recall a spill in the Sodium Reactor Experiment (SRE) building, but it was contained in the building.

The only protective gear I ever had to wear were booties in the hot buildings and they were taken as you left the building.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 11/10/2009

Interviewee(s): 17

I worked in the Sodium Reactor Experiment (SRE) building in the early 1980s. At the time I was employed by Penhall Company. I recall that they were working for one of their branches or subsidiaries - Nuclear Control Corporation (NCC). At the time NCC was working as a contractor to Rockwell. My job was to cut the concrete wall that separated the reactor area from the loading cells, and cut another wall so a sodium contaminated 20-inch pipe could be removed. I never saw what they did with the concrete slurry, but I do recall the foreman for Rockwell said it was not radioactive. The crew from Rockwell seemed to be truly concerned with my safety and we reviewed our safety procedures every morning. The only thing that struck me as odd was every guy on Rockwell's crew was a chain smoker.

The load cell room was where pellets were loaded into rods. While I was there I could see pockmarks all over the ceiling, floor and walls from chipping and cuts that had been made from previous removal of radiologically contaminated concrete and rebar.

Penhall (Anaheim office) did the reactor core removal at SRE using the "stich-drill" method of over drilling (by 8" core bit) the reactor cores down to 30-foot depth then drilling directly next to it a second hole to facilitate core removal.

I estimate about 300 gallons of slurry were produced from 60 holes. Slurry is the water that cools the drill bit and gets mixed with the ground concrete and rebar and usually contains tiny pieces of the metal and diamond drill bit. At that time, the disposal practice for the slurry was simply dumping it into pits or on ground. This was the usual practice up through the 1980s. Now pits must be lined prior to disposal in this manner. I do not know how Rockwell dealt with the concrete slurry, but this is why he called, in case the Environmental Protection Agency comes across the light grey, dried, slurry material in our investigation.

I wore a film badge throughout my work there, but was never told the results. I assumed I would have been told if any bad results came back. "Naval D" personal protection was the only thing necessary with a film badge while I was working.

This page was intentionally left blank.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 11/12/2009

Interviewee(s): 18

I worked with Rocketdyne at the Santa Susana Field Laboratory (SSFL) for 22 years from 1965 to 1986. I have nothing against Boeing whatsoever and I don't want to be involved in the community disputes over SSFL, but I do want to share information that I think could be useful to the Environmental Protection Agency (EPA).

I don't have any information about Area IV, but I can tell you about hazardous materials at the site. EPA may want to consider the following issues.

Alleged depleted Uranium projectiles: Projectiles found in Area I were not uranium. I, myself, manufactured the projectiles using lead from tire/wheel weights. I can't describe the specific location well enough to pinpoint on a map, but these projectiles have been identified during a cleanup effort and I want EPA to know that they were not depleted uranium.

Beryllium contamination: In Area I, on a hill overlooking Happy Valley is or was a "mix building" where beryllium projectiles were manufactured. There was a tank set down in the hill to catch excess beryllium attached to the building by a hose. I worked there with a crew and we cut off that hose and let the beryllium go to the ground because of a structural issue with the tank.

Diaboron/Pentaboron contamination: Downhill from the beryllium contamination described previously in the "PRE building," where propellant research occurred there was a tank that contained diaboron that frequently leaked. The tank was kept surrounded in dry ice, but it still leaked. When exposed to air, diaboron became pentaboron and ignited. This occurred frequently.

TCE contamination: Between the "Area 1 road" and the "PRE building" was a leaking concrete-lined pond that mixtures containing trichloroethylene (TCE) were pumped into. This area was known as a "Fluorine Area" and fluorine dumped in the pond would be burned off during "Toxic Firings," which was only done when wind came from the west. A subsurface tile pipe between the "PRE building" and the pond would have to be frequently repaired or replaced due to explosions in the pipe from the fluorine.

“Fuming Sulfuric Acid” and Fluorine leaks: There were “fuming sulfuric acid” and fluorine leaks, but I don’t have any details.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 11/15/2011

Interviewee(s): 19

I worked at the Santa Susana Field Laboratory (SSFL) from April 1979 to May 2003 as a mechanic and propulsion systems technician. During my first year, I worked on engine testing equipment in Area I including work in Building 301. I worked with general maintenance at the Sodium Pump Test Facility (SPTF) facility in Area IV. I also did metallurgy work on cladding in the Hydrogen Lab, which was also known as the Environmental Effects Lab (EEL).

I don't remember any accidents other than a big sodium spill at the SPTF in 1995. I never handled radioactive materials and I didn't need to wear a film badge until 2004 during remediation work I assisted with. (Note that this year conflicts with stated career time frame at SSFL). I worked in Building 24, a Systems for Nuclear Auxiliary Power (SNAP) building, removing concrete plugs out of ground that were used for storing fuel rods. I also recall that there may have been groundwater flooding in the basement of Building 9. I can also think of some other people who you may want to talk to with information at the site.

I recall that blueprints were kept in a safe in Building 38. And plutonium and uranium pellets could be found in Building 20. I think Building 55 may have been used for plutonium enrichment. A number of building foundations often had holes in walls for drainage.

There were some cleanup efforts at the gun range, outfall #5, and outfall #3.

There was a "Northeast Debris Field" where drums used to be stacked, but that area is clean looking now. There were "concrete ponds" that have been removed. During the late 1970s, grey water used on site came from Silvernail Pond, but then the source was switched to a city municipal source.

There was a "burn area" with an incinerator for badges and "secret" documents. The only employees I think that worked across the different areas of SSFL were maintenance folks. Radiological work was only in Area IV so if anyone had to wear a film badge in other areas of SSFL it was because they had worked in Area IV. I don't ever recall seeing radiological work outside of Area IV.

This page was intentionally left blank.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 11/12/2009

Interviewee(s): 20

I read the article in my local paper about the Environmental Protection Agency (EPA) seeking information and thought I would pass this on for what it's worth.

I used to live in Bell Canyon, which shared the property line with Rocketdyne in 1981-1984. I was much younger then, actually a teenager then.

We used to go hiking all over the area, one in particular. This hiking area was near a stream, we followed this stream up the canyon; it topped out in the property of Rocketdyne. I remember seeing the water change, in an area where the water pooled. It was very brackish, brown, with a film on it. There were many blue barrels laying around. I just remember the stream being very polluted.

I remember the way to get there to this day and have always wondered why the stream was polluted. The locals called the area "Stoner Den." It was a big tunnel/cave along the north side with two exits and parts filled with water.

Note: EPA discussed the information provided by interviewee. The approximate location of a cave with pooled water that may have been polluted was located. It was along a popular hike up to the southeast corner of Bell Canyon. We identified the approximate location by both reviewing "Google Earth" while on the phone. The coordinates are: 34º 13′ 16.63″N by 118º 42′ 02.75″W. It also may be near 34º 15′ 27.80″N and 118º 39′ 36.45″W.

This page was intentionally left blank.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 2/11/2010

Interviewee(s): 21

I worked for Atomics International (AI) on and off at the Santa Susana Field Laboratory (SSFL) from 1955 to 1970. I started as a Senior Engineer and watched the Sodium Reactor Experiment (SRE) being built. I became a Supervisor and Assistant Group Leader at the SRE and was in charge of planning test programs and maintaining the plant. I also prepared test programs for the Hallum reactor in Nebraska. I moved to Nebraska in 1961 to work on the Hallum reactor for a few years and then I came back to SRE at SSFL. Then SRE went into a holding pattern and I moved on to the Energy Technology Engineering Center (ETEC) sodium facility.

Most of my work was in planning test programs. I was around for fuel loading, start up, and operation of the SRE and was at SSFL during several incidents, but I was down at the DeSoto facility during the 1959 fuel element damage at SRE. I worked around radioactive materials and observed waste disposal during my time at AI.

I thought the work at SSFL was successful and a lot of hard work went into enforcing safety rules. I think lay people lack the knowledge to understand the actual risk and typical radiation exposures that happen every day. People start spreading scare stories to get grants.

This page was intentionally left blank.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 2/11/2010

Interviewee(s): 22

I worked for Atomics International and Rockwell from 1959 to 1989, but I was never permanently stationed at the Santa Susana Field Laboratory (SSFL). I started as an engineer and did nuclear analysis and fuel development for the Sodium Reactor Experiment (SRE), Systems for Nuclear Auxiliary Power (SNAP)-2, and SNAP-10A. I then became the head of operations and oversaw everything from people to purchasing. When I was the head of operations I would go up on the hill and visit or oversee my crew. I also spent 1 month on the hill running and experiment. Over the course of my 30 years, I probably spent 6 months total time at SSFL. I later went on to work at Hanford and at reactors in Idaho.

My work involved nuclear analysis and fuel development. I worked on the decommissioning of SRE and was up on the hill during that period as I had a number of people on my crew working on the decommissioning. I also worked on a uranium oxide (UO_3) experiment that used a closed loop system that not did involve fission products.

I did work around radioactive materials. The biggest "incident" that occurred when I was at the SSFL was when I was at the Hot Cell and an alarm went out. Everyone evacuated and the Radiation Protection Technicians came in to determine the problem. They determined residue from hydrogen testing in China (fallout) had been tracked in on the shoes of employees and the alarm sensors were sensitive enough to detect it.

I observed waste disposal at SSFL and as far as I know it was all handled properly because the Atomic Energy Commission (AEC) was all over us. The director of nuclear safety was one of the sharpest radiation protection experts. I never observed any improper disposal of materials.

I thought the work at SSFL was successful and we should be proud of the many firsts that occurred there. The U.S. was a leader in nuclear technology in the early years. I was treated well my entire career and still do some minimal consulting (1 or 2 weeks a year) because of my extensive resume in nuclear operations.

This page was intentionally left blank.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 2/12/2010

Interviewee(s): 23

I retired in approximately 2007 after 30 years at the Santa Susana Field Laboratory (SSFL). I worked for the Energy Systems Group, formerly Atomics International (AI). The last 8 or so years I worked with Rocketdyne. I was a research mechanic for most of my time. I did all kinds of work ranging from setting up equipment to running and operating the facilities. I worked in both Area II and Area IV of SSFL at many different facilities. I worked at Building 20, the Hot Lab, for 1 to 1.5 years.

I worked with radiological material and dealt with waste disposal, but I am not aware of any waste that was mishandled. I am not aware of any radiological releases in areas I worked in, but I do recall that a cleanup crew found radioactive shavings in the Sodium Burn Pit that were probably dumped there in the 1950s. That's the only area I can think of that you may want to look at for contamination.

Any documents or photos I have from my work in Area IV have been packed away, but I am not sure I have any more useful information for your investigation.

This page was intentionally left blank.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 2/12/2010

Interviewee(s): 24

I worked for Atomics International (AL) at the Santa Susana Field Laboratory (SSFL) from 1974 to 1997. I worked in the Engineering Department and in the Construction Management Department at the Energy Technology and Engineering Center (ETEC). Out work was funded by the Department of Energy (DOE). I wrote procedures for the cleanup of radiological facilities and managed outside contractors working at the sodium facilities. I had offices in Buildings 9, 26, and 487.

I did not have hands on radiological cleanup responsibilities, only supervisory responsibilities, but I did have to wear film badge and protective clothing if I was visiting a building with residual contamination. Any materials collected during a cleanup operation were removed and packaged then shipped off-site to proper disposal location.

I am aware of the previous history of SSFL in terms of radiological accidents and disposal issues, such as the Sodium Burn Pit, but I don't recall any issues during my time there. I don't think I have any useful information for you and I do not want to participate in any further interviews.

This page was intentionally left blank.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 2/12/2010

Interviewee(s): 25

My father was a test engineer for Rocketdyne. He died from kidney cancer about 25 years ago. He worked for Rocketdyne and then left during layoffs and came back to work at Rocketdyne's Seal Beach facility.

My father was a chief engineer on a test that "went bad" and he went in to shut down the test. He had to go through a decontamination procedure and get washed down. The accident happened probably between 1962 and 1964. I am not sure of the specific test my father was working on when he had to shut it down. I am not sure which area of the Santa Susana Field Laboratory he worked in, but he did a lot of rocket testing and later went on to do rocket testing at Vandenberg Air Force Base.

I am not sure if my father worked with radioactive materials, but when the accident happened he seemed to go through a decontamination procedure similar to someone involved in a radiological accident.

You may want to examine employment records to determine where my father was specifically located and what really happened with regard to the accident.

When I was in Thousand Oaks a number of years ago, I met an FBI agent that did a public records request with the City of Thousand Oaks. He told me a story of radioactive water inadvertently being placed in Sparkletts water bottles and placed next to drinking water. I wonder if EPA could find FBI reports or contact the City Clerk to examine public request records.

My mother still receives benefits from Rockwell, so she does not want to get involved with issues at the site, but I wanted to pass on the information I had to see if it could be of help.

This page was intentionally left blank.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 2/15/2010

Interviewee(s): 26

I worked for Atomics International (AI) at the Santa Susana Field Laboratory (SSFL) from 1969 to 1990. I was a quality assurance engineer and eventually became a manager of other quality assurance engineers. I oversaw activities at the test sites. I worked at the Sodium Pump Test Facility (SPTF), the Sodium Component Test Installation (SCTI), the Small Component Test Loop (SCTL), and at Trailer T486.

I didn't work with any radiological material and did not wear a dosimeter. I don't recall any incidents or unusual occurrences during my work at SSFL. I am aware of the Sodium Burn Pit and its use as a disposal site, so you may want to look there for contamination.

I do not wish to participate any further with the Environmental Protection Agency's investigation.

This page was intentionally left blank.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 2009

Interviewee(s): 27

I worked at Santa Susana from 1955 to 1970. Beginning in 1958, I worked in Rocketdyne Fire and Security until this department was "split" and discontinued in 1961. During this time, I and other firemen would get weekly or biweekly deliveries of sodium in chunks (in barrels or bags) to dispose of in the Area 1 burn pit. From 1961 or 1962 until 1970, I worked as an electrical technician in the Electronic/Instrumental Department until 1970. During this time I performed equipment tests ("vibration/pressure testing") but nothing on equipment that dealt with radioactive material. I have no knowledge of any radioactive waste handling, storage, or release and never was required to wear a radiation badge/film badge. The "Area 1 burn pit" would regularly receive solid chunks of sodium and drums of hydrazine, but I do not know the source of these materials. I recall 3 to 5 explosions related to the burn pit, but I don't have any information on radioactive materials.

This page was intentionally left blank.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: November 2009

Interviewee(s): 28

I worked for Rocketdyne for 20 years at Canoga Park. I did not work at the Santa Susana Field Laboratory. I was a purchase agent for Rocketdyne, but I also spent time cleaning barrels at Canoga Park. I have some medical conditions I think were related to this work. I have a friend who is in his mid- to late-80s who worked with me at Canoga Park. He worked for 35 years in a clean room, where they cleaned parts. He ended up getting cancer. I have a case file with documents on Canoga Park operations regarding the clean room that I will mail to you for review.

[The case file was never received and further telephone calls were not returned.]

This page was intentionally left blank.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 11/16/2009

Interviewee(s): 29

I was a Rockwell employee, but I don't recall the years I worked at the Santa Susana Field Laboratory (SSFL). The labs I worked in were already cleaned out. I worked at the Rockwell Experimental Laser Lab ("RELL") and was sent to "the Hill" frequently, but I just can't remember the building numbers or Area numbers I worked in. I don't remember working with any radiological materials or conducting any radiological operations. I am sick with a rare disease and I think it has to do with exposures I received in the building I worked in, but I just can't remember a lot of the details of my work at SSFL.

This page was intentionally left blank.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject:	SSFL / HSA	
Date / Time:	11/30/2009	Page 1 of 1
Interviewee(s):	30	

My husband worked for Rockwell/Rocketdyne and was laid off when he "pointed out something that was being done." I can give you the name of the supervisor that laid him off so that you can follow up. [EPA Notes: Implication of call was that husband saw something that would cause a release to ground, air, or water]. Upon further conversation, EPA learned husband did not work in Area IV and no further follow-up was conducted.

This page was intentionally left blank.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 11/25/2009

Interviewee(s): 31

My father worked up at the Santa Susana Field Laboratory (SSFL) and was an operator that buried barrels. He was a bulldozer operator that was contracted to do work up there. I remember being told one day when my father came home that "today we dumped some barrels that were filled with yellow stuff into a trench up at SSFL." I don't know the name of my father's construction company or even if he was an independent contractor/operator. My father is deceased. The incident took place during the 1970s. I remember my father saying that one or two barrels opened up and spilled the dry yellow material out. He said it was all buried in a trench along a curving road on a downhill slope. I don't know much more than that and am not sure what part of SSFL my father was working when the incident occurred. My father was not an employee of Rocketdyne (or predecessor/successors) but was only hired to do one odd job that day.

This page was intentionally left blank.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 11/12/2009

Interviewee(s): 32

My father worked for a period of time at the Rocketdyne site. My father has since passed away, but I had Power of Attorney over him and my mother. I understand there is possible settlement for former employees or their family/survivors. I would like more information if possible. Please contact me at this email address or via phone call. Thank you

[EPA inquired about the interviewee's father and his job at the Santa Susana Field Laboratory (job title, years of employment, documents, knowledge of releases or dumping), but the interviewee had no further information.]

This page was intentionally left blank.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 11/19/2009

Interviewee(s): 33

I was an employee of Rocketdyne and worked for Rocketdyne from 1955 to 1970. Much of that time was in the Rocketdyne Fire & Police Security Division.

I was assigned to the burn pit in Area 1 where chemicals were disposed. I don't know what types of chemicals were put in the burn pit. I don't recall any radioactive material use, storage or release. I also worked in Areas II and IV.

I have no recollection of fires related to radioactive handling or reactor operations, or of any other dump sites or release areas.

This page was intentionally left blank.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject:	SSFL / HSA	
Date / Time:	11/16/2009	Page 1 of 1
Interviewee(s):	34	

Years ago I did concrete work as a member of the Cement Masons Local 741 out of Ventura, California (Local 741 later changed to Local 600) and was dispatched to work at the Santa Susana Field Laboratory (SSFL).

I remember seeing a pit, or a small pond, with pipe draining "really nasty" stuff into it during the "Reagan years."

I was assigned to help construct a concrete wall near the test area for rockets. I do not recall the name of the area I worked in (i.e., whether it was Area I, II, III, or IV). The pit or pond I recall was a man-made pond and had a thick viscous brown-green color. Pipes came from a nearby building and went straight to this pond. I wore a radiation badge and had to leave the badge at the end of the day. That's about all I can remember. I don't remember any locations well enough for it to be helpful to review aerial photographs of the site.

This page was intentionally left blank.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject:	SSFL / HSA	
Date / Time:	11/09/2009	Page 1 of 1
Interviewee(s):	35	

Voicemail received that caller's father worked at Santa Susana Field Laboratory in the 1960s for Rockwell/Rocketdyne and was involved in a radioactive spill/accident. The Environmental Protection Agency returned call with no further response.

This page was intentionally left blank.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 11/11/2009

Interviewee(s): 36

My father was a former Atomics International employee who died of cancer and I think it was caused by the work he did at the Santa Susana Field Laboratory (SSFL) and Canoga Park. I don't have much detail other than the fact that my father worked at the "Conservation Yard" at the Canoga facility and was part of a crew that went up to SSFL to retrieve disabled, decommissioned, or older parts of equipment used in Area IV and bring them to Canoga for cleaning and reassembly. I know that is not much to go one, but I am willing to help any way I can in the future.

This page was intentionally left blank.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject:	SSFL / HSA	
Date / Time:	11/30/2009	Page 1 of 1
Interviewee(s):	37	

My husband, who is deceased, worked at the Santa Susana Field Laboratory (SSFL) between 1962 and 1967, but he only visited Area IV a few times for several months at a time. He primarily was involved with Shuttle and Rocket Engine projects in the other areas of SSFL. I think "radioactive stuff" was put in Lindero Canyon and the Bradley Dump in Van Nuys, but I don't have any other details about this. I don't have any more information on my husband's work in Area IV or radiation issues at SSFL.

This page was intentionally left blank.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 12/07/2009

Interviewee(s): 38

I have asked my father whether he would be willing to help the Environmental Protection Agency (EPA) gather information about potentially hazardous activities at the Santa Susana Field Lab (SSFL). He has indicated he is willing to be interviewed by your project team.

My father was involved in the testing of rocket engines and rocket engine fuel mixtures during the 1960s, and possibly other activities.

Please feel free to contact him via email or by phone at his home in San Rafael, California.

[Note to file: Interviewee had no further Area IV rad information.]

This page was intentionally left blank.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: _____

Interviewee(s): 39

I started with Rocketdyne in 1953 and worked there for 50 years, until I was laid off in 2003. I don't recall any information on dumping or releases and I don't ever remember heading about that sort of thing except for the sodium burn pit, which I took photos and video of. All negatives of my photos should with "Iron Mountain Archives" and are probably under ownership of Boeing now, or possible Pratt Whitney or UTC (other Rocketdyne successors). I don't have any photos or negatives myself that I can share. Look for a logbook at Iron Mountain Archives to locate my photos. But, I never photographed any incidents or spills.

This page was intentionally left blank.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: _____

Interviewee(s): 40

I was a laboratory technician at the DeSoto facility from approximately 1960 to 1963. I tested uranium pellets there. I never worked on the hill. I don't have any knowledge of releases, storage or use of radioactive materials at the Santa Susana Field Laboratory. I can give you the name of a colleague that you might want to contact.

This page was intentionally left blank.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 3/7/2011

Interviewee(s): 41

I worked sporadically at the Santa Susana Field Laboratory (SSFL), including temporary, part-time, and full-time to fill in for other mechanics on the hill from the 1980s to 2010. I was a full-time mechanic at Canoga Park and DeSoto. I think that SSFL has the usual "sloppiness" seen throughout the industry at the time (in the 1980s), specifically in the maintained areas.

I wore a radiation badge, but never when I was up on the hill. I recall a 30-foot by 20-foot body of water on the hill that always had an oily sheen on it, but I would not be able to locate it. I was probably a dumping area of some sort.

This page was intentionally left blank.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: _____

Interviewee(s): 42

I worked for Rocketdyne and its predecessor/successor companies for 32 years beginning in 1978. I was primarily a jig-bore machinist/metal machinist. I was also a propulsion mechanic for a while. I never worked at the Santa Susana Field Laboratory (SSFL), only at the Canoga facility. I don't have any information relating to radioactive material use, storage, or release at SSFL.

This page was intentionally left blank.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: _____

Interviewee(s): 43

Email from an undisclosed sender mentioned that someone present at the Santa Susana Field Laboratory (SSFL) during the "partial meltdown" had "fallout" on his car in Area I. Many cars had to be repainted as a result of the incident. The "fallout" went everywhere.

This page was intentionally left blank.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 11/11/2009

Interviewee(s): 44

An anonymous voicemail said person was a neighbor of a former worker at Santa Susana Field Laboratory (SSFL) in the 1960s and 1970s. Contact information for the former worker was provided, but found to be outdated. No callback number was left. Former worker was later found to be deceased.

This page was intentionally left blank.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: _____

Interviewee(s): 45

Handwritten note that interviewee worked in Financial Department, Account Assignment from 1956 to 1974, and reviewed all documents for purchases and travel assistance. No radiological information.

This page was intentionally left blank.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 5/20/2009

Interviewee(s): 46

Interviewee sent a letter notifying the Environmental Protection Agency (EPA) that he and a number of neighbors had gotten prostate cancer at the same time and on the same neighborhood block. He just wanted EPA to know for its investigation. No other information was provided in the letter.

This page was intentionally left blank.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 9/13/2009

Interviewee(s): 47

Interviewee left voicemail stating that he had four cancers over the years and his mother and father both died of cancer. He stated that his uncle "fell into a pit of plutonium or whatever." There was a class action lawsuit. No information on the location of the pit was provided, nor radiological materials used, stored or released. No other information, including caller's name or contact information, was provided in message.

This page was intentionally left blank.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 2/15/2010

Interviewee(s): 48

I worked for Rocketdyne in the 1960s and 1970s as an engineer. I worked in Area II doing rocket engine testing and rocket fuel testing. I did not handle any radiological materials or wear a dosimeter. I did not work in Area IV and don't know specifics of activities there.

This page was intentionally left blank.

Index

A

accident, 14, 19, 21, 38, 89, 109
accidents, 6, 21, 34, 35, 42, 43, 49, 60, 77, 87
AE-6, 1, 3, 23, 25, 26
AEC, 1, 2, 21, 39, 40, 46, 51, 69, 83
AI, 1, 2, 3, 5, 7, 11, 29, 30, 37, 39, 40, 41, 42, 47, 66, 69, 81, 85, 91
Area IV, 5, 13, 16, 19, 30, 33, 35, 37, 54, 61, 63, 64, 75, 77, 85, 99, 111, 113, 115, 135
argon-41, 22
asbestos, 15, 50, 54
Atomics Energy Commission, 1, 51, 83
Atomics International, 1, 5, 9, 11, 19, 21, 29, 37, 39, 47, 51, 63, 69, 81, 83, 85, 87, 91, 111

B

Beatty, 13
beryllium, 6, 69, 75
Boeing, 30, 31, 33, 34, 35, 36, 63, 65, 75, 117
Building, 1, 11, 12, 13, 14, 15, 22, 23, 24, 25, 26, 27, 29, 33, 34, 61, 63, 64, 65, 66, 71, 72, 77, 85
buried, 59, 60, 61, 69, 101
burn area, 3, 77
burn pit, 13, 30, 34, 93, 105

C

cesium, 6, 7, 43, 51, 53, 54
cesium-137, 6, 43
cladding, 52, 57, 58, 77
clean, 3, 9, 16, 17, 19, 26, 37, 51, 67, 68, 77, 95
clean dump area, 67, 68
cleaned, 16, 24, 26, 29, 51, 52, 56, 66, 71, 95, 97
cleaners, 19
Co-60, 2
cobalt, 2, 6, 7, 41, 63, 71
cobalt-60, 2, 6, 63
containment vessel, 7, 27
contaminated, 16, 22, 24, 30, 37, 38, 42, 44, 52, 55, 58, 64, 67, 73
contamination, 12, 16, 17, 19, 22, 24, 25, 27, 29, 30, 37, 42, 52, 55, 67, 75, 85, 87, 91
Contamination, 29
control rods, 5, 6, 7, 21, 22, 48, 53, 56
cooling system, 27
core, 1, 6, 8, 22, 23, 25, 29, 37, 38, 39, 40, 41, 43, 44, 48, 50, 51, 55, 56, 58, 73
Curies, 41

D

D&D, 22, 23, 24, 27
decommissioning, 19, 33, 36, 67, 83
decon, 51
decontaminated, 23, 24, 30
decontamination, 19, 33, 36, 51, 54, 89
Department of Energy, 9, 33, 37, 39, 87
disposal, 2, 8, 13, 19, 30, 34, 40, 43, 61, 64, 67, 69, 73, 81, 83, 85, 87, 91
DOE, 33, 34, 35, 39, 87
dosimeters, 2, 23, 49, 64
drain, 22, 24, 25, 55
drainages, 2, 9, 14
drains, 30, 55
drum, 40, 42, 54, 60
drums, 19, 30, 40, 41, 42, 45, 54, 55, 56, 60, 77, 93
dumped, 19, 30, 41, 61, 63, 64, 75, 85, 101
dumping, 30, 41, 64, 73, 103, 117, 121

E

Energy Technology Engineering Center, 11, 59, 63
EPA, 3, 9, 15, 30, 37, 45, 65, 68, 69, 73, 75, 79, 89, 91, 95, 99, 103, 109, 115, 131
ETEC, 11, 13, 59, 60, 63, 81, 87
exploded, 26
explosion, 7, 26, 30, 37, 43

exposure, 2, 3, 14, 15, 23, 29, 30, 37, 40, 51, 53

F

fallout, 83, 125
film badge, 3, 12, 13, 33, 34, 35, 59, 63, 73, 77, 87, 93
film badges, 2, 14, 23, 40, 42, 49, 63, 64
fission, 21, 22, 29, 42, 43, 44, 45, 51, 52, 54, 58, 83
fission products, 43, 51, 52, 58
fuel elements, 8, 30, 37, 38, 40, 43, 50
fuel fabrication, 11, 12, 14
fuel rod, 37, 38, 41, 52, 71

G

gas, 12, 22, 23, 24, 25, 26, 29, 44, 49, 50, 51, 53, 54, 58
gases, 21, 22, 52

H

hazardous, 11, 33, 45, 54, 65, 75, 115
hazards, 26, 37, 45
health physicist, 25, 29, 40, 49
hot, 3, 12, 13, 14, 15, 23, 25, 27, 38, 40, 41, 42, 44, 49, 51, 52, 53, 55, 56, 57, 63, 65, 66, 67, 69, 72
Hot, 8, 19, 30, 34, 83, 85
hot cell, 3, 14, 38, 51, 69
Hot Lab, 19, 34
Hot Laboratory, 8
HP, 25, 26, 49

I

incident, 23, 25, 29, 37, 52, 83, 101, 125
iodine, 6, 51, 53
iridium, 14, 71
irradiate, 7
irradiated, 9, 40, 44, 58, 64, 69

K

KEWB, 5, 6, 9, 21, 22, 23, 24, 26, 27, 42, 45, 46
Kinetics Experiment Water Boiler, 5

L

lead shielding, 12
leakage, 14, 59, 60, 64
leaks, 14, 26, 27, 35, 50, 71, 76
Liquid Metal Engineering Center, 11, 63
LMEC, 11, 63
logbooks, 21, 25, 27, 30

M

meltdown, 8, 44, 46, 57, 125
mercury, 13, 56, 64

N

NaK, 14, 26, 30
neutrons, 6, 24, 39, 48
non-radioactive, 43
North American Aviation, 9, 21, 39, 59, 69
NRC, 49
nuclear, 1, 2, 5, 26, 29, 33, 34, 35, 36, 39, 40, 44, 47, 54, 55, 59, 69, 83
Nuclear Regulatory Commission, 49

O

OMRE, 3, 14, 39, 44
Organic Moderator Reactor, 3, 14

P

pipe, 12, 13, 16, 26, 40, 50, 56, 60, 72, 73, 75, 107
piping, 15, 22, 24, 25, 26, 30, 50, 59, 60, 61, 63
pit, 13, 26, 30, 34, 55, 56, 63, 64, 93, 105, 107, 117, 133
pits, 49, 50, 51, 52, 55, 65, 73
plutonium, 11, 12, 14, 30, 69, 77, 133
pond, 17, 19, 43, 45, 51, 54, 55, 63, 65, 75, 107
primary loop, 43, 44, 51, 54, 56, 58
problem, 3, 8, 9, 17, 44, 57, 61, 83

R

radiation, 1, 2, 5, 6, 7, 8, 9, 14, 21, 22, 23, 26, 29, 30, 34, 36, 37, 40, 42, 43, 44, 49, 52, 55, 57, 59, 60, 66, 67, 69, 81, 83, 93, 107, 113, 121
radioactive, 2, 3, 5, 6, 7, 8, 9, 21, 22, 24, 25, 26, 27, 29, 30, 34, 35, 40, 41, 42, 43, 44, 45, 48, 50, 51, 52, 53, 54, 55, 60, 63, 64, 67, 69, 71, 72, 73, 77, 81, 83, 85, 89, 93, 105, 109, 113, 119, 123
Radioactive Material Handling Facility, 33
Radioactive Materials Disposal Facility, 67
Radioactive Materials Disposal Unit, 30
radioactivity, 6, 22, 29, 51, 53, 58, 65
radiological material, 14, 85, 91
reactor, 1, 2, 3, 5, 6, 7, 8, 9, 12, 14, 21, 22, 23, 24, 25, 26, 27, 29, 38, 39, 40, 41, 43, 44, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 61, 63, 64, 65, 67, 69, 71, 72, 73, 81, 105
releases, 53, 54, 85, 103, 117, 119
RIHL, 34
RMDF, 23, 24, 25, 67
RMDU, 30
RMHF, 33, 34, 35
Rocketdyne, 1, 3, 5, 7, 9, 15, 17, 19, 33, 34, 35, 36, 39, 45, 51, 54, 59, 60, 61, 63, 75, 79, 85, 89, 93, 95, 99, 101, 103, 105, 109, 117, 123, 135
Rockwell, 34, 35, 59, 65, 67, 73, 83, 89, 97, 99, 109

S

Santa Susana Field Laboratory, 1, 29, 37, 39, 47, 63, 65, 75, 77, 81, 83, 85, 87, 89, 91, 95, 97, 101, 103, 107, 109, 111, 113, 119, 121, 123, 125, 127
SCTI, 11, 12, 15, 16, 17, 61, 63, 72, 91
SCTL, 61, 91
secondary loop, 44, 56
sewers, 9, 14, 36
Small Component Test Loop, 61, 91
smears, 13, 42
SNAP, 1, 5, 6, 7, 9, 12, 13, 14, 23, 27, 29, 42, 45, 77, 83
sodium, 8, 9, 11, 13, 14, 15, 17, 26, 27, 30, 35, 37, 39, 43, 44, 45, 46, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 63, 65, 67, 69, 71, 73, 77, 81, 87, 93, 117
Sodium Burn Pit, 64, 85, 87, 91
Sodium Components Test Instillation, 11
sodium loop, 39, 43, 51
Sodium Reactor Experiment, 3, 19, 29, 37, 39, 42, 47, 72, 73, 81, 83
sources, 1, 2, 7, 42
spills, 24, 29, 34, 35, 42, 43, 60, 67, 71, 117
SRE, 3, 8, 9, 12, 14, 19, 29, 37, 38, 39, 40, 42, 43, 44, 45, 46, 47, 49, 51, 52, 53, 54, 63, 65, 67, 72, 73, 81, 83
SRE incident, 8
SSFL, 1, 2, 3, 5, 7, 9, 11, 19, 21, 29, 30, 31, 33, 36, 37, 39, 40, 47, 59, 63, 65, 67, 68, 69, 71, 73, 75, 77, 79, 81, 83, 85, 87, 89, 91, 93, 95, 97, 99, 101, 103, 105, 107, 109, 111, 113, 115, 117, 119, 121, 123, 125, 127, 129, 131, 133, 135
stack, 22, 23, 52, 53, 58
storage, 12, 19, 21, 22, 23, 30, 34, 36, 38, 45, 54, 63, 69, 71, 72, 93, 105, 119, 123
strontium, 43, 51, 53, 54
Systems for Nuclear Auxiliary Power, 1, 29, 42, 77, 83

T

tank, 2, 7, 21, 22, 51, 52, 54, 55, 56, 71, 75
tanks, 1, 2, 8, 26, 29, 36, 44, 45, 51, 52, 54, 63
TCE, 3, 75
tests, 2, 5, 12, 15, 21, 22, 23, 26, 35, 44, 59, 63, 67, 93
tetralin, 37, 50, 51
toluene, 50, 51, 56
Toluene, 50
trench, 64, 101
trichloroethylene, 3, 19
tritium, 14, 69

U

U-235, 22
underground tank, 22

uranium, 5, 6, 8, 13, 22, 25, 30, 48, 66, 69, 71, 75, 77, 119
uranyl sulfate, 22, 42

V

vault, 14, 22, 71

W

waste, 2, 8, 13, 16, 19, 23, 24, 25, 33, 34, 35, 36, 40, 41, 42, 44, 45, 50, 51, 52, 55, 60, 61, 63, 65, 69, 81, 83, 85, 93
wastewater, 10
water, 2, 5, 6, 8, 9, 10, 11, 13, 14, 15, 17, 21, 22, 25, 29, 30, 39, 40, 43, 44, 46, 51, 53, 55, 56, 57, 59, 63, 67, 71, 73, 77, 79, 89, 99, 121

X

xenon, 51, 53, 58
x-ray, 1, 5, 41, 63, 71

Appendix E

DOE/EPA Joint Interview Summaries

Redacted

This page was intentionally left blank.

UNITED STATES DEPARTMENT OF ENERGY

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 7/14/2010

Interviewee(s): 8

I never actually worked up on the hill at SSFL. I worked at the Van Owen facility and went up occasionally to the hill for visits. I worked with budgets, planning, project administration, acquisitions, and finally data processing.

I worked for Atomics International which was a division of North American Aviation. Projects that I was involved in included the Sodium Reactor Experiment, the Pyroprocessing Refabrication Experiment (PRE), and SNAP. I worked on another project for AI that was called Project Pluto – but that project was never up at SSFL to my knowledge. I handled the paperwork for all of those projects. I knew a fair amount about them. All of my work was documented in project reports. I do not know where those reports went once they were submitted.

I handled radioactive materials, but that was before my time at Atomics International. I worked for General Electric at Hanford, up in Washington State. I started there in 1951; I started with North American Aviation, Atomics International Division at the Van Owen facility on July 16, 1956. I never handled radioactive materials at SSFL. By 1955, handling radioactive materials was becoming routine. There was a way things were done and I doubt it was much different from what we did at Hanford. I am sure things were done the same way everywhere.

I also did not handle any chemicals in my position. I am not familiar with the location of where any radioactive or chemical materials were stored or disposed.

At SRE, things were by the book as long as they were working on the specified project objectives. However, they did not shut down once those project objectives had been completed. A project engineer who worked up there told me “things were getting pretty soggy in there.” I interpreted that to mean that they were getting near the safety limits of the materials they were testing, but that is just my interpretation, I have no firsthand knowledge of that.

Things were quite different back in those days. Atomics International was a cost plus operation, and the amount of money the company made depended a lot on how good the relationship was with the client. Once the work that was supposed to be done had been completed, the AEC was interested in learning about the safety parameters. In other words, they wanted to know how much the design could be passed beyond the operational guidelines and still operate safely.

It was my impression that AI had been given verbal instructions (never written down) from the AEC to test the reactor to destruction. It was common in the aerospace industry to test to destruction – that meant you ran conservatively until you had met all the project objectives and then tested beyond that to determine the safety limits for the particular object being tested, and see how consistent the actual results were with what the modeling predicted. They were pushing the limits on purpose.

I am not aware of any other situations at SSFL that were similar or that had similar results.
The PRE was developed to re-process spent reactor fuel into new (metallic) fuel elements. This was accomplished through metallurgical processes that were conducted using remote handling equipment in a hot cell rather than via wet-chemical processing of the kind we used at Hanford in the "purex" facility to extract plutonium. Hanford reactors used metallic fuel which we discharged after relatively short exposure to fission because the weapons program wanted plutonium-239 but didn't want other isotopes of plutonium which would gradually accumulate after longer exposures. Work at other sites (not at AI) revealed that metallic fuel elements swelled after fissioning for a long time, so that metallic fuel could not be used in power reactors. This discovery resulted in a decision to terminate the PRE project. Work at other sites (not at AI) subsequently developed oxide fuels.

We had a lot of exotic materials up at SSFL. The SNAP reactors at SSFL used beryllium reflectors. I don’t know that they ever had any problems with that, but beryllium is pretty toxic stuff.

I am confused why they think the tritium that they are finding up there now could possibly be attributable to operations on the hill from the 1950s. Tritium has a very short half-life. Even if tritium was released from a reactor at SSFL, it would be long gone by now.

Frankly, I think the tritium is there because someone screwed up their measurements. Tritium is what I call a “soft beta” – it is not energetic. When I worked with it before coming to AI, I had to put tritium in a counter to detect it. You cannot detect tritium with a hand-held detector due to its classification as a “soft beta.”

I have no knowledge of any spills or leaks.

In reference to the SRE accident, radioactive iodine could not have been released. Iodine reacts strongly with sodium, so if it were released, it would have bonded with the sodium and it would not have gone anywhere. I would believe it if there were some noble gases (krypton, xenon,

etc.) released in that accident. They would not have chemically combined with anything so they would have been sure to escape. If they were released, they would have begun decaying immediately. Radioactive isotopes of those elements could, after escaping, have decayed to radioactive isotopes of halogens.

I have no knowledge of any chemical or radioactive materials being disposed on site.
I was trained to do my job mostly through on-the-job training. We learned as we went. Things were changing under our feet. Everything was done manually when I first started up there. Things changed rapidly though and things were beginning to be computerized.

People with clearances were working right next to people without clearances. I had a “Q” clearance. It carried over from my prior work at Hanford. The numbers that I was working with might have been considered classified. The only real use I found for my clearance level down here was when it helped me buy a car.
I do not know anything about policies for handling chemical or radiological materials. I was involved in monitoring project costs. I am not saying that there were not policies; I just do not know what the policies were. Everything that was done related to SSFL was documented.
I do not know anything about any liquids being disposed of down any drains.

Beginning in 1951, I worked in the 100-B/D/DR/F reactor areas at Hanford. I was familiar with 100-H but didn't work there. 100-C was being built when I left. Reactor control was via horizontal control rods which could be moved in measured increments. Emergency shutdown ("scramming" a reactor) was via vertical control rods which were an all-or-nothing operation. When we shut a machine down, a decay chain that passed through a radioactive xenon isotope began to accumulate an inventory of that isotope, which had a very large neutron capture cross-section. If we didn't get back up before too much of that isotope had accumulated, we had to stay down for 12 hours or so, until that isotope had in its turn decayed away, after which we could start back up.

After an emergency "scram," which stressed components, (not after normal shutdown to re-fuel) we tended to experience random fuel element failures necessitating additional shutdowns. The galvanometer power level indicator measured in-core radiation. The integrating unit instead measured bulk coolant temperatures and flow. When we shut down to push fuel, or to clear out a tube which contained a failed fuel element, operators had to uncap the coolant pigtails for the selected tube(s) on both the front face and the rear face of the reactor. Refueling was strictly a batch operation with the reactor shut down. Increasing or decreasing production levels was done when the machine was up, by adjusting horizontal rod(s) position.

Hanford was a production facility. All the people who sat at the console were union people, paid by the hour. However, the operator, who was very interested in how much power the reactor was producing, wanted to maximize power production. Shutting the reactor down was something he was trying to avoid. Every once in a while a fuel element would get stuck in the pigtail. If that happened and it did not come out, we would have to shut the whole operation down. Well one operator in charge of the reactor figured out a way to handle it. He would take

his film badge off, hand it to someone else, run to the back end, kick the pigtail and get the works flowing again, and then go back up and put his film badge back on. That kept the whole operation running. The B reactor was a production facility.

By contrast, AI was like a graduate school. SSFL had a completely different set of incentives. I experienced a bit of culture shock when I moved from Hanford to SSFL.

Unfortunately, at the end of the day, Atomics International's strategy was not successful. The consumers public power district (CPPD) sodium graphite reactor at Hallam, Nebraska was built, but failed after operating for a while. I don't think the decision to go with (untested) stainless steel cans for the graphite moderator was an attempt to reduce cost. I think they thought they were being conservative in going from an exotic material, zirconium, to a more conservative material, stainless steel.

Atomics International then built the Organic Moderator Reactor in Piqua, Ohio. The design had been tested up in Idaho. What worked under lab conditions failed a short time after it began operating. When they went to replace the reactor fuel, the oxygen atmosphere got to the coolant and turned it into a tar causing blockage of the coolant channels and the reactor was damaged. The designs worked on a small scale but not at production scale. They were trying to scale things up by a factor of 100 and that is not realistic. They did not want to hear that. They were too conceited. They didn't know what they didn't know. They had PhDs but they did not really understand how to scale up the idea. They knew the science, but not the engineering.

Many of the designs that they looked at were good designs, they operated at low pressure and did not require containment domes. We thought we were being innovative here – everyone else was using designs using water as the coolant. We were using sodium. Humans have thousands of years of experience using water; we do not know that much about sodium or organic coolants.

After the Three Mile Island accident happened, they had a hydrogen bubble as big as a boxcar, and it was under pressure, 100 times atmospheric pressure. That is a lot of hydrogen. The hydrogen was not caused by radiation. It came from the water. We knew they had a meltdown, although it was years before they admitted it. Atomics International sent them a hydrogen recombiner – an emergency shipment – to help them avoid having an explosion. The recombiner exposed the hydrogen bubble to oxygen using an oxidizer, which effectively turned a potentially explosive situation back into water. We knew the only way that could have been caused was by a meltdown. It took years for them to admit they had a meltdown.

As part of the SNAP program a critical assembly test facility was to be built at SSFL. A critical experiment is sort of a zero-power reactor used to measure reactivity. The SNAP reactors didn't use in-core control rods to control power levels but instead were reflector-controlled by varying the number of neutrons allowed to escape from the reactor versus the number of neutrons reflected back into the core. The reflector was beryllium metal. The designers,

seeking perfection, didn't want their measurements compromised by having anything other than beryllium in the reflector. They requested beryllium bolts. Unfortunately, beryllium bolts were very hard to machine. When they estimated the cost for the experiment, the beryllium bolts would have cost more than the entire rest of the machine. The idea worked in principle, but it wasn't practical.

As a junior member of the unit doing chemical process engineering for the designers of the "purex" reprocessing facility, I was responsible for maintaining a very large schematic drawing which indicated all vessels and piping, etc., and listed quantities, temperatures, compositions, etc., for every vessel, pump, pipe, etc., and was responsible for heat and material balance calculations for the design project.

One of the listed properties was viscosity. That line was blank because the chemical research people hadn't yet suggested any viscosities. A staff assistant for the guy in charge of the plant asked to use my drawing in a meeting (to which I wasn't invited). He noticed the blank viscosities row, and said he didn't dare take it to the meeting with any lines blank. After a certain amount of discussion I agreed to see what I could do, hit the books, fudged up some numbers, and filled in the row with one-significant-digit guesses.

I carefully erased those numbers when I got the vellum back. A year or so later, when I was on the road as a vendor inspector, while carrying out an inspection on large agitators at an automatic signal company division of Eastern Industries Incorporated, I was astonished to recognize my viscosities in the contract specifications.

I have no knowledge of the liquid materials being disposed of using toilets or floor drains; the sodium burn pit; the surface disposal area at the western edge of Area IV; any leach fields, septic tanks, or drainage discharge locations; the old conservation yard; any storage tanks, gas holdup tanks, etc.; nor any underground pumps, sumps, storage tanks, piping, sewer, or drainage systems.

I remember one time a guy wanted to develop new instrumentation to measure sodium flow. He needed a sodium tower so he could take advantage of gravity flow. He submitted a proposal requesting two kinds of funding, expense (wages, purchases, etc.) and capital (buildings, etc.). The expense portion was approved. The capital portion was rejected, leaving him with approval to proceed, but no facility to proceed in. He got a guy in facilities engineering to design him a tower made up of a small variety of standardized components, submitted purchase requisitions each just under the amount which would have been routed to me for review, personally hijacked a cement truck intended for another project on the hill, had PhD's out working with wrenches and trowels constructing his tower, and got the job done - which made him a hero within the technical community, but not to me. Once the new building had been built, an AEC guy saw it on a new aerial photo and said, "What's this?" He obviously hadn't approved the construction. The scientists were forever trying to figure out a way to work around the administrators. The sodium tower was located in the AEC Triangle.

I think that a lot of people are overreacting. There is not that much to worry about up there.
I enjoyed working there. Altogether, I worked for Atomics International and the companies that bought it from 1956 through 1997. I retired on January 31, 1997. Three days after I retired, I went back to work as a contractor. I was a contractor until 2007. The Rocketdyne Division was sold to Pratt & Whitney in 2005. They had a two-year rule. No contractor could stay on longer than two years. Therefore, I finally had to stop working in 2007.

I liked working here a lot better than I liked Hanford. I went to Harvard Business School after working at Hanford, and I wanted to get away from weapons and into energy research. I was single when I lived in Richland, but it was a company town with plenty of rules. All the housing was controlled. Single people had to live in dormitories. Even the waitresses in the local restaurants had to have clearances. If you lost your job, you had to leave town because there was nowhere to live.

I moved here and I am glad I did. The culture here was a lot more relaxed.

UNITED STATES DEPARTMENT OF ENERGY

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 6/2/2010

Interviewee(s): 31

I worked for Atomics International as an electronic tech from 1959 to 1960 at the SRE and SNAP reactors in Area IV. I measured radioactivity on samples used in reactor tests. These tests involved placing the rods in different positions to expose samples to varying levels of radiation. The position of the rods had an effect on the output of the reactor. Sample material consisted of various metals, approximately 3 to 4 inches in diameter, and enclosed by a resin casing. Beryllium was one of the sample materials I specifically recall handling. I was in charge of taking the irradiated samples to the laboratory, measuring the amount of radioactivity, recording the measurements, and returning the samples to the physicist in charge of the experiment.

A photo multiplier tube and a scaler were used to count the radiation given off by a sample. Data from the sample analyses were recorded on data sheets and maintained with the samples. Duplicate copies of these data sheets were not generated by me. I can't remember if I used a logbook and do not know where one might have been kept. It is possible that sample numbers were recorded in a log book, but I can't verify that information. I likely initialed or signed the data sheets following sample analyses. I measured samples from the SRE and SNAP reactors. The testing and measurement data would be used to make improvements to the reactor.

Once the samples were analyzed I would place the samples and their corresponding data sheets on a work bench shelf. The samples would sit on the shelf until a physicist working on the experiment picked them up. Sometimes I would have to remind the physicists to pick up samples left on the shelf for long periods of time. Samples were not thrown in the trash. The samples were either in the laboratory or with the physicist.

Sometimes a sample result would show more radiation than expected, but this was not considered an accident or incident, as it was part of the experimental process. Sample results that were outside the expected "norm" were further evaluated to determine if there had been an error or if the results were valid.

I wore a dosimeter, but no protective clothing. My dosimeter was taken once a week by a "safety person," presumably for monitoring, and was given back to me.

I received on-the-job training. They told me what they wanted and showed me how to use the equipment. There were not really any written policies for the work. One other electronic tech worked the same shift, but his duties were different than mine. There was not much oversight and I was left alone to do my job for the most part. The culture was such that the techs had a certain amount of camaraderie. During lunch or break time, we would talk, maybe have coffee, and sometimes watch the rocket engines firing.

The physicists talked about non-work a little, but most people were too busy to sit and gather for any long periods of time, except as it pertained to work. The work was standardized and there wasn't much variety in it, it wasn't that interesting or exotic. Everyone knew their jobs and did them. People stayed in the area they worked in and would not be moving between buildings or walking around the site.

I had Q clearance in progress while working at the site, but left before it was finalized.

Samples needed to be kept clean for accurate results. Pure alcohol, as opposed to denatured alcohol, was used to clean any resins, dust, dirt, fingerprints, or other deposits off of the samples. Special signatures were required from a Ph.D. physicist in order to obtain the pure alcohol. I think it came in a one pint size bottle, but it would not have been more than one quart. I think I used Kimwipes to clean the samples with pure alcohol.

Used wipes and/or rags were placed in a trash can, but I don't know if it was a controlled waste container or special depository for waste wipes. The alcohol evaporated quickly and was only used in the lab in small quantities. I don't recall any waste alcohol that had to be disposed of. There were no written procedures for cleaning samples that were given to me.

I would examine samples under a magnifier to ensure they were sufficiently clean before taking measurements.

I am not aware of liquids being dumped down drains or toilets. I don't know why anyone would do that. The toilets were kept very clean and nothing went down the toilets that I'm aware of. I am not aware of any liquids going down any drains. I have no recollection of any problems with pumps, storage tanks, pipes, sewers, or drainage systems.

One of the smaller reactors, possibly called the SNAP reactor, was for the Germans. The work was being done through Atomics International, but it was for German reactor development.

UNITED STATES DEPARTMENT OF ENERGY

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 7/16/2010

Interviewee(s): 34

I worked at SSFL from 1953 to 1987 as an engineer in the Facilities department and Purchasing department. Initially, I was involved in building test stands. Over my 34 years, mostly at SSFL, I was employed by various entities including, North American Aviation, Atomics International, Rocketdyne, Rockwell, and Boeing. I worked at Area IV from 1969/1970 to 1981/1982. After that time period, I still went up to the hill but my office was at the DeSoto facility.

I am a graduate engineer and was the 330th employee hired on at SSFL/Rocketdyne when I started in 1953. I was in Test, but I was not a button pusher. Everyone on the hill was in Test, but I was in a support organization, which later became Facilities Engineering. In 1956, I became the youngest supervisor in North American Aviation Corporation history at 24 years of age.

Between 1953 and 1958, I was on the hill. After that, my office was no longer on the hill, but I would still make trips up there. We built 17 test stands. When I started on the hill there were two test stands. We went from 2 to 19 test stands while I was involved. Atomics International didn't really have a presence on the hill until about 1956. I had nothing to do with AI. I didn't know much about them in my early years.

I spent a lot of time interacting at corporate offices from 1958 onward, when I was in Facilities and Purchasing, because we were building and growing. I had a lot of knowledge of the site history because I was involved for so long.

I have testified on Boeing's behalf in court regarding contamination issues three or four times since 1987, but not recently. The lawyers involved in those cases cautioned me that it was alright "not to remember things" if they incriminated Boeing. I understand that you would like me to remember everything for this interview to support the investigation and the final cleanup. I will do my best to be candid and forthcoming. All the press coverage now on the rocket and

reactor side is stretched beyond the truth and a lot of the history isn't told. I have experience over the entire SSFL site, the whole 2,500 acres.

Even after I left the company in 1987, I worked for Facility Design firms that did work for Rocketdyne and Atomics International. So I stayed involved for another 10 or 12 years and made many other trips up to the hill, but not as an employee.

I have a lot of information on chemical contamination in Area I, II, and III. Maybe you could pass my name along to NASA as I am sure they could use this information when they move forward with their cleanup efforts. I also know about some contamination in Area IV and at DeSoto having to do with Atomics International.

We used certain chemicals, including trichloroethylene, in monstrous amounts. At that time there was no concern over its environmental impact because we didn't know how "dangerous" it was. We used hundreds of thousands of gallons of solvent in Area I, II, and III.
Trichloroethylene was used in Area IV as well. Trichloroethylene was used to clean things. Other cleaning chemicals, such as toluenes and ketones, were used as well. We were experimenting with how clean we needed to be. Many solvents were used experimentally. Trichloroethylene (Trichlor or Trike as we called it) was used in huge quantities over the whole site because it proved to be the best cleaning chemical we used.

Liquid sodium explodes if you introduce water to it, but it dissipates. It is not, in my opinion, a contaminant. There are claims today that it is a contaminant if other things get in it, but I don't believe that.

As far as radiation, I had offices throughout Area IV starting in 1969. The Big Reactor was shut down by then. I was in the Facilities section of LMEC, which later became ETEC. I had full access to everything all the time. I don't use those words lightly. There was no place I couldn't go. I had the top clearance, above top secret, this was called Q clearance. I wasn't denied access anywhere. This also includes my time in Purchasing. They wanted engineers in the Purchasing department that knew what was going on so that, for example, when we ordered a certain grade of stainless steel we knew why it had to be so certain. There are lots of varieties of stainless steel. The engineers knew the exact type of material that was required for each job and that's why they wanted us in Purchasing. I was one of the first engineers in Purchasing for both Rocketdyne and AI. I later brought some engineers in with me as well.

I had little or nothing to do with the nuclear side of the business. When I first came in, there were no nuclear facilities left to be built. The nuclear facilities had already been constructed when I joined. We were building liquid sodium test facilities. Liquid sodium was dangerous, but not a contaminant.

The radiation hazards from 1969 on only existed in small laboratory areas because the Big Reactor was shut down. It has since been demolished and the site filled in. The test runs over the years, which I was not involved in, reportedly showed that there was some residual

radiation, but DOE, AI, North American, and Boeing revealed the level of contamination. They weren't trying to hide anything. I think the contamination at the site has been overstated.

I was involved as the Principal Construction/Facilities Engineer at North American's facilities in Nevada. We built test stands there. In 1960, concerns were rising in areas of SSFL regarding potential hazards and noise and the effects they had on the adjacent communities. The noise hazard was exclusive to rocket testing in Areas I, II, and III. We built the facility 40 miles north of Reno because Boeing/North American didn't want to subject the Southern California community to any "more" hazards from SSFL. Pentaborane was awful stuff, but it was a superb rocket engine propellant. It was only tested on a very small scale in Area I at SSFL. It was tested more thoroughly near Reno because that facility was a "safer" testing location; it didn't have people living nearby. Other "dangerous" propellants were also used there.

Many of the propellant chemicals did not get tested at SSFL because North American, Rockwell, Boeing, and NASA were always very concerned about hazards to the ground, community, and employees. But there are many things we did in the 1950s, 1960s, and 1970s that we did lawfully because there were no laws against them, such as using Trichlor. No one said we couldn't use it – it wasn't against any laws. Once it was made "illegal," they stopped using it. I used to wash my hands in Trichlor in the early years. We all did.

In 1971, when I went into Purchasing at SSFL Area IV, our office was in Building 30, which was 200 yards by air from the reactor, the big one that "over-reacted" and had the big incident. I was in charge of many things when I was in Purchasing, including packaging and warehousing, in AI. My Box Shop was in one of the buildings right next door to the reactor. We built crates, boxes, and shipping containers. I had a guy, ABC, who worked there full time for the entire time I was there. He lived to be 87. He had no history of radiation "poisoning." People in Simi Valley are concerned about being subjected to radiation and ABC worked right across from the reactor and never had any problems. I don't glow in the dark. I'm sure the radiation hazard was there. I'm sure there were people who had problems, mainly the guys and girls who worked down in the reactor itself before the incident happened in 1959. There are many things we did at Rocketdyne that, from a chemical hazard standpoint, were way worse than the radiation hazard. I mentioned pentaborane, a very hazardous chemical. We tested every chemical known to man in order to find the combination of oxidizers and fuels that would produce the greatest thrust (ISP).

Much experimentation was done in the early 1950s. That's when we were so concerned with cleanliness, and Trichlor was the best cleaner. We tested all sorts of solvents, including some that would "burn your toes off." Trichlor was a solvent we used when we worked with liquid oxygen because liquid oxygen (always the main oxidizer) would react with anything and things had to be exceptionally clean to prevent this from happening. Liquid oxygen was never used other than in "test-tube form" in Area IV. We did a lot of testing with liquid nitrogen in all areas where you needed extreme cold. But nitrogen is completely benign.

I mention liquid oxygen because in Areas I, II, and III not every test was successful. Many tests ended in explosions. We had a full time weather station at SSFL and had it for years and years. Explosions could have released clouds of hazardous chemicals that went over Area IV, but the fact that they went over Area IV hasn't been in the news and should not be a concern. But it may come up if someone is claiming that Rocketdyne contaminated Area IV. I don't think any of the explosions contaminated anything in Area IV.

As far as liquid sodium, there was an area called the Sodium Burn Pit in Area IV. I went by it many times over the years. That area was used to dispose of contaminated liquid sodium, so there are probably other "contaminants" in that area. So many things were used, there could be over hundreds of different chemical contaminants. West of the Sodium Burn Pit there were other buildings where I think spills may have occurred.

There were 13 active water wells at SSFL over the years. The wells were used for everything but drinking. The water was not potable. Some of the wells were near Area IV. The water had too much calcium for it to be safe to drink. It came from deep in the crevasses of the rock and it has been "proven" many times that the water can't get out. Many of the contaminants that were used, kerosene for one, seeped down into the crevasses, but could not escape down into the valley because the crevasses were too tight. I think that has been proven by Boeing, North American, Rockwell, DOE, and NASA. As said, in some of these crevasses there was naturally occurring water, how it got there I don't know, but that's where we drilled the wells. Some of those wells have been sealed off and they may have "contamination." There were a few wells bordering Area IV.

I can identify the Big Reactor, Box Shop, Building 30 (where the Purchasing people were), a Warehouse, Clean/Unused Liquid Sodium Storage (storage was in barrels), Chem Lab, Machine Shop, and SPTF (Sodium Pump Test Facility) locations on the 1978 aerial photograph. There was a well just outside the aerial photograph's view. I would look at the Chem Lab for contamination. There could also be chemical contamination in a deep hole/pond near Buildings 40 and 59. The warehouse stored valves and parts like that, never any chemicals.

The Sodium Burn Pit stayed in the same place. We had other disposal areas in Area I and in Area II near CTL-3. We would get a lot of our chemicals in gaseous form. Once you finished what was in a gas cylinder bottle (called a K bottle) you couldn't just get rid of it and throw it away. We had a marksman from the police department/plant protection. He took his 30-06 and set up a K bottle 50 feet away and shot the valve off the K bottle to let the gas escape, but this has nothing to do with AI. The only disposal facility that I knew about at AI was the Sodium Burn Pit. I don't know exactly what they put in the Burn Pit because I was not responsible out there. I knew they disposed liquid sodium, but I don't know about any other chemicals poured into that pond.

The Area 1 disposal area could have had radium from instrument dials. Radium was then used to make instruments glow. I don't think there was any other radiation per se in this area. I don't think it had anything to do with AI, but I cannot say that as fact.

There were many things in the early 1950s that went on at SSFL that occurred before AI and the reactors were built. They did jet engine testing at the entrance to the facility. They brought jet engines up from the Los Angeles Division to test there. There was a "lot" of kerosene used. This had nothing to do with AI, but I wanted to make the point that a lot of things happened on the 2,500 acres of the entire SSFL site over the period 1947 to today that are not related to AI. AI was in a big corner that we "drove by" for years before LMEC. LMEC started in the mid-1960s.

I have the most experience at Rocketdyne in Areas I, II and III. We were pioneers, doing things that hadn't been done before. Some people probably thought that the people in AI are nuclear oriented and don't know what happened up here in 1947 or 1951, the early years. Although there wasn't a physical fence separating the areas, there was a technical separation between the rocket and nuclear side. There wasn't any technical interaction between the sides until the 1970s when some of us from the Rocketdyne side helped build test facilities for liquid sodium components. AI needed our experience from building rocket test facilities to help build the sodium test facilities. SPTF was a huge structure with a big derrick that we got from Peenemünde, Germany. That is when the relationship between Rocketdyne and AI warmed. A lot of guys came from Rocketdyne to AI with test experience that AI needed at the time. Many people at AI (in Area IV) were scientists and had little test experience. As engineers, we got our hands dirty. The scientists didn't. They did things at AI that we didn't need to know and we did things at Rocketdyne that they didn't need to know. There was technical separation between the two sides because of the work each side was doing. That is my opinion.

Our Maintenance people got into everything all the time. We worked very closely with them. We wore green and yellow hard hats, they wore green hard hats. All the different departments had different colored hard hats. They wore whatever they wanted at AI – they didn't have just one color. That illustrates one of the basic differences in the divisions.

We had a lot of camaraderie on the rocket side. We were "brothers of the spear." We all knew what could happen if things went wrong because of our years of experience. Safety definitely was part of the reason we had a lot of camaraderie. But there are many incidents, explosions, and things that happen that there was no track record for and once something bad happened then we knew we couldn't do that again. The scientists were nuclear scientists and they knew what made a nuclear reactor, but we on the rocket side didn't know about that. When I moved over to AI, they put a "velvet" rug down because I carried with me all my years of experience on the rocket side. They were grateful to have the experience of the rocket people that crossed over. In 1969, I was at the Downey Division working on shuttle facilities, but AI needed people with hands-on experience and they asked me and others to come up to Area IV at SSFL. The supervisors at AI knew of our test experience and they wanted it, so we crossed over into AI to help build the sodium test facilities. Eventually, the divisions merged and became

Rocketdyne/AI, but I think the "schism" was still there. I call it a schism; you call it a cultural difference in the two sides. It was a technical schism in my mind, not a cultural difference.

The scientists at AI were doing small scale experiments, while we were doing mostly full scale work. When AI needed large scale structures for the sodium test facilities, they called on our experience with large scale structures. By the 1970s, we had built 19 test stands. They wanted to marry test experience with science. Initially, in the 1940s we knew nothing about rocket engines, but the Germans did, so we later brought the Germans over. This is what AI was doing, bringing in the people with the experience and knowledge they needed.

A lot of people at AI knew of explosions. We had a guy killed from an explosion in the Area I Research area and another guy lost his arm from an explosion, but those were the only two serious incidents I can recall. The people in AI knew of the explosions and incidents and thought that Rocketdyne was unsafe. That's the reputation we had from AI's perception because of the "hidden fence" or schism between the rocket and nuclear sides. I had a friend who came from the AI culture and there was a technical schism between us, but we remained friends. We were learning as we went along, doing things that had never been done, even in the 1970s and 1980s.

I know very little about how radiological materials were handled in Area IV. I did wear a film badge when I went in certain places. Wearing the film badge was very strictly enforced. I had to show my badge, and often they would check my clearance before they would even let me in certain buildings.

I am not aware of any "off-normal" events that dealt with radiological materials. I don't know anything about the storage or disposal of radiological material. I knew radiological storage existed and that is was disposed, but I do not know anything specific.

Just about everything that came into Area IV went by the building I was in (Building 30). We could see trucks carrying barrels and cylinders coming into the site. There were a few buildings in the heart of the LMEC where the so-called "hazardous materials" were stored. They did little testing with hazardous chemicals. They tested valves and pumps that pumped liquid sodium. There were a couple of small buildings that stored the chemical gases, but I am not sure which buildings specifically.

The Sodium Burn Pit was used on a "daily" basis. I don't know if anything "off-normal" occurred at the Burn Pit. I had nothing to do with the Burn Pit per se. I knew where it was and I would sometimes hear the explosions when the sodium hit the water.

Company policies dictated how material was handled. We had a large Facilities Manual that dealt with that kind of stuff. People followed these policies. I don't think there were ever any intentionally unsafe practices. If we had a bad result from something we had never done before, then we knew that practice was unsafe. We were learning about and improving our knowledge on safety as we did tests. The policies and procedures evolved as we learned. The

Facilities department included 130 engineers in my Design department and nine environmental engineers that reported to me. From 1980 to 1978, the nine environmental engineers were responsible for making sure that environmental hazards were monitored and controlled, such as disposal of chemicals. But by this time, there was no disposal of anything nuclear because the nuclear operations were shut down on the hill. There were some incidents in Building 103 at DeSoto, where there was a radiation lab doing some bench-type research. My nine environmental engineers were responsible across the entire site, Areas I, II, III and IV. They would disseminate any new rules in writing and ensure the people that needed to know received the information. There was wide dissemination in manual form.

I don't think anyone ever intentionally disregarded the procedures or rules to my knowledge. It would be sabotage or subversion if someone didn't follow the rules. We had accidents, but they didn't necessarily occur because a procedure was violated.

I don't know if any radiological or chemical material was ever left or disposed of in Area IV drainages. We had a big pond on the Rocketdyne side that residual kerosene would flow into in the 1950s and 1960s. We would sometimes burn it off at night, like they are doing in the Gulf now. When it would rain, there was nothing we could do and the kerosene would flow down South Canyon just south of Area III. A lot of chemicals left SSFL, but I don't know of any chemicals that left Area IV in quantity. There was a creek that flowed north of well 13. There were some chemicals I'm sure that left Area IV, but not in large quantities in my opinion. Although there are those who will say that's how Simi Valley became "contaminated."

Any incident, large or small, had to be documented. In the 1970s and 1980s, it was documented by my environmental people. Every test that was done was documented. I don't know where those records are or how they were kept. There were probably things that were not documented, but these would be routine things. Anything related to a test was documented. That's what we were there for, scientific history.

The Sodium Burn Pit was used pretty much all the time. I always felt it was used properly and with some level of guidance. There were always certain personnel involved and I saw them, they wore white uniforms and masks. They knew what they were doing, and what they were doing was not illegal. They were not doing anything at night, like when we used to burn off the kerosene from the pond in Area I and II. We knew we weren't supposed to burn off the kerosene and that is why we did it at night, but it was a better alternative than letting it flow down the hill in a rain storm.

I am not aware of any surface disposal area on the western edge of Area IV. There was a pond in Area IV (noted on aerial photograph) that you might want to look at. I don't know if it is still there. I recall a leach field (noted on aerial photograph) in Area IV.

There were conservation yards/junkyards in Areas I, II, and IV. The junkyards contained steel, pipe, and other parts that were cut up. Eventually, things were hauled off and sold. We would

recycle things from the junkyard, if possible. When the tests stands were eventually torn down, a company came up and took the old steel. I wasn't there at the time, but I know about it.

I don't know of any liquid material being disposed down floor drains or toilets. We had toilets, but they went to septic tanks, we didn't have sewers. Maintenance people can tell you more about that than I can.

We sometimes had problems with our piping. We had a lot of "cross-country piping" in Area I where we transferred gases, (gaseous nitrogen and helium), water, and kerosene.

I look at my experience on the hill as one of the most wonderful experiences I could ever have as an engineer and as a person. To work up there for 34 years, doing things that had never been done before was something special for a lot of us. We didn't do anything that we knew was unsafe. Many incidents that occurred at Rocketdyne and AI occurred not because we were doing things that were unsafe, but because we were doing things that had never been done before.

UNITED STATES DEPARTMENT OF ENERGY

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 7/19/2010

Interviewee(s): 57

I worked at the Santa Susana Field Laboratory from 1953 to 1956. I worked all over the site. It was a long time ago so it is hard to remember my experience there.

I did not work with any radiological material. I mostly worked with sodium. I worked with sodium, primarily in capsule form, in a glove box with remote handlers. The glove box had an inert atmosphere to allow us to work with the sodium safely. I felt pretty safe working in the glove box. I had to wear a protective apron and a dosimeter, but that was about it. I didn't have to wear any breathing protection.

When we were done with our work, we would throw old sodium capsules into the Burn Pit and let the sodium dissolve away. Anything that wasn't good was put in the Burn Pit. A guy worked up there and he would take care of stuff at the Burn Pit and make sure everything went as planned. He would help us out if we needed it.

I primarily worked with sodium, but I also worked with some associated cleaning chemicals. All the chemicals were stored in a location that was convenient for us to use. When we needed to dispose of anything, including the chemicals, it usually went to the Burn Pit. I do not recall any chemicals being dumped down the toilet or drain. I didn't see anyone dump any chemicals on the ground.

I received some training when I first started at the site. The lead men and other bosses would assign me jobs. They would tell me what they wanted done and how to do it.

We had rules and regulations that we had to follow. Sometimes the rules would change and I would have to read the new procedure to learn what had changed. Most everything happened as it was supposed to though and we followed the rules. Procedures were written down and we followed the procedures.

I also worked with asbestos. I would cut asbestos off of sodium tanks and piping.

I documented my work by filling out forms. I don't know how the forms were used or where they were stored after I turned them in to my boss. If anything went wrong it was noted in a report.

I was involved in an accident once on the hill, but I do not recall the details of it. My eye was burned by sodium and I had to go to the hospital for a while. On the way to the hospital, they flushed my eye with water to remove as much sodium as they could. It was painful, but my eye got better. A report was made to document the incident.

I heard about the "meltdown," but that was after I left the hill. I heard about it after the fact, but we didn't get involved in a lot of stuff that happened. It was a dangerous accident. Things were classified and secret, so if we didn't need to know about something, we didn't know about it.

We probably did things we shouldn't have done, but we shouldn't condemn the company for that. It was not the company's fault. It was our fault. I don't remember anything happening that was the fault of the company. I have no regrets or bad feelings about the company. We tried to always do things by the rules, but when the rules changed sometimes we could no longer do things the way we used to. Sometimes we made mistakes or had accidents, but no one ever did anything wrong on purpose. We made sure everything was documented and we would correct any problems. In all the time I was on the hill, everything was done according to the rules.

I would look at the Burn Pit to make sure it is cleaned up.

I really enjoyed my job and liked working on the hill. We always had things to do. I was on the hill for three years and then I left to work for Rockwell at Canoga Park. I liked the people I worked with. The bosses were good guys and never did anything bad on purpose. I really want to stress that the company was not to blame for anything. If something went wrong, it was our fault and not the fault of the company.

UNITED STATES DEPARTMENT OF ENERGY

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 7/21/2010

Interviewee(s): 58

I worked in a sodium building in 1978, it may have been called the Sodium Component Test Loop. We were running transient studies involving liquid sodium. Sodium melts at about 200°F. The sodium came in looking like Styrofoam. We would heat it up and pump it through various pipelines ranging from 1" to 12" in diameter. There were vertical and horizontal pumps. There were heaters along the lines. We would vary the temperatures from 250° to 1250° F. We would heat the pipes up, and then cool them down. The whole point was we were trying to see if we could break the line. It was a heat exchanger/heat transfer system. We were testing the pipelines to see if they could handle the changes in temperature. We were trying to see if we could break a pipeline, but we were not successful in that. I remember being told that they were running the tests to see if the pipes could be used in a breeder reactor. I don't know if that was correct, I don't honestly know. I am not an engineer. But that is what I was told.

Part of my job was to open the pipes to examine them. When we wanted to do that, we had to let them cool down so the sodium wouldn't be liquid any more. Then they would plug up the pipelines and I could open one up to examine the pipelines. Sometimes they would plug up a vertical pipe; sometimes it would be a horizontal pipe. If a pipe was still warm enough, the sodium would still flow down once the pipe was opened.

I don't know for sure what happened all the time, round the clock. I know what happened when I was on duty. I just worked one shift but the facility operated all the time.

One time they told me to cut one of the lines. They seemed to think the line was plugged up for some reason. I said it was a bad idea; that the pipeline was too warm and the sodium would flow out. They told me to do it anyway. They thought the pipeline was plugged up and that nothing bad would happen. I didn't want to lose my job, so I did what I was told. I cut the line, and liquid sodium started flowing out all over the place. A fire started immediately. We shut the pumps off, turned the heaters off, and used NAK to put the fire out. We called the fire department and they came. We had the fire out in about ten minutes. The engineers wouldn't even talk to me. I think they wouldn't talk to me because I had been right all along. We had to

use NAK to clean the mess up. Once we got the mess cleaned up, it was back to business. That is the only time anything like that happened. It was frustrating to me because they didn't listen to me. We cut a horizontal pipe. The sodium was still liquid and a lot of it came out because the location of the cut was close to a vertical pipe and the liquid sodium flowed downhill. The only thing that went right was that I made the cut in the pipeline away from my body. This was smart because if I had cut it towards myself, I would have caught on fire. I told them it was a bad idea, they didn't listen, and I had to clean the mess up. They wouldn't talk to me after that happened. It was a frustrating experience. I think they were trying to see how I would react to the situation.

There was a pool of water outside the sodium facility. They used to throw things that were contaminated with liquid sodium in there. Then the water would blow up. The item that had been thrown in there would explode and burn.

I left my job on the hill shortly after that. My brother got sick. He lived in Las Vegas and I quit to go be nearer to him. Eventually, I went back and asked for my job back. They hired me back, but from then on I worked at the Canoga facility. I didn't work on the hill again. I was only up there a year, or maybe even less.

The only time I ever handled radioactive material was one time when we were told to go out and pick up some pieces of equipment that were on the ground. Then the Health Physicists figured out that the equipment was contaminated with radioactivity and they told us to stop what we were doing. I had only been picking up the equipment for about one-half an hour.

I know they had a glove box that they used to examine items that were radioactive. I saw it done once, but I didn't do that ever.

I didn't handle any hazardous chemicals. The only thing I ever did that seemed hazardous was when I cut the sodium piping. That was the only problem that I was ever aware of. Things really ran pretty smoothly up there. I did handle the NAK. I don't know if it is considered a hazardous chemical. It was disposed in a dumpster right outside the building. After the explosion, I just swept it up and then we threw it in the dumpster. It wasn't a normal dumpster. I used the dumpster that I was supposed to use. The dumpsters were easily accessible.

I don't remember any written procedures. As a general rule, people did what they were supposed to do. They had procedures down at Canoga, but I was not aware of procedures when I was on the hill. Our supervisors told us what to do and we did it.

I was a janitor before I started working in the sodium facility. The only training I ever got was on-the-job training. I didn't handle any waste.

I didn't submit any documentation for what I did. The engineers in the sodium facility probably documented what we did there. I think the supervisor was probably responsible for the paperwork.

I never saw any liquids disposed of down any drains or in any toilets.

The Sodium Burn Pit may be the place I already told you about. We didn't call it that back then. I don't know how it was used. It was there. I saw someone throw something in it once. It was like a show-and-tell. It was probably when I first started working in the sodium facility. It was a good thing for me to see that, it was a good experience, a learning experience. I was glad to know what I was up against in handling the liquid sodium. It was very easy stuff to handle and it was surprising how dangerous it could be.

The only incident I know about was the time I cut the pipelines. They thought the pipelines were plugged up. I was the last one hired and that's probably why they asked me to do it. I told them I didn't want to do what they told me, but that I would if they told me to. I didn't want to get blamed if things went wrong.

I don't know anything about any surface disposal area or any leach fields. I don't recall anything about any conservation yard or junk yard. I didn't even know those things existed.
I was a janitor for the first 90 days after I was hired, during my probationary time. They wanted to see if I was okay.

One day they asked me to go work in another sodium building. The working conditions were not as good in that building. I filled in for a guy who wasn't there, just one shift. I didn't like the place. My intuition wasn't good about the place. In my normal building, the layout was clean. I could see everything I needed to see. I was not interested in finding out what was going on in the other building.

I was a janitor before I went to the sodium facility. I swept the floor. I emptied the garbage in the dumpsters. I washed floors. I worked all over the hill. I did what a janitor would do anywhere else. Occasionally, I would have to sweep up these chips off the floor and put them in a big drum. When the drum would get full, someone would come pick it up and haul it away. I don't know where it went. No one else was around while I worked except security. There was this one guard who would sneak up and watch what I was doing. He seemed to want to catch me doing something wrong. He wouldn't talk to me. I was minding my own business, busy doing my job and suddenly, I would feel someone watching me. I was all alone, but there were bobcats and mountain lions up there. It would startle me. I told him I would take his gun from him and use it on him if he kept doing that. He stopped after that. I was only a janitor for 90 days.

They were good to me and I have no complaints. I have no concerns about the site.

We did not have any leaks in the sodium building. There were not any containment trays under the pipes, but there weren't any leaks. Our pipelines were very tight. I never saw any leaking or spills. NAK is like a fog. When we sprayed it to put out the fire in the building, I couldn't see anything. I called out to my partner. He didn't answer. It was scary. He was okay. I think

he didn’t respond because he didn’t want to say anything. He knew they should have listened to me. I wasn’t sure I was happy about having to breathe the NAK. I am in hospice now. My doctor asked me once if I knew what caused my emphysema or COPD. I smoked for 35 or 40 years. I don’t know if the NAK could have made things worse. I was exposed to other things. I worked for a while plating parts. That was a really dangerous place to work.

I retired from Rocketdyne. They were good to me. They took care of me. It was a good company. I enjoyed working there.

UNITED STATES DEPARTMENT OF ENERGY

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 7/12/2010

Interviewee(s): 78

I worked full time on the hill from 1976 to 1982 or 1983 for both Rocketdyne and Atomics International. There just was not that much difference between the two parts of the company, we just went back and forth. After I left SSFL, I went to Canoga Park as a purchasing representative and my duties took me back up on the hill occasionally in the 1990s and 2000s. I had an office in Canoga Park and then later on in West Hills. Later on, I was also involved in a laser and electro-optical program.

I was there during the years that DEF was the general manager, after GHI was in that capacity.

I left under my own gumption when I finally decided, "I need to get out of this mess." I knew that if I had to suit up and wear a respirator to work with radioactive materials, it was not going to be good for me in the long run. I wanted a safer job with less health risk, so I found myself a job in production controls and moved on.

I worked with radioactive materials, handling "a little bit of everything." I worked in decontamination, including the Sodium Reactor Experiment, the Sodium Burn Pit, and Buildings 5, 6, and 59. All the buildings had a yellow stack – which meant that radiological materials were handled there.

When I worked at the SRE, we took the facility apart. I was there for 1½ or 2 years, working 30 feet below ground surface and using a jackhammer. We would take a radiation reading and when we found contamination, we would dig it up, box it up in special lined boxed, and they would ship it away. I do not know where it was shipped to, but everything went off-site. I think it went to Beatty, Nevada. I do not know where it was stored on-site before it was shipped away.

We wore film badges. No one seemed to think it was that all that hot. We also used dosimeters and collected urine samples in a bottle every 30 days. This was all pretty standard health monitoring, and no one seemed to be too concerned.

A lot of things did not go as planned.

Building 5 had a coal gasification system that we ran around the clock. Coal was converted to a low butane gas by putting the coal in a vessel of molten salt. One day the molten salt vessel blew up. The vessel was under pressure and a 36-inch blind flange malfunctioned. Molten salt was spewing all over the place and going into the drainage system. Building 5 and Building 59 had both been contaminated from previous experiments. I asked, "how come we are not wearing film badges?" I was told that the buildings did not have that much radiation left in it and we would all be adequately protected as long as they were monitoring the building. So I asked for the radiation records, specifically for Building 59, and I was told they could not find them. When I pushed hard, they came up with some kind of calculation of their best guess as to what I had been exposed to.

A lot of stuff seemed to disappear like that.

I was working in Building 59 – which had the yellow and black stacks. I asked why we were not wearing film badges. I was told that they were not necessary because they were monitoring the building. The SNAP reactor was still in the vault in that building. JKL, the project manager, is dead. The shift manager, MNO, is dead. Another guy I worked with, PQR is dead. All cancer related deaths.

Going back to my story about Building 5, after the explosion following the flange blow out, nasty crap was coming out of there and running into the street in front of the building. We were putting sand bags out to keep it on the street. The stuff eventually froze up again. We got it shut down. I was one of the victims of that accident. I filed a workman's compensation case for hearing loss afterwards. I was wearing a respirator and a breathing apparatus – but no hearing protection. I went to an audiologist and found out I had tinnitus, damage to my hearing.

Working all those years with a jackhammer inside an enclosed vessel, and around the rocket testing, took a toll on my hearing.

I almost got killed once in Building 59. I was working on a rotating shift and they were in testing mode. There was a big pressure vessel in the other vault (not the one that the SNAP reactor was in). They had a big mock-up of the Clinch River fast breeder reactor that was planned for Tennessee. It was never built due to politics after the Three Mile Island accident. A previous test had been run and the meters were reading like all the pressure had been bled off as required. I was removing a blind flange from the vessel with a crane and soon learned there was still pressure in the vessel. It blew and sodium oxide was all over the place. I couldn't breathe and I couldn't see. I do not know how, but I got out of there. STU was there too. He died eventually of leukemia. It sounded like a nuclear bomb going off in that vault. There was not any radioactivity in there. But I do not know how I got out!

When I was working in Building 5, we would cut out components, like some piping for example, and take it over to the Sodium Burn Pit to burn off the sodium with a hose. We would stand behind a blast shield at the Sodium Burn Pit because you know what happens when you add water to sodium. That is what we would do. I do not know what that pit was used for before then. I have seen photos of buried objects in the Burn Pit, and I know contaminated valves full of sodium have been buried out there for years.

I was licensed to drive a skip loader. One time, I was operating the skip loader in the Sodium Burn Pit digging up asbestos from old tanks. I had to be suited up in protective clothing for this work. I ran into something that was solid and shiny – it was not a rock. I got a pug and got a reading on it; it was radioactive. It pegged the dosimeter. I reported into my supervisor and he told me to cover it back up and go away. We boxed up the asbestos I had already removed and I did what my supervisor told me and covered whatever it was back up and left.

Later, when I was a program representative for purchasing, I remember seeing a purchase order for some big tarps they would use to cover the place up before it rained. I have heard that a lot of things were buried out there and that everything went there back in the old days. The thinking was, out of sight, out of mind. I ran into one thing with that skip loader. I know from that experience at least one thing was in there that was not supposed to be. How many more things are in there?

We used trichloroethylene when I worked for Rocketdyne. We used that stuff all over the site, at CTL5, CTL6, and on the test stands, including Coca, Alfa, and Bravo.

One thing I found somewhat strange is that they do not have good records of who worked where. We were all part of this general pool with a common job classification. I was low man on the totem pole when I hired out there. Everyone else had 30 years of seniority – they could have all been my dad, I was all over the place, working here and there, wherever they told me to go. Then things got slow and I went over to Atomics International. That is when I started working in Building 59.

We used cleaning solvents for everything. Trichloroethylene was the most common, but we used other things, like Freon. We would flush things out in the open, and it would run down the asphalt, eating away at the asphalt as it drained. There were no catch basins. We used a line to flush with the solvents and the grease and oil would wash off. We did this outside of buildings. The tanks were already outside. We also used Dilenol (alcohol and water combination) in a closed, pressurized system.

Where did the solvents go after we used them? I do not know. Hopefully into a 55-gallon drum with some other miscellaneous solvents, but I do not really know. They were all stored in large vessels or tanks with pumps. Every building on site had trichloroethylene available. I have no idea where it was disposed.

Part of the problem was that no one knew how to properly dispose of solvents like we know today.

Did we have policies and procedures? Well yes – we pretty much did what we were told.

Rocketdyne was a lot more safety-conscious than Atomics International. They had a higher standard. The rocket side had a book of procedures on safety and everything else. The AI side was looser, it was more experimental. We did what our bosses told us to. Everyone at Rocketdyne followed the procedures. No one wanted to get hurt. One time I got a metal chip in my eye. They got me in to see an eye doctor right away and took care of it. They were always after us to wear safety glasses, hard hats, etc. The NASA folks, a lot of them had Air Force experience, and they were strict.

AI was completely different. They were looser and using different kinds of standards. DOE was not nearly as visible as NASA was.

The training we got up at SSFL was mostly on-the-job training. We did get some training in how to work with liquid oxygen and liquid nitrogen. I had been trained in how to handle those while I was in the Air Force. I was smart enough to know what not to do.

I do not know of anything buried at SSFL except for perhaps in the Sodium Burn Pit. I am not aware of any liquids being dumped on the ground.

As for record keeping, I have my own radiation records around here somewhere. I do have some questions about what I may have been exposed to while I was working in those buildings without a film badge. They claimed they monitored the buildings, not the people. They told me not to worry – they could come up with an estimate of what I had been exposed to. However, they do not know where I worked or at what time. They cannot seem to find any of their records. Maybe they do not want to find them.

That whole attitude did not set well with me, so I left and went on. Now I am starting to worry about it, especially when I started realizing how many of the people I worked with have already died. I wonder if anyone has ever done any analysis on mortality rates by buildings.

Could there have been any hot spots in Building 59? The SNAP reactor was in there until very recently. They kept it behind a locked door, but it was still in there. Building 59 is now gone. The same is true for Building 5.

On a daily basis, the shift leader filled out a log. The logbook kept records round the clock, each shift filling in what had happened in the building during their shift. Where are those logbooks now? I do not know. Maybe in the same place as the radiation records for the buildings that they cannot find.

My concerns at the Santa Susana Field Lab are with the Burn Pit, Building 59, and Building 5. Who knows what went into the Sodium Burn Pit over the years. The nuclear experiments that they ran up there ended long before I started working up there. It is possible that all kinds of things are buried there. It could have all been taken to the Burn Pit. No one seemed to think that was a problem, it's just the way things were done. Building 59 still had the reactor in it when I worked there. They buried it in place, but this still concerned me. Building 5 had previous radioactive experiments before I worked there and it too concerned me.

Would I want to build a house up? No.

If you buy a house anywhere near SSFL now, there are all kinds of disclaimers that you have to sign during your purchase of a property. Based on what I know, I would not even want to live in Simi Valley. I do not know what went on in the 1950s, 1960s, or early 1970s before I worked at the site, but I would be concerned living in the area. Many people have gotten sick around there since the 1950s. At one time, there were 8,000 people working on the hill between AI and Rocketdyne. There were only 500 people employed up there by the time I was hired on.

I retired from Boeing. I think they are a good company. They are very safety conscious. They bought a real mess when they bought SSFL. They are not doing much now beyond cleanup. They are a good company and I do not think they would do anything sleazy. I feel sorry for them, getting stuck with that mess.

This page was intentionally left blank.

UNITED STATES DEPARTMENT OF ENERGY

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 7/16/2010

Interviewee(s): 80

When I first started working at SSFL, there was nothing at Canoga or DeSoto yet. There was a facility (called Slauson) on Slauson Street in Los Angeles. Once the Canoga facility and the DeSoto facilities were built, they closed down the Slauson facility. I reported to the Slauson facility for the first two days I worked for the company, and then I went to Beverly Hills for a physical. I didn't start working up on the hill until Friday. My hire date was Monday June 13, 1955. There were no administrative services up on the hill at the time. In 1956, the Rocketdyne Division opened its own administrative services on the hill (Santa Susana).

When I started in 1955 there were no separate divisions within North American Aviation. It was one big company and the test site at Santa Susana was called the Propulsion Field Laboratory. In November of 1955, they divided the company into five divisions: 1) Autonetics, 2) Space, 3) Aircraft, 4) Atomics International, and 5) Rocketdyne. We became North American Rockwell when we merged with Rockwell International and then ultimately became Rockwell International. Subsequently we were sold to Boeing.

I worked for Rocketdyne from 1955 to 1992 and from 1996 to about 2004. I was in the Turbomachinery Development group at Santa Susana from 1955 to 1960. After 1960, I was based at Canoga but had management responsibility for one unit at SSFL. I was not up there full time after 1960. From 1955 to about 1958, I was located in the Area 1 engineering building which was a one-story wood-frame building on the road west toward CTL1. It was painted North American green, just like all the buildings up there. In 1958, my unit was moved to the engineering building in Area 2.

There was a Sodium Pump Facility just inside the front gate. They were learning how to pump liquid sodium.

I had only brief involvement with the atomic side of SSFL. There was a launch failure involving a rocket launched from Johnson Island, near Kwajalein Atoll in the South Pacific. The launch involved atomic warheads. It failed shortly after liftoff and the atomic warhead

contaminated everything around it. They brought the engine back up to SSFL. Because the engine was one of my engines, I was asked to help see if we could figure out what went wrong.

My office was at the Canoga Park plant when the engine from the Johnson Island failure was brought up to the hill. I was managing turbomachinery engineering at the time and went to the hill specifically to look at the turbomachinery to see if I could detect any problems. I didn't find anything wrong with it. I think the Engine Systems people had already figured out what had gone wrong. We were just making certain that what they had not missed a problem in the turbomachinery. Based on what little experience I had up there when I was investigating the Johnson Island failure, I was under the impression that they were very cautious. I thought maybe they were being overly protective of me. I had to put on a white suit, booties, and gloves. I had a badge that you would pass in front of a Geiger counter to see if I had been exposed to radiation. You would check the badge going in and coming out to see if you had been exposed. It is my recollection that they had strict rules about how long you could be in the areas.

I have no knowledge of how radiological materials were handled, stored, or disposed. In fact, I never even heard about the accident involving the reactor until years later. Everything that happened up at Santa Susana was classified. If you didn't have a need to know something you didn't have access to the information. The rocket engine people didn't know what was happening on the nuclear side and the nuclear people didn't have access to the rocket engine information for that matter. I probably wouldn't have found out about a nuclear accident in real time unless a health emergency was declared. If there were any concerns about unsafe conditions, the area would have been cordoned off. In the late 1980s a computer tomography machine, which was an inspection tool, was installed in the area previously used by Atomics International. I made a few trips up there to observe the construction and installation. There was never any atomic testing going on during this period.

VWX was the Facilities person I dealt with on this project. She provided the Facilities support in setting up the computer tomography machine in the late 1980s. She did a great job.

I was involved in testing turbopumps at CTL1, CTL2, Bravo, and Delta test stands. I was so busy with turbopump stuff, I didn't even know about the other rocket engine testing. There was a lot going on. The military was pushing us. They needed the IBMs and the ICBMs. We were right in the middle of the Cold War.

Regarding chemical materials, I worked with a lot of trichloroethylene. It was a great cleaning solvent and a great degreaser. It didn't have an environmental stigma at the time. I wasn't afraid of it because I had a job in a machine shop during high school where I cleaned machine parts with trichloroethylene using my bare hands. I've always felt the furor over trichloroethylene was overblown. I know it did a good job at just about everything, including taking the skin off your hands. Parts used in LOX systems had to be cleaned thoroughly to remove any hydrocarbons left by the fabrication processes and 'triclor' was the best cleaning agent available.

I really don't remember where we stored the stuff. I think it was stored in metal cans. I don't think it was stored in plastic containers. It may have been delivered to us in 55-gallon drums. I wasn't involved in transporting or storing it.

There were two groups on the hill: the development people and the test people. I was in Turbomachinery Development. The development people directed the test people regarding which tests to run. The test people then supplied the materials, operated the test stands, and did maintenance on the facilities. I wasn't involved in the management of chemicals. I wouldn't be surprised if someone just poured trichlor on the dirt when they finished cleaning something back in those days. It wasn't considered hazardous. It didn't even occur to me back then that we shouldn't do something like that. Maybe I lead a sheltered life.
I was aware of some off-normal events. I remember an accident investigation involving CTL-4 in the mid-60s. They were using UDMH and NTO as a propellant and a test stand blew up one morning. It killed a couple of guys. YZA was the chief engineer at the time and asked me to be his representative on the hill during the investigation.

I remember another incident that occurred at Delta 3 one night. They were testing fluorine, which is a great oxidizer but a miserable chemical to handle. You got more for your buck with it than with liquid oxygen. A fluorine leak occurred somewhere in the piping system. I was testing turbopumps at Delta 2 on second shift. Fluorine has a strong odor (they put fluorine in public water systems to help your teeth, but its smells bad). At any rate, I remember the Test manager, BCD, came roaring over in a jeep and told everyone to get out. To my knowledge, no one ever had any ill effects from that event. I don't remember what they did with the fluorine. They probably drained the tanks. I don't know where they drained the fluorine to, to the ground maybe or they could have brought in hazardous handling rigs, but I don't think so. I don't think they existed at the time.

There is a difference between getting a strong smell and suffering ill effects from it. For example, when I was a kid, my father's machine shop was in an ice plant that used ammonia as the refrigerant. That building was built in 1900. It was an old place that had lots of leaks. We smelled ammonia all the time and had no ill effects.

Kerosene, oxygen, and nitrogen were the highest consumption liquid materials used that I worked with at Santa Susana. Nitrogen was an inert gas used to pressurize tanks, but is not hazardous.

I do remember we had these big water cooled flame buckets that deflected the rocket flames away from the ground. The engine exhaust produced a lot of soot which flowed downstream with the flame bucket water. The soot from the Alpha and Bravo areas flowed into ponds. There were fish in the ponds but they weren't very appealing because they were all black from the soot. We didn't consider the soot to be toxic.

I didn't need (or get) a lot of training. We were all learning as we went along. Most of the training we did get was safety training for the test stands. Each test area had a system of lights. Red meant a test was underway, yellow meant a test was about to begin. Green meant you could enter. I didn't have any materials handling training because I wasn't doing that type of work.

They had a liquid oxygen plant up there for several years. It was between Area I and Area II. So we had our own, local source of liquid oxygen. Kerosene came up in tank trucks. We handled similar to the way gasoline is handled at a gas station. It didn't require anything special.

There were very few liquid oxygen accidents. One happened at Bravo 2 on a day with very low humidity. A layer of the liquid oxygen was floating as vapor close to the ground. It wasn't visible – it looked just like air. A guy came out with a cigarette and threw his cigarette butt on the ground. When it hit the liquid oxygen layer, the asphalt flared up. When he stepped on it to put out the fire it flared around his shoe. I heard the story, I didn't see it. The mechanic lost a pair of shoes but wasn't hurt and but there was no environmental damage.

There were company policies. There were a hundred rules and regulations. These were more focused on airplane plants than on rocket plants testing. It was against the rules to sleep in the airplanes. This didn't have much bearing on us in the rocket side, but because we were part of North American Aviation, it was one of the rules. They could fire you if you racked up too many violations. A lot of the rules were more focused on what we weren't allowed to do. They didn't allow tardiness or insubordination. The rules were mostly related to personnel issues and didn't guide how we were supposed to do our work.

We documented a lot of our activities. We recorded what we did in logbooks. We generated a lot of reports. Later, briefing charts replaced reports. The briefing reports went to the government, our customer. The government was paying for everything we did and each program had its own special requirements for reporting. They reports and briefing charts were kept in files in the program office. We also had to do progress reports and monthly reports. A lot of the files got trashed after we moved them around too many times. I kept my own reports in my file cabinet through about 1965. Almost everything was classified up to about 1965. I had a secret clearance, but I still didn't see everything. Files were organized by department. We saw things on a need-to-know basis. When I was in the Army, I was in the security division.

I was involved in developing turbopumps for the rocket engines. I worked on the Navajo, Jupiter, Thor, Atlas, H1, and Shuttle rocket engines.

The impression I had was that they were very careful with the nuclear stuff. The nuclear stuff was not very forgiving. There was a heavy emphasis on safety. They were conscious that they could hurt people and they didn't want that to happen. On the rocket side, we needed hardhats to go to a test stand. They were not designed for people as tall as me; I am 6 foot 4 inches.

We always documented what we did. In all of my years, Rocketdyne was a very open technical organization. There was very little political maneuvering. We could argue on a technical level, but that didn't carry over to the personal level. We got along like a team.

One of the wonderful things about working at the place is that we were all looking for the truth. We didn't want to do something wrong; it didn't make any sense to proceed with a test if we were going to do something wrong. We were interested in learning together. It was a fun place to work.

Trichloroethylene was no big deal. It was like how cocaine used to be in Coca Cola and doctors used to prescribe it; they thought it was good for you. We didn't know what was bad for us. We weren't afraid of it.

They worked more with chemicals in the research area. They developed solid propellants for armament rockets like NASTY, NAKA, and NALAR. The NA part always stood for North American. I don't know what the rest of the letters stood for. The solid propellant rockets had fins on the back to spin-stabilize the rocket. They had an explosive war head on the end.

I have a book about Rocketdyne, written by Robert S. Kraemer in 2006. It's called Rocketdyne: Powering Humans into Space. It provides a lot of the history.

I am not familiar with the Area 4 Sodium Burn Pit. I do know that sodium burns when it comes into contact with oxygen. It would seem like that may have been a place to get rid of sodium. I don't know what the result of that would be. I don't recall hearing about a surface disposal area. I would have probably heard about that if it existed.

I was told there was an area west of the old Area 1 engineering building where old rocket engine parts were used as fill. (Some of the old engines had gold in them. We had a lot of failures over the years; we blew up a lot of hardware. The engine parts became junk once they failed. It wouldn't have paid to have them hauled off. There was a long old building that was used as an equipment lab on the left side of the road and the engineering building on the right side. Just past the engineering building, there used to be a canyon that isn't there anymore and I was told they used scrap rocket engine parts to fill it in.

Most of the test stands have been taken down. If we had a propellant tank, before we scrapped it out, I am sure we would have cleaned it out first.

Once we had a contract to build two tanks, one each for NTO and for UDMH for the upper stage engines on the USAF Manned Orbiting Laboratory (MOL) program. They were designed with bladders to be squeezed. The pressure outside the bladder pushed the propellants in the bladder into the engine. They were built at Canoga Park but I don't remember if they were ever tested at SSFL. If they were it was before I came on the program and the tests would have been conducted in Area 4. But nothing was ever thrown into the scrap heap until it was decontaminated first.

In my experience, Rocketdyne was always very careful. I have to believe that Atomics International was the same way. It was a culture that came down from North American Aviation.

I don't recall any problems with any tanks, where the tank itself was a problem... Most facility tanks had to be designed with a 10 to 1 safety factor. Flight weight tanks were lighter than what we had on the hill. They rely on the pressure provided by the propellants for structural integrity. They only had to last until they were emptied. We never tested any flight weight tanks up there. Our facility tanks were very beefy.

I loved working up there. I can't think of anything that would have been more interesting to me. The government wanted these ballistic missiles. The public wanted us to be successful. The engine testing would rattle the valley. They knew it would help keep the Russians from bombing us. Now, they are not doing any more rocket testing here.

During the Cold War, the government wanted missiles bad. The contracts were cost plus. We didn't worry too much about costs. There were incentives for us to build lots of test stands. In 1958 or 1959, there were 18 large engine test stands. They were firing all the time. It was a phenomenal time that will never be repeated.

I retired in 1992. I was out for about three years, and they asked me to come back. Boeing was developing a "flex force." There were not any benefits except you could add to your pension. I worked on the RX68 engine – a gas generator cycle engine they were planning to use on the next moon mission.

I was a nuts and bolts guy. The one thing I missed the most once I retired was the interface with the people. EFG was the president of the company when I hired in. He was much loved by everyone. Everyone felt he was looking out for them, personally.

I remember the DC electrical generator for CTL-1 came out of a Pacific Electric substation. The Pacific Electric streetcars were the early rapid transit system in Southern California. The valley line ended at Shoup and Victory. There were double tracks running down Sherman Way. It was a magnificent system at one time. I rode it to school during junior high and senior high school.

UNITED STATES DEPARTMENT OF ENERGY

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 7/6/2010

Interviewee(s): 107

I worked for Atomics International at Canoga Park, California from 1961 to 1973 as an engineer with the SNAP 2, SNAP 10/10A, S8ER, and STIR programs. Prior to my time at Canoga Park, I worked on the OMRE, SPERT, MTR, and SL-1 for Atomics International in Idaho Falls (1957-1961) and for General Electric in Hanford, Washington (1951-1957). I provided a brief chronology of my work history to the interview team. (I also showed the interview team a scram button that was removed during decommissioning of the STIR facility, a pneumatic tube for collecting samples, and my QA stamp, which was the first neutron radiography level 3 stamp ever produced.)

I worked on SNAP 2 and SNAP 10/10A in Building 24. The SNAP 10A program became SNAPSHOT, the first nuclear reactor in space. I was involved in calibrating the reactor instrumentation. The SNAPSHOT program ran for less than 30 days as the DOD collected all the information they wanted from the program and then shut it down. SNAPSHOT has a 300-year orbit and is still in space.

I worked on the S8ER in Building 10, which was much larger than the SNAP 10/10A reactors. But after 2 years, the S8ER was shut down. I was an alternate engineer in the Building 12 critical facility, where all of the free plutonium in the world was located at one point.

Most of my work at Canoga Park involved the Shield Test Facility and Shield Test and Irradiation Reactor (STIR) in Building 28. The Shield Test reactor was a 50 KW reactor. It was shut down and converted to a 1 MW reactor, which became the STIR. The STIR was used to conduct irradiation tests for the Jet Propulsion Laboratory. Samples for this testing were handled quickly as the half- life of isotopes involved was just minutes. Under the STIR program, I conducted studies on shielding, neutron activation, and neutron radiography. Neutron radiography was my primary research in the early 1970s. I worked on neutron radiography of electronic explosive devices for the Saturn and Apollo space programs, including Apollo 7 through Apollo 17. An issue of the North American Rockwell Corporation journal *Skyline* shows examples of how neutron radiography can be used in non-destructive

examination. The radiograph of a motorcycle was my son's motorcycle. The radiography left the motorcycle slightly irradiated and an AI health physicist noted I could not take the motorcycle home right away.

I was also involved in non-destructive ultrasonic and radiographic testing of reactor vessels. I was part of a team that built a skate to move around the pressure vessel of a reactor and electronically transmit information back to the engineers. This system was developed at Santa Susana and then applied to the testing of railroad cars in Louisiana.

In 1973, I was part of a team that went to Sandia National Laboratories in Albuquerque, New Mexico to conduct studies on weaponry, such as the thermonuclear B61 (Mk-61) Bomb. We were known as "black hatters" (bad guys that steal weapons) and our goal was to determine how dismantled weaponry could be reactivated. The lab had three dismantled nuclear devices that we worked on reactivating. We had some assistance in our efforts in the form of the operator's manual for the weaponry.

The only incident I am aware of during my time at Santa Susana is the use of approximately two parts per million of potassium dichromate in the STIR cooling tower. Potassium dichromate was used to minimize corrosion, but the state of California came in as the regulator and stated it could no longer be used. A phosphate compound was used to replace the dichromate compound.

In the late 1960s, AI underwent a big layoff period. When I was first at the site, there were approximately 300 employees, but by the time I left there were approximately 60 people. It seemed that every Friday we were having a going away party. A reduction in forces occurred at other labs as well, including Argonne National Laboratory and Oak Ridge National Laboratory.

I wrote the safety analysis report and worked on the engineering of fuel element removal and shipment from the STIR facility. When fuel elements had to be replaced, the used fuel elements were placed in a storage rack inside the reactor vessel. New, unused fuel elements were taken from the storage vault in the building and placed in the reactor.

STIR was owned by AEC (now DOE) and used for neutron radiography. When General Electric built its own neutron radiography facility, AI decided not to compete with them and abandon the STIR for the L-88 reactor. The L-88 reactor was also used for neutron radiography and was the first reactor of its kind.

Documentation from experiments and testing, including rolls from recorders, were packaged quarterly and sent to Rockwell International storage facilities that were originally in downtown Los Angeles, and moved later to Newport Beach. The Newport Beach facility also contained documents from the Nixon library. Nearly 10 years of records from the STIR facility would have been sent to one of these locations.

In the late 1960s, I recall one day at the STIR facility when we were told to "shut her down" because of what was interpreted as being air emissions from the building stack. We never asked questions when told to shut down a reactor, so we did what we were told to do. However, the instrumentation and records on the facility were all normal. The readings that had set off the alarms were consistent with a bomb, not with normal operations of the reactor. About a half hour later, it was discovered that the Chinese had detonated a nuclear weapon and fallout in the atmosphere had been mistakenly attributed to the STIR facility. Weapons testing fallout was not a big deal to us, but this instance got our attention because we had to shut down the STIR as a result.

We had a "safety first" attitude throughout AI and this dictated how operations were conducted.

I never went to the sodium pond, but I am aware of a pond in the western portion of Area IV used by AI and Rocketdyne to dump excess sodium or NaK used in the S8ER. It would snap, crackle, and pop like fireworks when exposed to water. When SNAP piping was steam cleaned, you could also hear the snap, crackle, and pop in the piping due to the sodium and water reaction.

Water from the STIR cooling tower would drain into a holding reservoir at the edge of the asphalt driveway leading into Building 28. The reservoir would accumulate cooling tower water as well as rainwater. A sump pump located at the northwest corner of the test vault accessway was used to pump the water over to Rocketdyne. After the water was pumped to Rocketdyne, AI had no control over it. Rocketdyne conducted regular sampling of the water and then released it to the Los Angeles River. AI was essentially a guest of Rocketdyne's at the site and Rocketdyne could tell AI what to do. Presumably, if there were any issues with the water from AI, Rocketdyne would have discussed it with AI.

During a shielding study test, the intensity of the radiation was so great that a temporary perimeter, similar to the caution tape used by police, had to be established outside the regular building perimeter.

My last chore at AI was packaging up and shipping lithium hydride and tungsten slabs to Oak Ridge National Laboratory as part of an AEC consolidation effort. The slabs were approximately 8 square feet in size and ranged from 1 inch to 10 inches thick. They were used in shielding studies related to a project that aimed to send a person and reactor into space together. The AEC began centralizing operations and eliminating duplication. This involved moving operations to Oak Ridge, which had a reactor the same size as STIR.

Radiological material was handled very carefully. I was trained in both neutron radiography and explosive devices for my work at AI. The NRC developed "tech specs" for handling radiological material. These specifications were very comprehensive and almost made it difficult to build a nuclear power plant as some of the specifications were difficult to achieve. Work became more laborious after the tech specs were developed. Prior to the NRC tech specs we had operating limits that we had to work under. The operating limits provided more room

to operate than the tech specs and allowed common sense to dictate how operations were conducted. (I provided the interview team with a document describing STIR operating limits.) But after Three Mile Island, the NRC developed the tech specs, which became the way of living for nuclear power plants.

There were no real reactor incidents during my work at AI. If reactor instrumentation showed unusual results we would scram the reactor and operate in safe mode. Procedures dictated that an incident report would have to be written up. The incident report would be distributed throughout the organization and used as a "lessons learned" tool. An outside team from DeSoto would come to critique operations and review the incident report to prevent similar incidents from occurring in the future and ensure issues are handled the same way across the site. The incident procedures demonstrate the attitude regarding safety at the site.

I received a lifetime exposure of 24 rems during my time at Hanford, WA, Idaho Nuclear Laboratory, and SSFL. Most of my SSFL exposure was from neutron radiography using indium plates that were 16 inches by 20 inches by 1/16 inch thick. The plates would become activated and because of how we held the plates, I received facial exposure. I wore safety glasses and a dosimeter that kept daily records of my exposure. During shielding studies, the reactor room would sometimes become so hot we had to wait a few months for the radiation to subside so that acceptable exposure limits were met. This happened several times, but as a result, we never had any abnormal exposures. Objects used for shielding studies were 5 feet square of various thicknesses. Materials studied included lithium hydride, depleted uranium, lead, and tungsten

Radiological waste, including contaminated clothing, was disposed at the RMDU in 55-gallon drums. Initially, these drums were taken out to sea and dumped, but that practice fell out of favor and after than all waste from the RMDU was sent to Idaho for disposal. I am not aware of any Area IV waste disposal on site. When projects were shut down, uranium and plutonium were transported to Idaho for disposal. Beatty, Nevada was also considered as a disposal location.

The only hazardous chemical I recall working with at AI is lithium hydride, but it was encapsulated in aluminum and was pretty safe unless the lithium hydride was penetrated.

The Organic Moderated Reactor Experiment (OMRE) in Idaho Falls was an organic reactor that was cooled with an organic terphenyl. A by-product of this was byphenyl to which we were all exposed. Additionally, when we had organic spills, such as a spill on the floor, we would clean it up using trichloroethylene. These organics exposures were considered normal before we knew the materials were hazardous. I do know that UCLA did a safety study as a result of our exposure, but I never heard the final results.

Also, regarding hazards, I recall when I worked at the 100KE reactor at Hanford, I was associated with a technical group that performed coolant studies in a facility called the 1706 KE. The tests included high temperature coolant operations, which called for use of asbestos as

an insulation material. We had a contractor that was good at his work, but sloppy in his cleanup, consequently we had lots of loose, airborne asbestos all over the place. This went on for two years at which time I left GE Hanford, and I went to work at Rockwell Idaho.

Lab activities at AI used radiological sources and chemicals handled under a hood. Radioisotopes for calibration units were stored in the floor vault and when the STIR facility was decommissioned the calibration sources were sent to DeSoto, but I am not sure how they were ultimately disposed.

I was trained by ordnance people at the Downey facility to conduct neutron radiography on ordnance devices. I received radiological training by peers at AI. I also received hoisting and rigging training from an outside contractor. The people in the AI training department were sticklers for training.
As I recall, everything I did at the SSFL was documented. We had sheets documenting start-up and shut-down procedures and kept log books documenting work. All documentation was retained at the storage facility in Los Angeles or Newport Beach.

I think the sodium burn pit is the same sodium pond I referred to earlier where excess sodium and NaK was sent for disposal. I am not familiar with the service disposal area or any leach field or septic systems. I am not aware of liquid material being disposed down floor drains. I don't recall any issues with drainage systems or tanks other than two Rocketdyne guys that were killed when they entered an underground vessel that contained nitrogen gas. The Old Conservation Yard was a junkyard where lumber was deposited. One employee took lumber from the yard to build a house on the Colorado River in Nevada. People could bid on items in the junkyard in an auction.

This page was intentionally left blank.

UNITED STATES DEPARTMENT OF ENERGY

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 7/15/2010

Interviewee(s): 125

I worked for Atomics International from 1962 to 1965 in the Building 20 hot cell, and the DeSoto facility. I also did some hot cell work in the SRE cleanup, removing some fuel rods.

I handled radioactive material all the time in the hot cell.

I was young when I started and didn't know what I was doing on my first day. There was a pretty rapid learning curve, but I was impressed with the operations of Atomics International. I was impressed from one end of the facility to the other and thought operations were very well thought out and facilitated. The key was safety in handling radioactive material. I was quickly indoctrinated into the hazards of what I was working with. I had some basic knowledge, but I did not come to my job with all the necessary knowledge. I think we had a unique operation in the hot cell. There was the potential for bad exposures if something went wrong. But I thought the design of the building was well thought out and engineered with safety in mind. Safety was pretty much the number one concern and everyone I knew took safety very seriously.

Anything that occurred that was not planned was very minimal. From my experience any non-planned events were easily handled and rectified. There was constant monitoring, and the health physicists (HPs) in our building were constantly monitoring everything, including keeping track of our doses, and various areas of the buildings. The building contained separate areas that required different safety protocols and levels of personal protection. Areas were temporarily marked off with ribbons or tape occasionally so you knew not to go into a certain area unless you had the proper protection. Even if a temporary area had to be set up, it would have been well marked with tape or roped off. When you crossed into a certain area you had to abide by its dosage rates, cleaning standards, or protective clothing requirements. It might have seemed like they were going overboard now and then if you didn't know what they were dealing with. They took it seriously.

I am all for the company. I had a positive experience at Atomics International. My wife worked for Rocketdyne for 27 years and my daughter has about 27 years with Rocketdyne as well. My family has had a very positive experience with AI and Rocketdyne.

I know there may have been things that weren't done correctly, but part of that is probably a lack of knowledge at the time. As science progressed we were better able to predict outcomes and hazards. I feel Atomics International was very responsible and encouraging toward safety. I can't fault them for anything.

I did live in Simi Valley for a while and I do know what is going on in the community. I think some members of the community are what I call "Green Weenies." I thoroughly believe in environmental protection, but I also believe in common sense. There are people that go overboard and they go overboard without the proper knowledge of the situation.

I would definitely disclose any information I had on potential contamination if I had it, but I just don't have any knowledge of this.

I was interested in the SSFL community activities as a citizen of the area, and as an employee of the Ventura County Fire Department. I was even involved in some local politics and I know what the people have been saying for many years. Honestly, I am surprised this is still going on. The site was cleaned up and I thought that would be the end of the community frustrations, but even that did not satisfy everyone. I don't know what is still up on the hill today.

I took my work and the hazards associated with it very seriously. I knew the risks and we took the appropriate precautions. I don't see with the knowledge we had at the time, and probably even now, how they could have done a better job. We had certain jobs to do and there was a small percentage of risk associated with those jobs, but you assumed that risk with the job.

I was in the Air Force as a jet mechanic and I took my job very seriously because I knew that other people's lives depended on me doing my job properly. I had that same mentality working for Atomics International. Sometimes things didn't go exactly as planned, but if there was a potential exposure it would have been seconds, maybe minutes, but you knew what the exposure would be and you had a dosimeter, a film badge, and a hand meter. In some cases, a health physicist may be right there behind you with his own meter. I felt very well covered and secure with regard to health and safety monitoring.

We dissected the fuels that came out of the reactors in the hot cell and would run tests on them. We would take the fuel out of its casing, cut it apart, and take various measurements as our work dictated. I also worked in fabricating the fuel down at the DeSoto facility. I worked at two buildings in DeSoto. I am not completely sure of the numbers, but I think I worked in Building 1, the main building facing DeSoto Avenue, and another building behind Building 1.

I didn't machine any fuel at DeSoto, but we would pick up fuel from the machine shop. I think the machine shop handled beryllium. Safety rules dictated that we report any movement of fuel

from building to building. We had to have movement of fuel authorized and they had to keep track of how much fuel was in any one location to prevent potential danger. We knew we couldn't have more than a specified amount of fuel in any particular location at a time. We would have to make a phone call to get permission to move the fuel. I assume they checked the load in the area and then told us whether we could move the fuel.

Handling the fuel from the machine shop at that stage was not particularly hazardous. You had to wear gloves and prevent contact with the skin. Sometimes you would have the fuel installed in an air-controlled atmosphere. Although I didn't machine the fuel at DeSoto, I weighed and measured it. I can't remember for sure if we cleaned the fuel when we got it or when we finished working with it, probably when we finished working with it, but I am not positive. In retrospect, I think the cleaning process was the only part that could have been done better. We used trichloroethylene, a cleaning solvent used throughout industry. Current knowledge tells us that this wasn't the best chemical for the environment. But we were using the chemical in a little glove box, not in any huge machine. At DeSoto, we were just one line in the fuel machining and fabricating process. We ran tests and collected measurements on the fuel which had been cut into various lengths before we received it. This was done to collect baseline data for comparison with fuel that came out of a reactor after use. There were records associated with each fuel rod and they were numbered on the end. We would take measurements on each segment of the fuel that would later be assembled to form the fuel rods.

The only time I ever had a problem that scared me I was working at DeSoto. We were putting fuel into the cladding and then a welder was going to seal the fuel in the cladding. We had to load the fuel inside a controlled atmosphere. I think it was a nitrogen atmosphere. We had to purge the atmosphere, get it under a vacuum, purge again, and then fill it with nitrogen gas. Once the fuel was loaded into the cladding, we filled the cladding with NaK and/or sodium and then the cladding could be sealed by the welder. The glove box I worked in had an access port that was also atmospherically controlled. Under an inert atmosphere, we would clean the glove box out. I think we did a dry clean of the glove box first, and then used acetone and damp Kim wipes for the final clean I think. I was at the last step of the process and loaded the damp Kim wipes into the glove box. I went to stick my hands in the glove box when a big explosion occurred.

The explosion occurred because there was still a speck of sodium or NaK in the glove box and it reacted with the moisture from the Kim wipe. There was also acetone vapor in the atmosphere and once that flashed it caused a big explosion. I was very lucky in that I had not closed the access port so the explosive gases had a place to vent. It looked like a rocket engine with flames shooting out of the access port. That is the only major incident that happened to me, but I wasn't exposed to any radiation. The use of acetone may have been the biggest safety factor involved in that incident, but not being a chemist, I wouldn't know what other chemical was available to do the same type of job.

I cannot think of any similar large incident that occurred at SSFL. There were probably a lot of little things that occurred at SSFL that were unusual, but nothing that wasn't at least anticipated

at some point as being possible. For example, say you dropped a piece of fuel, you would have to stand back further maybe, reassess exposure issues, and clean it up. So if something that happened that was unplanned there were still procedures in place to deal with the situation. This was in the hot cell, so it was not in an open area. I did remote fabrication and machining of different parts at SSFL. So an unanticipated event in my work could have been dropping something from the remote manipulators onto the hot cell floor. The remedy for the situation may have involved something like moving things around and getting an overhead crane to pick up the dropped object. The remote handlers made things more complicated and clumsy, but we had procedures to deal with unplanned events.

You try your best to anticipate potential problems and avoid them, but things happen as they would at any job.

Worker health was protected differently depending on the area. You had cloth masks that went over the nose as one level of protection and then a more hazardous area may call for fully sealed air supply masks with face pieces. You may wear layered clothing depending on where you were working. You may wear a lot of layers in the most hazardous area and then shed layers as you moved through sealed entryways into less hazardous areas. The clothes, such as coveralls, gloves, or boot covers would be bagged in each area and go into separate contaminated collection bins. I don't know if they had a hot laundry facility or not.

I don't know of any disposal of radiological material on site. Disposal occurred either in a metal drum for regular trash or a lead, steel, or concrete container built specifically for the contaminated waste. Radiological material would come into the facility in a protective container and go out in the same manner. Sometime we shipped fuel rods back out to an off-site storage facility, but I don't know where that would have been. Most of our fuel came originally from Hanford, Washington or a site in Idaho.

I don't have any knowledge of radiological spills, leaks, or dumping, certainly nothing illegal.

The only thing I was aware of was the disposal pond for sodium. I never saw anything first hand, but I knew of the location of a pond, also known as the Sodium Burn Pit. I heard that they would throw the sodium out there and "let it do its thing," that is, explode when it hit the water. I assumed it was uncontaminated sodium, but I don't know that as fact. I never saw sodium put in the pond when I was at SSFL. Later in my life, when I was working with the Ventura County Fire Department, I saw training demonstrations of sodium reactions and we worked closely with Rocketdyne's Fire Department. They would often instruct us because they worked with much more hazardous fuels on a daily basis than we did at the Ventura Fire Department.

I know we used trichloroethylene and acetone and probably some other chemicals at the hot cell. Chemicals were stored in metal, fire resistant containers. As far as disposal, they were all shipped out in plastic, metal, or glass containers depending on the chemical. I don't remember exactly how we disposed of chemicals. We took out whatever we had to take out and followed

our established rules for that. You would monitor the waste for contamination levels and dispose as appropriate. In the hot cell, particulates would be swept up and put in the appropriate container. Damp wipes would be used as another level of cleaning, and finally you would go in with your cleaning chemicals. Contaminated solids would go into appropriate containers. Any contaminated liquid waste would go into the building's contaminated liquid waste collection system.

Building 20 had a liquid waste collection system and a gas filtration system. I don't think anything left the building immediately. Sanitary waste went to the sewer system, but everything else went into the building's own built-in disposal system. Everything was filtered. The basement of Building 20 contained the filtration system. The hot cell and the area outside the hot cell was kept at a negative atmosphere. Air would be sucked into the hot cell and then into the basement containment filtration system where eventually it was cleaned enough to be vented out.

I am not aware of any unusual occurrences relating to chemicals other than the incident at DeSoto I mentioned earlier. I am not aware of any on-site disposal of any hazardous chemicals.

As far as policies and procedures go, as a new employee I was told what my work would entail and the purpose of it. We had sessions with the HPs and they explained the types of radiation and effects of radiation. We watched training films. We learned how to avoid exposure, how to safeguard ourselves, and how to use and read the safety instruments properly. We also learned the limitations of the safety instruments. We had various training session on different things. I think the training may have changed over time to respond to issues that arose. I'm sure I read manuals as well. The company culture was such that we complied with the rules. We knew what we were dealing with. I was pretty low on the totem pole, but I worked with very intelligent people and had all the confidence in the world in them. I think safety was on the top of everyone's mind.

I also received on-the-job training. I had a good mechanical background before I came to AI, but working there around knowledgeable people and discovering how much I didn't know motivated me to go back to school. I took an algebra class through what is now Ventura College while I was still working at AI.

I never saw or heard of anything being buried on site as SSFL. Now, I have read some things on the site, but I don't know anything from personal experience.

We documented our work at SSFL through photographs and ledgers, maybe notebooks as well. Everything was documented. You pretty much did you job and wrote it down. I don't know what happened to these records after I turned them into the boss.

If there was any disposal down toilets or floor drains it went into the building's collection system.

I think a regular disposal team used the Sodium Burn Pit, but I was never there to see anything. I do not know anything about a surface disposal areas, leach fields, septic tanks, discharge locations, storage tanks, or gas holdup tanks. I vaguely recall the Old Conservation Yard as a disposal area. I can't really say anything for sure about it though. I remember a scrap yard on the west side of the road coming into the site.

I was not aware of any problems with underground pumps, sumps, storage tanks, piping, sewer, or drainage systems.

I was primarily up in Building 20 on the hill. As far as I know everything in this building went through air processing contained beneath the building. The building was self-contained, I can't remember but I think there may not have even been any windows in the building. If something needed processing it was processed internally before being discharged to the atmosphere or shipped off-site. There were a lot of below grade processing features at Building 20.

At one point I also got involved at SRE. As far as I remember we were down below in SRE's hot cell. I believe I was handling the fuel rods and getting them ready for off-site disposal. This was after the SRE was shut down. I also was probably involved in cleaning up the SRE hot cell afterward. I got sent over to SRE because of my skills and experience working with the remote manipulators.

I know I received some level of exposure while working at AI, but that was part of the small risk I assumed taking the job and I was not concerned about it. I remember having to scrub my head one time because some speck of radiation was found when they ran a meter over my head. You would have a final check before you could come out from a hazardous area to a nonhazardous area. You would have to run a meter all over your body to confirm you were not bringing any radiation into a nonhazardous area. They wouldn't let you out of a building until you had no detections on the meter. Otherwise, you would have to go back and shower to remove any radiation. There must have been hot and clean showers too now that I think about it.

Overall, I had a wonderful and interesting time working for AI. I really enjoyed my job.

UNITED STATES DEPARTMENT OF ENERGY

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 7/9/2010

Interviewee(s): 154

I worked at ETEC starting in about 1977. I had worked down at Canoga Park facility with a lead engineer that I was familiar with. He started up a new instrumentation group at SSFL and I requested a transfer to go up on the hill too. Later I transferred back to Rocketdyne. I think I worked at ETEC from 1977 to 1985 (about 7-8 years).

I was an instrumentation engineer. I tested the various sensors that were to be used in the sodium cooled reactors to evaluate their performance, dependability, and reliability. I tested level, temperature, and leak detection sensors, made mostly in the US, but some from Germany and possibly a few others countries as well. Before I went to work for Rocketdyne and Atomics International, I had worked for an electrical heating company in the Pittsburgh, PA area. Due to my electrical heater experience, I specified the types of heaters to be used, approved drawings, purchased heaters, and ensured the heaters were installed correctly on various tanks and lines. I was the resident expert on electrical, tubular heaters, but my primary responsibility was in testing sensors to evaluate how well they performed under different working conditions. I worked on small projects helping others with heaters or liquid level sensor devices. I also wrote reports on heaters and liquid level measuring systems and provided them to DOE.

I worked in an engineering building; really, it was a group of trailers across the street from the Instrumentation Lab. Later they built a more permanent engineering building adjacent to the trailers and I moved into that building. I also worked in Building 104, which is where I think most of my work was conducted; there were sodium tanks in that building for us to use for our testing.

I did not work with radiological materials, nor did I wear a film badge.

I did not handle any hazardous materials. I did not work around any hazardous materials unless you count sodium. I never handled sodium but I worked around it. I never had to wear any

protective clothing for my work. I did not knowingly work around anything that I considered hazardous to me personally.

I know of an area where they had a reactor that had some sort of meltdown and they closed it and put asphalt over top of it, but that was prior to my time on the hill and was all gone by the time I worked up there. I was not aware of any radiological spills or leaks while I worked up there. I do not know of any chemical leaks or spills up there that would be hazardous to people either.

There was a chemical laboratory – but I rarely went in that building. I believe it was the general practice to put hazardous materials into 55-gallon drums that were eventually shipped off site. Since I did not do that myself, I am just telling you what I was aware of. They were very careful up there. They had very strict procedures as to how things were done, such as with the handling of liquid sodium. It was pretty rare circumstance that anything went wrong.

I did not need much training for what I did at ETEC as I had a lot of experience from prior positions. My supervisor did make sure I understood the correct procedures for everything, but I did not need any special training. We got on the job training for how to follow the procedures.

A typical experiment would involve putting liquid level sensors in a proper position in a tank. In Building 104 for example, we would raise and lower the level of sodium in the tank and see if the sensor responded properly. We would test the sensors under different temperatures to see if that affected performance. We would test the performance and reliability of the various sensors and then write a report of the test results.

We obtained a lot of data, and gave that data to DOE in the form of reports. The original report went into the DOE library that was north of the administrative building for ETEC. Three women worked there. One copy was in the library, one copy we kept in our building, and one copy went to DOE. The results were not sensitive, we were just reporting on how the instruments performed, so we did not control the distribution of the reports. I do not know what DOE did with the copies of the reports once we gave them to them.

Once or twice a year, someone from DOE-HQ in Washington, D.C. would come up to check on what and how we were doing. I would demonstrate how I tested the various sensors and heaters.

Virtually everything we did at ETEC had a purpose.

We tested the sensors to see if they operated properly. We tested to make sure they detected leaks. We created leaks on purpose to see if the sensors would detect the leaks. We wanted to know if the sensors were working properly. We detected leaks because we caused leaks – it was purposeful to test the sensors.

I would recommend that you talk to others that worked at ETEC during this same time period. The others may not have responded to the opportunity to be interviewed since it came in the form of a letter. It might be better to give these other workers a telephone call; it may result in a more positive response! (Names of a few other engineers were provided.)

There was one building at ETEC that had a fence around it and barbed wire on top. They reprocessed fuel rods or something, but I never went near that building I just saw it as I went on my daily noon time walks to the water tower to get some exercise. It was the only building considered to be dangerous that I knew of. I did walk by the sodium burn pit now and then. Occasionally, there would be a dead animal in the pond. The sodium burn pit was a pond – sodium ignites when it comes into contact with water. They would put items that had been contaminated with sodium in there to burn the sodium off. It was a controlled situation when they did it. I did not observe it; in fact, I think it happened pretty rarely. It was not a pretty place.
I worked in Building 104, the instrumentation lab, where my primary work occurred. I went into most of the buildings at ETEC because I had associations of various kinds with different experiments going on, but I was never in a place where hazardous chemicals were being handled that I knew of.

There had to be some leach fields or septic tanks on site. I do not know where water went. The water on site was not potable. We drank bottled water in all of the buildings.

I know about the old conservation yard. It had mostly metallic junk, stuff that was no longer needed. I would go there to see if there was anything I could use – like tanks or piping – to save money. They encouraged us to check there before we ordered anything new. There were occasional items that could be reused for other experiments.

There was a large fuel tank, I think it has been removed, that was full of oil that they used for experiments. An oil line connected the tank to one of the buildings.

There were various types of sodium tanks at ETEC. They were aboveground, as they had to be heated and insulated. They had trays under them to capture any leaks. Of course, there were sensors to detect any leaks as well. They had trays under them just in case. There were a lot of safeguards to prevent sodium leaks in place by the time I worked up there.

Air contaminates sodium. They did not want to contaminate the sodium. Leaks were not good.

Of course, we caused leaks so we could observe the results. We wanted to see if we could cause a fire or an explosion. The leaks were purposeful. We made them for experimental purposes. They were purposeful leaks.

You may be aware that there is a corner of the San Fernando Valley where an unusually high number of people have been diagnosed with cancer. My ex-wife claimed that she had cancer caused by exposures she received as a result of working up at SSFL. I was tested annually

after I worked up there. Now that I am no longer working up there, I am not tested. I try to pay attention to what is going on at ETEC with the cancer cases so I can determine whether I should be concerned.

I am amazed at the reported costs of cleanup at SSFL. I am afraid it is a bit of over-kill. It is hard to believe there is sufficient contamination up there to require all the cleanup going on. I do not know how they can spend so much money to clean that place up.

I am concerned that they will never get it cleaned up to everyone's satisfaction. I pay taxes and the money being spent on this clean up does not seem justified.

To the best of my knowledge, no one purposefully caused any contamination. While I still worked up there, they would bring a trailer on site every so often and I participated in voluntary medical testing, with tests such as breathing into a tube to test our lung capacity or blood tests. We would only hear about results if the results were out of the normal range. I was told that I tested fine.

UNITED STATES DEPARTMENT OF ENERGY

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 7/20/2010

Interviewee(s): 254

I worked for Atomics International (AI), Rocketydyne, and Boeing at the SSFL from 1957 to 1989 for a total of 32 years. I had worked in almost every building on the hill by the time I retired. I was a mechanic, an MTS3, and then the Engineer in Charge (EIC) at the RMDF.

I first handled radioactive material in about 1965 when I worked in Building 5. We had been doing heat transfer studies with loops using non-radioactive materials. Then we received radiologically-contaminated organic material for use in our loops in Building 5. That was my first encounter with radioactive material.

I received schooling and training on how to handle radioactive materials and what we were expected to do before we did anything. By that time, the AEC was coming up with all sorts of rules so we could protect ourselves and the company. I was under the impression that before 1965 safety had been much more lax. But by the time I was involved in handling radiological materials, the AEC had established some guidelines for safety. For my entire time at the site, I was always under the eyes of an HP (health physicist).

I worked for Rocketdyne from 1957 to 1960. In 1960, they laid off 10,000 people and I was one of them. I had worked for one of the Von Braun engineers who had come over from Germany. He and I were friends and he helped me get a job at AI in 1960. My initial years at AI were spent working on heat transfer studies with loops. At first we worked with organics and not radioactive material. We would go into a room full of pipes and cover them with asbestos. The asbestos would be thicker than all get out. We didn't know at the time that asbestos would later turn out to be a hazard. That was one of the health and safety changes that occurred during my time at SSFL.

During my days at Rocketdyne, we used lots of trichloroethylene and acetone to clean engine parts and didn't worry about where it went. We used every kind of chemical known to man at Rocketdyne. I was a crew chief in gas generation at CTL-2. We would stand on a grated

platform about 10 feet from the ground and use chemicals to clean the rocket engines. All the chemicals would drain down from the test stand into a holding pool of water located below the grates we were working on. The pool would drain to holdup ponds outside the buildings. The fire department would then come along about once a month and set the ponds on fire to burn any chemicals off.

Over time the safety got more stringent and we had more training. We eventually started catching any chemical runoff and putting it in barrels. A group was created to handle waste at the site. There was an evolution of safety in my 30^{+} years at the site on both the Rocketdyne and AI side.

When I first started working with radiological material in Building 5 we had safety procedures to follow. We had to dress appropriately and we had to protect the area we were working in by controlling access. You had to clean the area when you were done and put radioactive waste in RA (radioactive) disposal containers. The door going into the lab had radioactive stickers to let everyone know that it was a radioactive lab.

Dressing appropriately for radioactive work in Building 5 included shoe covers, coveralls, a soft hat or head gear, and a couple of pairs of gloves. I didn't have to wear a respirator in Building 5. I always wore a film badge and dosimeter my entire time at AI. Those were standard issue at AI even before I worked with radiological material. I was told that I got the most radiation of anyone who worked at Rocketdyne. We were supposed to wear the film badges at work, but it was like our company badge and we got so used to it we put it on all the time. A few times I even wore it home.

The level of radiation was so low in Building 5 that time limits for exposure were not in place yet. Most of the contamination in Building 5 was alpha contamination so it wouldn't penetrate very far. I did have blood and urine samples collected at least once a year while working in Building 5. When I later moved to the Hot Lab, I was monitored monthly because I was working with more radioactive material. There was a monitor at the entrance of the radioactive lab room and you were expected to monitor yourself entering and leaving the lab. I don't remember if there was a building alarm for Building 5. The radiation levels were low in Building 5 and there were no reactors in the building. I never received any exposures in Building 5.

There were 13 reactors on the hill over the time I worked there. I didn't work in any of the reactors when they were operating, and I didn't handle radioactive material until the coolant went to Building 5.

I moved to Building 20, the Hot Lab, after my time in Building 5. That became my primary place of work. That was a high radiation lab and Building 20 did have a building alarm. You had to sign in and out of the building near the entrance. The health physics office was near the entrance as well and you would go there to get a film badge or dosimeter before leaving the lobby if you didn't already have one on. Building 20 had all kinds of barriers because there

were different levels of radiation in the building. If you were in the operating gallery you didn't have to wear any protective clothing, unless you were handling something that could penetrate the walls. If you were on what we called the backside of the building, or the service gallery on this floor plan I have, you had to be fully dressed with coveralls, gloves, and boot covers. If you were "in cell" you had to add another set of coveralls and a respirator. The hot cells had 4-foot thick walls and radiological glass to keep the radiation in the cell. You also had to wear a respirator if the hot cells were being opened or if you were transferring radioactive waste.

When you came out of the hot cells, the first thing you would do would be to take off one layer of clothing in the decontamination room right outside the hot cell. That top layer would go in a container for disposal as radioactive waste. Then you would step into the hot change room room and take off the second layer of clothing. The hot laundry was packaged and sent to the loading dock area and off to the hot laundry facility where the clothes would be cleaned and could then be reused. So when you had two layers of coveralls on to work "in cell" you would remove one layer in the decontamination room and then you would remove the second layer in the hot change room. Masks were also laundered and a "cold guy" would help you take off the mask and place it in a bag for laundry.

Once you were naked, you would go into the shower to rinse off. There was a monitoring device between the hot shower and the cold change area and you would have to check yourself. If anything was picked up on the monitor you had to go back to the hot shower for another rinse to get any remaining radioactivity off of you. You didn't leave the hot shower room until the monitor said you were clean.

The operators that had to set up equipment in the hot cells wore lots of protective equipment and multiple layers of clothing and gloves because the hot cells were really hot and dirty. You always wore a respirator with supplied air in the hot cells. Depending on what you were working with, you may even wear three layers of coveralls in the hot cell. Sometimes if you were going "in cell" to clean the cell you would even wear raingear.

Safety rules became more strict as time passed. I had the feeling that before I was there safety was less stringent. During my time there, we had monthly unit meetings to keep up to date on safety and training issues. We took it very seriously.

We were mostly company people and we were there to invent things. Two or three people were just there to get a paycheck, but the rest of us looked forward to going to work. We worked for engineers, inventing new things for the nuclear industry because it was a brand new field. The engineers often had an idea in their minds of what they wanted their experiment to do and we would talk to them to see how we could develop the tools and equipment they needed for their experiment. Many of the young engineers didn't know the difference between a wrench and a screwdriver. The engineers got the projects and the money, but we were the ones that had the practical experience to help them develop their experiments. We looked forward to accomplishing things at work.

The Hot Lab had a hot storage room behind the hot cell. The guy who ran the place, BDE, was a strange duck. He used to be a piano player from Las Vegas, but he made sure the backside of the Hot Lab was run properly. Before he got to the Hot Lab, there wasn't a "dedicated backside man" at the Hot Lab. This was a problem because we found things that were too hot in the backside of the Hot Lab and they shouldn't have been there. He fixed that situation though. I don't think enough money was spent on waste management in the early days. We didn't have dedicated waste handling like we had later. This was another example of the evolution of safety. In hindsight, things should have been cleaner and we should have gotten rid of waste faster.

We had a hot storage and equipment room in the Hot Lab that would store things like a milling machine, drill press, or tools that we needed for operations in the hot cell. The work would change so we would need different tools, but they were all stored in the hot storage. Casks would come in through a door at the north side of the building, through the mock-up and assembly areas. In the case of fuel elements, it was because they were too long to enter the building any other way. The size of the material dictated where it went in the Hot Lab. Metallurgical work was done in Cell 1 because this involved the smallest pieces of fuel. I had to modify and build a machine that would cut out small pieces of fuel and cladding from a fuel element so we could actually work with it. Cell 4 held the largest pieces of hot material, often a section of the fuel rod. As fuel rods were dissected and smaller pieces were removed for examination they were moved into different cells. I remember cutting out small sections of the fuel elements from the SNAP 10 reactor for study in Cell 2. We looked at very small pieces of fuel; it was too hot to work in large quantities. It could make the lens of a microscope go black from high levels of radiation. So we had to invent a system that allowed us to look at very small portions of the fuel. You didn't need a big piece of something to examine it in the metallurgical room.

Waste from the Hot Lab went into casks, which were essentially lead-lined barrels that were sized based on the quantity of waste and the radiation level. Casks were sent to the RMDF, now called the RMHF. We held the casks there until we could complete all the paperwork necessary to ship the waste off-site for burial.

I worked at the Hot Lab for many years on and off. Every time we had a slow period I got farmed out because I was an instrumentation guy. I could work with anyone on the hill.

When the SRE was finally shut down, they ripped all the instrumentation out and got rid of a lot of stuff. In 1975, they found some residual sodium in the reactor vessel. They asked me to go over to the SRE and figure out where and how to hook up the existing thermocouples and heaters. That was a really fun time. I became the lead man on that project and worked on dismantlement of the SRE. We needed to heat up the reactor vessel to melt the sodium to a liquid so it could be removed. Because they had ripped the old instrumentation out of the control room, I had to go find and install the instruments and figure out the electrical wiring for heating elements located on the outside of the reactor vessel. I had to find the correct heating

elements on the vessel and their corresponding switches on the electric box with thousands of wires and make sure everything was connected properly. Once this was done we could heat the vessel to 230°F to melt the sodium. Just to be clear, we did not run the reactor. We just reconnected the heating elements on the outside of the reactor vessel to heat the sodium to its melting point so we could remove it.

Before we could even get to the reactor vessel though, we had to dig out the dirt around it because the reactor was buried in the ground. We removed the 4-foot thick magnetite concrete, which was a concrete with steel shavings in it that surrounded the reactor vessel. When I was working on SRE dismantlement I also had to deal with the "dip-leg tube." The "dip-leg tube" was a tube that went down 20 or 30 feet into the ground. It was located in a separate pipe gallery beside the reactor vessel. We found radiation at the bottom of that hole and it "gave me terrible fits getting that cleaned up." In fact, a piece of concrete fell on my head when I was working in that area. It is a good thing I had a hard hat on.
I worked on the dismantling the SRE from 1975 to 1980. Then in 1980, I was sent to the RMDF as the EIC. We started getting rid of a lot of things at that point because there was stuff stored everywhere. I worked at the RMDF from 1980 to my retirement.

As far as spills go, I only have first-hand knowledge of one spill at the Hot Lab, but I have heard of others. A holdup tank was located in the basement of the Hot Lab (Building 20), under the operating gallery, and it had a line that came out at the north end of the building to a transfer tank. A tanker from the RMDF would pump the radioactive water from the holdup tank and take it to the RMDF where it would be put in an evaporator and reduced to sludge before being disposed. One day either the hose broke or the tank outside the Hot Lab overflowed, I can't remember which exactly, during the transfer process and contaminated water spilled onto the asphalt. The asphalt on the north end of the building became contaminated with the radioactive water. We spent quite a bit of time cleaning that up. We had to invent a super vacuum that used HEPA filters to clean up the contamination. We also used foam to help clean up. We kept cleaning until we brought the radiation down to acceptable levels. That is another safety issue that has changed over time – the acceptable level of contamination. What was acceptable then may not be acceptable now. I'm sure that incident was written up in an incident report.

I also heard that the asphalt behind the loading dock on the west side of Hot Lab was a spill. I heard later that they dug down about 10 feet to make sure they removed all the contaminated dirt. That was after I had left though.

Additionally, there was a driveway along the east side of the Hot Lab. At the northeast corner there was a 10-foot high bank. Before the days of chemical containment, chemicals from the shop area of the Hot Lab, such as trichlor, acetone, or paint thinner, were dumped on the ground down this bank.

When I worked at the RMDF, everything that came in there was already packaged. Depending on exactly how it was packaged and what level of radiological contamination it had, we either

had to repackage it, clean it further, or just complete the final necessary paperwork. Some waste at the RMDF came from DeSoto, but most of it was from SSFL. The level of radioactivity also dictated where the material was stored at the facility. There were different areas specified for each level of radioactivity. Highly radioactive fuel that came to the RMDF was stored in the RMDF Vault. The vault contained cells designed to hold fuel elements. A 50-ton crane would lower a cask that contained four or five fuel elements onto the vault floor. Another manipulator would then transfer one fuel rod and place it in one vault cell that was then topped with a plug. The cask would move to the next vault cell and lower the next fuel element in so that each fuel element was stored in its own cell. The RMDF stored waste, but it also stored items that were waiting examination in the Hot Cell. So some material was stored at RMDF until it could be examined at the Hot Lab, and then when it was done at the Hot Lab it would come back to the RMDF and await final off-site disposal.

We stored all kinds of chemicals at the RMDF and I don't think we did a good job managing the chemicals in the beginning. Eventually as safety regulations changed, they decided it wasn't a good idea to have all those chemicals sitting around so we started getting rid of the chemicals. We also started using chemicals much more sparingly. We also stored a lot of radioactive tools and equipment at the RMDF that had been used at other facilities.

At one time they washed towels at the RMDF. This was not hot laundry. The washing facility wasn't that good and by the time I got to the RMDF, they had gotten rid of it. But we still had 10-20 barrels of soap left over from the laundry facility. Eventually they asked us why we were keeping them around and we got rid of them.

The RMDF had some spills over the years. There was a spill into the leach field that happened before my time. I only learned about it because we had a big program, with a big budget, to clean up the leach field. It was going on while I was at the RMDF, but I wasn't directly involved in the cleanup at the leach field itself. The people working on the cleanup had to be fully dressed in protective clothing that was supplied by the RMDF.

If something occurred that was unplanned we would call RST first. He was the manager at Building 20 and then became the manager at SRE and RMDF. Everything went through RST no matter what it was. We would also call CEF or an HP if they hadn't been called first. After making the phone calls to the appropriate people, you would all work together to determine how to deal with the unplanned event.

The film badges measured your accumulated daily exposures and they had to be processed. Our film badges were given to HP once a month so they could be sent to Chicago for processing. HP would keep track of your lifetime exposure. A dosimeter measured your minute by minute exposure and could give you immediate feedback. We were only allowed to be exposed to 120 mR a week and 5 R a year when I was there. If one of your two dosimeters pegged for any reason (even if you suspected it was inaccurate) you had to leave the area immediately. The 5 R a year exposure limit was a North American limit. I think the

government limit was 20 R, but North American set higher safety standards than the government.

Going back to the Hot Lab, anytime you worked in a hot cell you had to wear two new film badges. You would take off your monthly film badge and put it in your locker and then sign out two new film badges from HP. Then when you got to the backside of the Hot Lab you would put on your two new film badges and a dosimeter before going into the hot cell. The reason for this was that you knew you were going into a very hot area and they wanted to separate out that daily exposure in a hot area from the monthly exposure where you may be working in a variety of different areas. HP would add the hot cell exposures to the monthly exposures so they still kept track of lifetime exposures; they just kept the records separately.
There was absolutely no on-site disposal of radiological waste to my knowledge. I mentioned the spill at Building 20 from the transfer tank overflowing, the leach field spill at RMDF, and the "dip-leg tube" at SRE.

Originally we were supposed to save the SRE building. It was going to be used as a building for the Saturn rocket. We did a lot of work to clean up the SRE building over the years and it was really disappointing to me when the decision was made that the building would never used again. It was sad to see it demolished. That happened to a number of buildings. We cleaned them up for reuse, but they were not used and eventually demolished.

As far as chemical handling went, we didn't contain anything when I worked at Rocketdyne in the late 1950s. It wasn't until the 1960s when I was at AI that I think we started looking at containment of chemical waste. I don't remember exactly when we initiated chemical containment at Building 20, but it came through training sessions from the Health and Safety Department.

I had a couple of jobs that involved searching through junk that was deposited in canyons. Debris, deemed to be clean at the time, had been disposed in the canyons and when we learned about the hazards of asbestos I had the job of searching through the debris piles to get the asbestos out. This occurred when I worked at RMDF when I was heading up D&D teams.

At some point, Rocketdyne outlawed the use of Trichlor. I don't remember exactly when. When that happened, our chemical standards at AI changed as well. Where we used to have Trichlor delivered to us in 50 gallon drums, our delivery dropped down to 2-liter jugs. We still used it, but much more sparingly. The safety rules evolved, but so did the chemicals. New cleaning chemicals were being invented. The chemicals were just getting more volatile and more dangerous. At AI, we wanted anything associated with the reactors to be clean and dry. We didn't want there to be any oil that would hold contamination. But at Rocketdyne, cleaning involved making sure there was nothing left on equipment that would react to oxygen. So while cleaning was important to both sides, there were different purposes for cleaning.

After about 1980, I know that TCE was found in the groundwater under the reactor in Building 59. One of my jobs was to set up the sump pumps to capture the groundwater. Normally, there

was an automatic pump that continuously pumped the groundwater from the reactor building. The water would go to a holdup pond where it would be monitored for radiation and if there was no radiation it would go to another pond before being released. Once TCE was found to be dangerous, we had a program to catch it. Early on, we pumped TCE-contaminated water into a tank and hooked an air compressor to the tank to help evaporate the TCE. After a week or two, chemists would test the water to see if it was safe to release. That doesn't seem like such a good idea, looking back on it now. Now, they filter the TCE-contaminated water instead of evaporating it. We didn't get rid of the TCE – we just released it into the air instead of onto the ground.

Every building had chemical storage lockers located outside of the building. They were fire safe lockers and were marked for the specific type of chemical that could be stored in them. There were special cabinets for each type of chemical. We also had catch barrels that stored the used chemical material. Rocketdyne eventually created a waste management unit that was responsible for picking up the used chemicals and take care of them properly. Since they were the bigger organization they had more capacity and they could pick up chemical waste throughout the entire site.

I don't recall any unplanned events or on-site disposal that dealt with chemicals. Chemicals weren't my focus though. I am not sure when the fire department stopped burning chemicals off the ponds.

We had a lot of company policies and procedures, including large books of information. We had monthly meetings were pertinent information to our operation was passed on. In Building 20, RST had a young engineer who was in charge of policies and procedures for his facilities. RST would make sure we were doing things properly. The policies changed continuously. Rockwell/Rocketdyne was adamant about keeping current because they had to bid on government contracts and the contacts had a lot of procedural requirements. People were generally good about following the rules. Some of us may have been reluctant to implement new rules, but generally, everyone followed the procedures. I'm sure CEF, our head HP, would cringe if he heard my name. He didn't always think I was doing everything I could. One of the toughest things for me was to quit smoking. I finally was able to do it when they told me our health insurance premium would double if I kept smoking. That gave me the motivation I needed; it was hard though.

Training depended on the job. There were certain health and safety courses that everyone had to take, such as how to dress and wear masks properly, how to read and understand signs and sirens, or how to properly climb ladders with a SCUBA tank on. Everyone was indoctrinated. Then specific jobs may require specific additional training. Due to safety rules becoming more stringent, we had to be trained in the use of SCUBA gear. We had to demonstrate that we knew how to operate the gear properly and we even had to be able to climb a ladder wearing it. We had to be recertified every year in some of the required skills. We would also have health and safety meetings to be advised of new or changing rules or procedures. There were also some specific rules for radiation workers, such as men couldn't wear beards.

I don't recall any contamination being buried on the site. The debris disposed of in the canyons was deemed clean at the time. I think it was buried as landfill material. Once we learned about asbestos, we went back to dig any of the asbestos out of the debris. This was in the early to mid-1980s. I think the debris may have been disposed in the canyon near the Burn Pit.

We would document what we did in weekly highlight reports that we had to give to RST, our unit manager. It was a written report of what we did in the week. It would be published and he would send it to his manager, DFG. I didn't have to keep any log books for my work, but EGH kept the best log books. He kept them because he had a higher classification than I did and that was part of his job. In all my time at AI, everything was documented! It was part of the culture to document everything. It is possible that some people didn't document things before my time, but I don't know for sure.

I don't know of any liquids being disposed of in toilets. The drains in Building 20 all went to a holdup tank in the basement. The holdup tank drain was kept full of water to prevent backflow. The only things that weren't connected to the holdup tank were the bathroom drains and they were connected to the sewer system, but I don't recall any liquids being disposed in the toilets.

The Sodium Burn Pit was not the best place, in fact, it was a bad place. It was not supervised as it should have been. Everybody at AI used it for cleaning chemicals. It was a big pool and you would take sodium contaminated things to the pit. Generally people dropped stuff in the pond to clean the sodium out, then fished the items back out of the pond, and finally left the items outside the pond area on the ground. Eventually they authorized a salvage operator to come up and haul the material away. The Sodium Burn Pit was out in "left overshoe." The HPs monitored it constantly. There was a lot of stuff that was taken there. There was one strange incident I remember about the Sodium Burn Pit. One day there were a bunch of generals in the area and a guy had a bunch of glass balls full of sodium. He was standing on a rock and throwing the balls into the Burn Pit and letting them explode. He was suggesting to the generals they could be hand grenades for use at the rice paddies in Vietnam.

In 1984 or 1985, the Sodium Burn Pit was drained and radiation was found. They had to let the pond dry out for a while. FHI was working on cleaning and digging out the Burn Pit. He would know about cleanup there. We had worked together at the "fart factory." That's what we called Building 5 because there was sulfur dioxide (SO_2) involved in the coal gasification process. One interesting thing that was also done in Building 5 was the grinding up of old x-rays from World War II. The x-rays were ground up and reacted with salt to extract silver from the x-ray. They could get about 99.9% pure silver back from the x-rays.

I am not sure about a surface disposal area. This might have been an area where contractors took construction materials and debris from building demolition or it could be an area where asphalt and soil were piled up for monitoring. I don't have any other information about leach fields, septic tanks, or drainages other than what I have already told you. Everything went to holding ponds and the HPs would monitor the ponds.

In 1977 or 1978 we had a lot of rain and the holdup ponds were overflowing. I would get a phone call in the middle of the night that a pond alarm was going off. This meant the water level of the pond was getting too high. I would have to go up to the hill in the middle of the night and we had to catch any excess water from the holding pond. We would use whatever we had to catch and manage the excess water, including those plastic swimming pools for kids, 55-gallon drums, and pumps. We had to catch everything because the HPs had to monitor it to see if it was clean. Even though it was presumably clean, it was rain from the sky, the fact that it fell in areas where radiological or chemical material was used meant we had to monitor the water. If it was clean it could go to the Rocketdyne holdup pond.

A picture I have shows how careful we had to be at SRE when we were dismantling it. We had to set up tents in the building to seal off areas we were working in and contain any air contamination. The men working to jackhammer concrete or other material worked under the tents to keep any contamination from becoming airborne and they had to wear full respirators. We did not "jack the building up" and lay it back down. We dug under the building and systematically dismantled it.

There were three areas where water would pool at the bottom of the SRE when we were dismantling it and we had to put pumps in those pools to take the water to the SRE pond. We had alarms go off there when the pond got too full.

The RMDF had a 10,000 to 20,000 gallon holdup pond down to the west, past Building 75. That pond had alarms and radiation monitors on it. During the rains, we had to store all the excess water in 55-gallon drums so the HPs could monitor it. We had a lot of drums that had to be stored in an outdoor storage area at the RMDF complex so they could be verified as clean before being released. One whole parking lot was full of drums of rainwater.

The Old Conservation Yard was a favorite place to get recycled equipment. We would go there to get equipment or materials for building things. We could reuse parts left there and we were encouraged to do so.

I don't recall any gas holdup tanks. All radioactive facilities had HEPA filters that filtered the air and gases.

I can't think of any other issues with pumps, sumps, tanks, piping, or drainages other than what I have already told you. There was a sewer pump located north of the Box Shop that went bad one night and all the buildings on that line got backed up. Maintenance crews fixed it in the middle of the night.

I was told I received the most radiation of anyone working up there. In those days, we were allowed a lifetime exposure of 100 R and one HP told me I had been exposed to 85 R, the highest of any employee. The company doctor would always monitor us and document everything. When I left the company I had to get a family doctor and I made sure to tell the

family doctor about my work history. I have never had any health problems that I attribute to my work on the hill. I did receive an extra large dose one time "in cell" at the Hot Lab and I couldn't go back in there for a while. I was in a lot of radiation fields with the kind of work I did and I would get high doses of radiation. Another thing that changed over time was they changed the dose rate to sieves or sieverts. When I retired, I got a document that told me I received a lifetime radiation dose of 38 sieves.

I had a wonderful time working at SSFL. Every day was new and exciting. I worked in every building up there. We had a lunchroom in the middle of the shop in Building 20 and we would play cards and ping pong during our lunch hour. There was a lunchroom in the RMDF as well. The lunchrooms were always isolated from any radioactivity. We would also see a lot of wildlife up on the hill, including mountain lions and bobcats. Mornings I was at the SRE we would see mountain lions on the rock outcropping above the building. I really had a fun time working there.

This page was intentionally left blank.

UNITED STATES DEPARTMENT OF ENERGY

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 7/9/2010

Interviewee(s): 255

I worked for Atomics International from 1967 to 1985 as an atomic reactor inspector and certified x-ray technician. I also conducted helium leak tests and magniflux non-destructive tests. I worked in a number of buildings, but never went into a building unless I had a reason to be there. I have a few concerns about the Santa Susana Field Laboratory.

One of my concerns is with Building 4059, which was a reactor building. I know they took sand that was discovered to be contaminated out of the pit. I don't know what else they have done since then. I heard the building was torn down. Building 4059 was the last reactor that went in and the reason I know that is because I was the inspector when the fuel rods were placed in the vessel. That reactor ran about a year and then they took everything out.

I am also concerned about the large pit that had been dug out for another reactor or test site that was located between Building 4059 and Building 4626. The pit was out in the field a little ways from the road that comes down past Building 4059 and 4626. I have seen the overhead pictures of it. I think it has been filled. They were filling it when I left with miscellaneous dirt and concrete, but the fill material was not radioactive or anything like that.

I worked in Building 4005 and we made fuel rods for a reactor. That building has been cleaned up and used for other purposes since then. I don't think there were any problems in Building 4005. We didn't manufacture a lot of fuel up there.

Building 4022 was used to store radioactive material. It had a storage facility in the floor and you would take the cap off and put a fuel rod down there. They monitored that pretty close. I don't know how much fuel was stored in the building, because I only went to the building to magniflux the hooks on the cranes. I don't know anything about 4022 other than it had a fuel rod storage area. I don't know exactly what Building 4021 contained, but I suspect it had some radioactive material also.

Building 4012 was a reactor building that had some radiation in it at one time. It was cleaned up and we used it for an x-ray lab in later years when I was an x-ray technician. The walls in Building 4012 were 3 feet thick. If I was going to be x-raying in Building 4012 with cobalt or a 350 KV x-ray machine, I had to call security first so they would adjust the radiation monitors that were across the road and down the hill. Even with 3-foot thick walls, without that adjustment, alarms would go off in nearby facilities when I was x-raying. They could adjust the monitors so that they were not as sensitive as they normally were for the duration of my x-ray work.

Building 4021 and 4022 had outside drainage systems, most likely for handling rainwater. They did not expect the water to have radioactivity, but they monitored those systems just in case.

I know that everything was removed from SRE, the building was jacked up and everything below ground level was removed. I never saw anything in the sublevel basement until they started tearing it out. Everything was removed, including surrounding dirt. The dirt was packaged in boxes and shipped to a radioactive disposal site in Idaho or Nevada. I used to sign the shipping forms when they shipped that stuff out in the mid-1980s. I remember signing the form, but not where it was being shipped to.

The only time I handled any amount of radiological material was when I worked in Building 4005. Not a lot of us actually handled radiological materials. I didn't handle radiological fuel rods that went into reactor in Building 4059, but I was there and they were taking numbers off them and I was recording them.

There wasn't a lot of handling of radioactive materials as far as our group was concerned. I was in Building 4005 and working out of Building 4011 at that time for Atomics International, but there wasn't a lot of radioactive materials handling in those buildings. In ETEC, we didn't handle radioactive material other than a cobalt source and iridium source in the x-ray lab.

There was another building up there that I was in one time that had a reactor in a vat of water. The building was used for neutron radiography, but I went in the building to magniflux the hooks. I assume that building is long gone.

As I mentioned earlier, they took the reactor out of Building 4059 years ago and then they set that building up for other tests at that time. Even though Health & Safety said Building 4059 was a safe building to be in, I went in with my own equipment, including a Geiger counter, and walked that whole building to make sure it was safe. I did my own checking to verify that Health & Safety was right. When we were working in Building 4059, we wore rubber gloves, and in some cases booties and coveralls. When you come out of the work area you removed clothing or anything else that had become contaminated and put it into a separate container for disposal as radioactive material. So they took pretty good care up there.

Anything radiological was shipped off the site to a burial ground in either Idaho or Nevada. I am not aware of anything being buried on site.

I heard of something not going as planned at the SRE, but this was before I went to work on the hill. I heard that they had a holding tank for lightly radioactive liquids and it overflowed, drained into a gully, and Health & Safety was out there picking up radioactive material with table spoons. That's how little radioactivity was spilled; they could clean it up with spoons. It was a small spill that was removed with very small equipment. I was told that it was completely cleaned up.

I have had people in Simi Valley tell me that there has been radioactive material that has come down a wash from the hill and drained all the way to Royal Avenue, but I find that hard to believe. We were pretty safety conscious up there. By the time I started working on the hill in 1967 people were a lot more conscious of contamination than they had been years before. I can't vouch for anything that happened up there prior to the time I got up there, but I would not be afraid to go up there and set my motor home up and camp out.

The only incident I can tell you from SRE other than the minor spill from the overflowing holdup tank was when they cut the vessel out and removed it. They put it on a flatbed truck and were taking it off site, possibly to Idaho. They got down off the hill and before they got to Topanga Boulevard, the flat bed collapsed. I was not at the scene, but I was working on the hill at the time. They had a crane in there within minutes, loaded the material on another flatbed, and took it back up on the hill. They strapped it down securely and left it in Building 4022 overnight, and then hauled the vessel off site again the following day. There was no radioactive spill from it, but in the vessel was radioactive material. There was no contamination down there that I am aware of because they had Health & Safety down there real quick.

I am familiar with the Burn Pit near the Building 4886 area and don't think this area was used as it should have been. It has been cleaned up. I was never out there, but I know they took piping out there with sodium in it. They had a pit of water and to clean the piping out they would dump the pipe into the water and of course water and sodium don't mix.

As far as monitoring worker exposure to radiological material, I understand from others that in areas like the SRE people could suit up and go into the heavily radioactive areas and work for about 20 minutes and then they had to come out and another crew would go in. This was the case when the SRE building was being modified after the reactor had run for a while. And that was the way it was handled when there were any highly radioactive areas. That was before I got up on the hill though. At this point it is all hearsay, but I feel there was some other place where cleanup of radiation occurred and people could only go in for a short time. They also wore badges, film badges and dosimeters.

When I went out in certain areas I wore a film badge, a dosimeter, and in some cases two dosimeters because occasionally one would go off scale. If one went off scale it was not always clear if it was accurate because badges could be defective or it was possible to bump one and

set it off. If you wore two badges and one picked up something, but the other didn't you knew you were probably okay. The only time I went into areas where I had to wear the badges was when I was x-raying.

We had a couple of mishaps up there with an x-ray technician that wasn't paying attention. An example occurred in Building 4032. I was in Buildings 4036 and 4037, which served as office areas near Building 4032. A guy was x-raying in Building 4032 with a cobalt source and I was up there to make sure the people in the office were in a safe area because cobalt splatters all over and can go through 7 inches of steel and 1 inch of lead. I noticed the radioactivity went up as the x-ray technician was running the pill back into the "pig," as we called it. The pill went up and never came down. The technician tried to lock the source up in the pig, but it was still hanging out of the pig a little bit. So the technician got exposed to a little bit of radiation. That was what I called clean radiation. It didn't emit anything that would be harmful for you to breathe, but it sure could kill you if you got too close to it.

I am not really aware of any other spills or disposal, other than the SRE holdup tank overflowing.

The only other building I was in on occasion was Building 4020. That was the Hot Lab. I never heard of any spills in there, but when I was in there you had to wear a film badge and a dosimeter. They remotely handled radioactive equipment in the Hot Lab. The operators looked through windows that were essentially two panes of thick glass, separated 30 inches apart, filled with clear oil between the glass panes. I understand that they would pull some fuel rods in there and use remote handlers to put them in a lathe, remove the cladding from the fuel rods, and reclaim the fuel. I wasn't in there for that purpose. I went in there to helium leak test some things they were making up, little radioactive materials they were making up for the space program. I remember running some helium leak tests on little bolts about 1/4 to 1/8 inch in diameter and 1.5 inches long that they had drilled holes in the end of and put a piece of radioactive wire into it before welding it closed. Those bolts went into something destined for outer space.

Building 4010 was a reactor building. The reactor was removed and everything was cleaned up before I left in 1986. We used the control room of Building 10 as an office for our department.

At one time in Building 10 there were caskets of fuel rods that were already made up to go into either the SRE or the Hallum, Nebraska reactor. We used to go check the inert gas in the caskets to make sure it was acceptable. I remember the fuel was removed, but I don't know where it disposed.

I am still concerned about Building 4059. It might be a good idea to put in some wells around it and close to it and make sure there is no contaminated groundwater around that building because the reactor was in the basement and they had a 5-foot diameter tube that went from the reactor vessel to a huge diffusion pump packed in dry sand. The pump was used to prevent water from filling the cavity. The pump went bad and the cavity filled up with water. The

water may have become radioactive at that time. It wasn't what I called dirty radiation, but the water and/or cavity probably became radioactive. That's the place I'm concerned with. If it's been cleaned up and a report has been written on it then fine. You would have to go down at least 40 feet to see if there was any groundwater contamination because the basement was 32 foot deep and this was below that. The Building 4059 radioactive water could have possibly drained down into Simi Valley and could be the reason people are saying there is some contamination down as far as Royal Street in Simi Valley. It might be worth looking into.

As far as hazardous chemicals, I handled acetone and some alcohol, but I don't know how they were disposed. It wasn't dumped on the ground, I know that, but I think there was some kind of container that they were put into and then disposed of properly. When I worked with hazardous chemicals they were handled reasonably well. I don't remember anything with hazardous chemicals occurring in a way that it wasn't supposed to. I am not aware of any spills of hazardous chemicals. Going back to Building 59, anything we used with radioactive materials, like contaminated gloves, booties, or coveralls, was disposed of in separate containers, other than a wastepaper basket. It was handled differently. I am not aware of where it was ultimately taken or disposed.

When we were manufacturing fuel in Building 4005, there were two or three times we had to evacuate the building because some of the monitor alarms went off. In Building 4059 when we were getting that reactor core ready to go into the vessel we had to scram the building two or three times because alarms went off, but there was no contamination. Once we put the fuel in the container, one person could get within 2 feet of container, but if more than one person got in and around there, they say that the reactor would flash and it would set off the monitors. I don't know whether it ever did. I was in the building when we had to leave, but Health & Safety came in to check it out and clear the building. We were back in the building in 3 or 4 minutes. So, the radiation alarm went off, but I am not exactly sure why. There are a two ways the radiation alarm would have gone off. It could have been defective or it could have picked up radiation from a reactor flash. I know my film badges didn't pick up anything so it wasn't a flash on the reactor.

I'm sure there were company policies that dictated how we worked. The policy that irritated me the most was that they wouldn't let me drive my motorcycle between buildings with equipment strapped on the back. I used to ride a motorcycle to work and a lot of time we had transport equipment between buildings. People who drove their own cars to work were allowed to use their cars to transport equipment, but if I wanted to carry something on my motorcycle and drive between buildings, but they would stop me and make me walk. It was strictly a health and safety issue, you were not going to go up there and do anything that was going to put your life or limbs in jeopardy.

I'm sure that at one time there were rules or regulations that we had to read. I don't really remember that much about it. I think for the most part everyone did what they were supposed to and looked out for their safety and the safety of everybody else. We were pretty cautious up there. We all wanted to get off that hill alive and in good health. We had lead men and

supervisors who oversaw our work and provided training. We had procedures that told us how we were expected to conduct our work. There were instructions and we pretty much followed them to the letter.

We kept quite a few log books and I also documented a lot of stuff with a camera. I took a lot of pictures for use in reports. Many of my pictures went back to Washington, D.C. for reports by other people. I had a color darkroom and had the capability of making a 16" x 20" color print. So I put out a lot of information that way. I believe my negatives all went down to the Atomics International DeSoto facility. There was a photo lab down there and I think all my negatives went there. I didn't ask to keep any of my photos. One print I wished I had that I was called in to take a photo of was a result of a test article in a sodium tank. We put a test article in a tank of sodium, pulled it out, cleaned it and wrapped it in plastic in the evening, unwrapped it the next morning, and immediately placed it back in the tank. We didn't check it again until it was pulled out four or five months later. A spider had gotten in there and created a web on the baffles at the top of the unit. The sodium vapors created droplets on the spider web and I photographed it. That was a neat photo that I wish I still had. I had been called to take photos because a heater used to keep the sodium piping hot burned out. I went in and photographed that to show the extent of the damage. This all occurred in Building 4032.

There probably were things that went on that were not documented, but I can't think of anything. I am not personally aware of anything that was not documented. If there was something that happened at ETEC (also known as LMEC) I was out there with a camera to document it. We built big sodium pumps in Building 4463 and then transferred them into a pump case in Building 4462. I was out there shooting as many as 70 pictures while they were lifting that pump and transferring it over. I was continually shooting pictures.

The only liquids that I am aware of being disposed down a toilet were photochemicals from my darkroom. They were really not hazardous. I had my hands in those chemicals all the time.

Some tanks were removed from the outside of the Building 4024 years ago and I understand that the tanks were potentially holding radioactive gases at one time. The tanks were pulled out and everything around the tanks was removed. If it was contaminated it was hauled off. The tanks were located between Building 4024 and 4027, just outside and to the east of the Building 4024. The only reason I am aware of the Building 4024 tank is that at that time our department was headquartered at Building 4027 and they came in and took out the 4024 tank while we were nearby in 4027. I didn't know what Building 4024 was used for originally, although I think it was for a reactor that went out into space. It's still up there. They may have built that reactor in Building 4024 or there was also another reactor that was built up, but never had fuel placed in it, so that reactor could have been in Building 4024 as well, I'm not sure. So, there was the possibility of radioactive material in the basement pit of Building 4024, but I was never down there. Building 4019 also had a pit in it, but I don't know what was there. The pits were lined with reinforced cement.

The only disposal area I am aware of is the Sodium Burn Pit. I am not aware of any surface disposal areas at the western edge of Area IV or of any leach fields, septic tanks, or drainage discharge locations. I am familiar with the Old Conservation Yard. We got surrounded by wildfire in Simi Valley at one time and I came up to work after the fire had gone through the valley. I saw that the fire had come up the hill. It didn't do any damage at the edge of the hill, but it jumped to the salvage yard as the Old Conservation Yard was also known, and it got hot enough that it fused stainless steel piping together. It takes over 2,000 degrees Fahrenheit to fuse stainless steel together. There were also some lead acid batteries in there, glass cases that were melted down, and some puddles of aluminum.

I am aware of the following tanks at the Santa Susana Field Laboratory: Building 4059 had a liquid nitrogen tank. There was a big day use tank for diesel fuel between Building 4011 and SCTI (Buildings 4355 and 4356). There was a big tank farm in either area E, F, or G on the map. It contained a 1.5 million gallon tank for diesel fuel.

I remember one time we went down to Building 4356, where the steam generator was located in SCTI, and I was going down in the pit to do some inspection. I got down to the bottom grating and the whole bottom floor, about 10 feet down, was full of water. The sump pump had quit working. There was a steam generator down there. The other sump pump break down was in Building 4059. Those are the only issues I am aware of relating to sump pumps.

I feel as though everything was cleaned up at SRE. SRE as it was originally built is not there anymore. As I noted before, everything below the main building at SRE was removed. The building was jacked up, and everything was taken out and cleaned. Fill dirt was brought in and they put down a new foundation, filled it with cement and the building was used as a storage facility when I was there. I don't know where the fill dirt came from. I don't know if they had an area that they dug out up on the hill or if it was hauled on from some other location. I know it was clean fill dirt.

As far as specific radionuclide sources, we built uranium fuel rods in Building 4005 for an off-site reactor. The building was cleaned up completely and used for other tests afterward, but I wasn't involved then because I had moved to ETEC/LMEC. I had a cobalt source and an iridium source for x-raying only. The cobalt source was 100 curies of cobalt and the depleted pig that the cobalt was in weighed 500 pounds. It was transported on a unit with two large rubber tires and a dolly wheel. It would read about 20 mr (milliroentgens) at the outside of the case, but it was not contaminating anything. It could kill you if you received a big enough exposure.

I can't say that the Santa Susana Field Lab was a bad place to work. If it had been, I wouldn't have stayed that long. I enjoyed what I was doing. I was privileged in some ways because I did a lot of photography for reports and spent a lot of time in the large darkroom I had in Building 4027. Even though I was self-trained in color printing I managed to get it done. I think my specialty was helium leak testing for various areas. I was also an x-ray technician and we x-rayed welds of various things. I think the worst job I had was x-raying inside a gas-fired

heater at SCTI. That was hard work. You had to go in and set up your equipment and your film, crawl out through a burner opening, run the iridium pill out, x-ray it, crawl back into the heater and make another set up to do it all over again. The worst of it was when I had to go underneath the heater and I'm a little claustrophobic. There was just room enough to squeeze through. It was a bit scary when thinking about what could happen if we had an earthquake and the unit collapsed.

I don't think it is necessary to re-evaluate SRE and spend a lot of time and money on it. The only thing I think might need to be done, and might already have been done, is put a test well down around Building 4059 and other than that I don't know of any problems up there. I don't have an ax to grind and am not trying to make trouble for anyone. I don't think it is necessary to go back and duplicate past clean-up efforts.

UNITED STATES DEPARTMENT OF ENERGY

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 7/15/2010

Interviewee(s): 287

I started at SSFL on January 23, 1962 as a senior engineer at the Shield Test Reactor. Later I worked at the SNAP Critical Facility. I travelled to other locations as part of my job, including the Idaho National Laboratory. There I worked on a reactor test in Test Area North called the SNAPTRAN-3 – we blew that reactor up on purpose. For AI, I managed work at several places in addition to SSFL. That was the only reactor we blew up on purpose.

I handled radioactive materials as part of my job. Mostly I handled fuel rods when we were putting them into reactors. They were clean and there was no concern about handling them. Generally, the reactors were supporting research. The experiments produced gamma rays and neutrons. We were testing how the reactor handled various situations and various shielding designs.

The fuel was generally stored at the facility where the reactor was located. If it was stored the way it was supposed to be, it posed no risks. We did things the way we were supposed to. Critical facility fuel was not radioactive, so we could handle it without any risk before, during, or after the testing. When fuel was removed from a reactor, it was stored temporarily in the same building, and then it was shipped out. Some went to Oak Ridge and some went to Idaho. Some of the SNAP cores are still at Oak Ridge. I know one guy did some work on some fuel that came from here; I saw that he used some of the calculations from my report in his work. He confirmed my calculations. They used some of our fuel in the Tower Shield Test Facility at Oak Ridge. Much of the fuel removed from the reactors here was not that radioactive. We would store the fuel in the water pools for a while, and then ship it somewhere else for reprocessing. We used fuel that was composed of a standard uranium-aluminum alloy.

In some cases, we decided what to do. No one had done it before, so we made up the rules and documented what we did. If there were paper pushers they could not tell us what to do because they did not know anything more than we did, probably much less. Today, it is more paper than work. But back then, we could figure out what was best without interference.

I think we had logbooks. I do not know what we did with them. You got me. There were retention rules. Five years or ten years. We kept them as long as we were supposed to.

I did not handle many chemical materials. We did have some hot gases, some transient fuel tests. We handled all sorts of stuff. Mostly when we were working with something that was potentially dangerous, we worked with it under a hood. We were not crazy. We did not do anything stupid. We didn't put ourselves in any kind of danger. We had plain water drains and we had contaminated liquid drains. We did not put anything but water down the water drains.

Some of this is hard to remember. That was a lot of years ago. Aside from the reactor tests, I cannot really distinguish between some things I did up on the hill and what I did down in Canoga Park. But we did not pour anything in the toilet in my day.

Nothing unusual or out of the ordinary happened on my watch.

We always wore film badges and sometimes we had pencil dosimeters. The film badges recorded what we were exposed to, but they did not tell us anything. They were checked later by the health physicists. The pencil dosimeters would show the level of radiation. All the buildings were alarmed. If we didn't hear the alarm, we knew that we did not have anything to worry about. The film badge just tells you what you were exposed to. The dose that you got was the dose that you got. You could not undo that.

Later, when I worked for General Electric up in Vallecitos, a guy dropped a bit of plutonium on the floor. He bent down and picked it up. He nearly turned purple he held his breath so long. We used to joke about how he turned purple from holding his breath. Nothing like that ever happened near me at SSFL.

We wanted to do things safely. We were about safety, in spades.

I went to school for nine years before I went to work up at SSFL. I did summer jobs under people who were outstanding in the field at Oak Ridge and at Brookhaven. I was well trained by good people. I learned good habits before I got here.

It has been said, if you can do something, you do it. If you cannot do it, you teach. If you cannot teach, you do quality assurance. There was not anything of consequence that wasn't documented. We might occasionally have something happen that had no health and safety consequence that we would not bother to record. The reactors were designed to shut down (or scram) if something went wrong. Sometimes they were over-sensitive, and shut down too easily. It was a hassle to start them back up again. There were safety interlocks designed into the facility – that's the purpose of the instrumentation,

Occasionally we would have power hiccups. Everything was designed to fail-safe. It was a pain in the neck, but it was designed to be that way.

At the MIT reactor, the controls on our subcritical facility attached to the reactor were on a relay such that if a shutter was opened too fast the relay would trip and shut us down. There was no safety risk, just unneeded instrumentation. In this case, the instrumentation was overly sensitive and hindered our ability to get our work done. In those circumstances, we would purposely put a matchbook cover between the contacts of the relay to prevent the automatic shutdown. This would allow us to operate and not shut down most of the time. This type of thing was probably not documented, but it was done. Back then, I would have no problem with this sort of thing because it helped me get my job done. There is no way you could do something like that today. You would have to go through a lot of paperwork to get rid of the useless relay.

I do not know anything about the sodium burn pit. I have heard that they shot barrels there. That was the way things were done. Sometimes it was important to let the pressure out of a barrel, to expose the contents to air. It would have been dangerous for a worker to open a barrel. The safest and easiest way to puncture a barrel was to shoot it. That was done all over the country in those days.

I have heard there were places to dispose of things on site. I wasn't a cleanup guy. I was a reactor guy. I do not know where those disposal sites were. I know we ran a clean facility.
I do not have any information on leach fields, septic tanks, drainage locations, sewer lines, storage tanks, and gas holdup tanks.

Most of what the community is worried about here is over-blown. I have no doubts that EPA will do a good job on the survey and that DOE will clean up whatever is found. I am confident of that. There have already been clean ups and my guess is that 90% of the contamination has already been cleaned up. The surveys will not find any smoking guns.

This page was intentionally left blank.

UNITED STATES DEPARTMENT OF ENERGY

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 7/20/2010

Interviewee(s): 296

I think most every site that I was involved with at Santa Susana Field Laboratory (SSFL) has probably already been cleaned up.

The first time I was on the hill was probably about 1956 on a visit. I started with Atomics International in 1954 at the Downey plant – actually it was called North American Aviation at the time.

I transferred up to the Liquid Metals Engineering Center in 1959. I was an engineer and I worked on the Kinetic Experiments for Water Boilers (KEWB). I designed a water boiler reactor. I had worked on a very similar reactor on a project in the 200 Area at Hanford before moving to California. The KEWB was underground. They eventually filled it in and put a cover on it. I assume it was cleaned up before it was filled in, although I have no knowledge that this was done.

I didn't have to wear a film badge in the beginning because we were just designing the facility. Film badges weren't necessary until the reactor went critical. The KEWB was the first reactor to go critical at SSFL, even before the Sodium Reactor Experiment. That was in about 1957. The SRE furnished power to the city of Moorpark for a little while. SRE was a lot bigger than the KEWB. I did not work on the SRE design.

I never handled any radioactive materials at SSFL. I handled radioactive materials at Hanford before I moved here, but I never handled any at SSFL.

KEWB was an experimental reactor. Once I had finished my job, contributing to the design of the reactor, I worked on other projects. My involvement was really only during design and construction. I wasn't involved once the reactors were operational.

I did work on other reactor designs, including two for Japan and one for Germany. I also worked on a small reactor for Denmark. I didn't go to any of those places. They shipped the

reactor to Denmark after it had been constructed. Another engineer went to Denmark and supervised it until it went critical. I got my picture in Newsweek along with a Dane while I was working on the Danish facility. This was a similar reactor to the KEWB. They were built of metal parts, mostly steel parts.

They did have a lot of radioactive materials in the Hot Cell at LMEC – but I was not involved in that operation. I would visit once in a while, but I wasn't assigned there. The research done there was part of the Advanced Sodium Program, which was funded and monitored by Argonne National Laboratory.

I left the company in 1963. I went to work for AeroJet in Azusa, California. I supervised the radiation effects program. They had two reactors in Fort Worth, Texas. AeroJet eventually moved everyone to Sacramento. I still lived in Northridge, but I flew up to Sacramento on a daily basis. The program manager was out of Cleveland. The company had four private jets. They were large and could carry 40 passengers.

In 1965, I went back to Rockwell and worked at Downey and Compton on the Apollo program. I was recruited by Rockwell to work on ground support equipment (GSE) for the Apollo program.

In about 1970, I went back to Hanford to work on the Fast Flux Test Facility. That was a $3 billion program. I was the systems manager, in charge of all of the sodium systems. Bechtel in S.F. designed that facility. We were the program managers. I was in charge of waste disposal, also. They built this facility out in the desert. The foundation was poured while we were still working on the design.

My first wife hated it there. We didn't want to live there. So, I went back to work for Atomics International at SSFL in 1972 and became involved in the sodium program. I worked directly for ILM. I was the program manager for the Advanced Sodium Components Test Program. A lot of my job was concerned with fiscal budgets. I was to make sure we spent money wisely.
I took courses in nuclear technology on my own, not through the company. I was a degreed engineer at 20. My degree was from the University of Washington.

At ETEC, I was not involved in handling radioactive materials or chemical materials. I had an office at ETEC formerly LMEC, not far from where the SNAP work was being done. That was JMN's program. Eventually he left the company and started his own company.

Every job up there was different. One time I was working at the Small Components Test Laboratory and I was supposed to document all the piping in that building. It was three or four stories high. We needed to have a full inventory of all the piping so we could have accurate drawings. Things were getting changed all the time. One time I stopped at the end of a day and I marked the pipe that I was at with a piece of black ribbon. When I got there the next day, the entire pipe had been re-routed.

I was involved in responding to a letter from DOE or AEC, whatever it was called at the time. CF Braun had been doing a design construct for the Large Component Test Facility. They had been working on it for seven years. They claimed they were 85% done. DOE got fed up with them. They asked if we could help get the building finished. I ended up writing a 13-page letter for ILM that described how we could get that facility finished. They liked the letter. They fired CF Braun and put me in charge. I used about 12 engineers to help me. We got in there and realized they were only 30% complete. We ended up completing the project in only a few months.

Any way, we finished it up. I had to supervise the electrical work in addition, even though I am not an electrical engineer. I finished the electrical design in about a month, and then we built it. The LCTF was built to test large pumps that were to be used in the future fast breeder reactors.
I don't know anything about any liquids being disposed down drains or in toilets. The company was pretty careful. Things were pretty lax at Hanford, but not at SSFL. LMEC was pretty good. Everyone wanted to do a professional job.

We used bottled water the whole time I worked up there. The tap water was never drinkable. It wasn't contaminated, but it didn't taste good. It was hard water.
I never went to the Sodium Burn Pit. I saw a movie of them throwing sodium in it, but I never witnessed that myself. It was just a big hole in the ground that contained water. In the movie it sounded pretty loud. Pure sodium is an excellent heat transfer medium. It is non-corrosive in pure form, but very corrosive as sodium oxide.

I don't know anything about any leach fields. I don't really know anything about on-site drainage. I think we outsourced a lot of design for the waste management work.

I don't know much about the old conservation yard. I knew about it, but I didn't know where it was and I never went there. We may have gotten some materials from there for the KEWB, because we didn't have a lot of money when we were building that facility.

For the KEWB reactor, we had to order special state-of-the-art valves. They took 20 weeks before they were delivered. They came, and I told the contractor to take the internal seals out of the valves before welding them into place. He forgot to do that. The valves were ruined when he welded them into place. The valves leaked live a sieve. We would have to order them all over again. This incident would have set the project back 20 weeks. However, the contractor was able to get replacement valves in one week because he didn't have to go through the company process, which was inefficient.

The SSFL was one of the cleaner places I worked. It was above average.

I never knew very much about the SNAP program. That was JMN's area. I used to hear stories about some problems with that program. But in general, I think the SSFL was run pretty well.
By contrast, I remember they used to say at Hanford, if you needed to dispose of radioactive material, just take it out and bury it. That was not how things were done at SSFL.

It's too bad there is so much fear about SSFL. The residential community grew up around the place. They didn't make the same kind of mistakes that were made at other sites. I remember one time at Hanford they wanted to build another chemical reprocessing facility. Everything would be done in it by remote controlled robots. There was one in 200 East and one in 200 West, and they wanted to build another. They pulled out the old drawings; they were in a big hurry. They poured a foundation, a 5-foot thick concrete foundation, and then decided they didn't want it after all. Then they just covered it up and cancelled it. I am not aware if the project was ever re-started.

Atomics International was run originally by the physicists, not by engineers. Physicists figure out the science, and engineers figure out how to get it done. It is great to work around the physicists.

I also worked for Lawrence Laboratory for about four years. I worked at both locations; in Livermore for one year and at Berkeley for three years. I worked there after I worked at Hanford and before I went back to SSFL. I helped set up Livermore Lab. I worked for Dr. Teller. It was exciting. One time I was in a meeting room with three Nobel Prize winners. I felt privileged.

I was working for IJL prior to the SRE core meltdown. He wanted to increase the power of the reactor. I told him I thought it was a bad idea. He wanted me to take over the project even though I did not want the job. They announced that I was taking over that program, and then the accident happened before I started. They took a lot of pictures of the damage down in the tank of the SRE. They gave the slides to me. IJL told them to give the pictures to me, so they did.

I don't think there was a cover-up at SRE because after the accident I was asked to give a talk at the last minute. I asked IJL if I could talk about the accident and use the slides I had been given and he said I could. I thought I was going to talk to 20 people for about 30 minutes. They gave me the address and I had just enough time to get there. I arranged the slides on the way and drove to the place where I was to give the talk. Three guys came out and met me. They said we've been waiting for you; you should start in about two or three minutes.

I went inside. It was an annual meeting the East Coast Utilities. There were 1,500-2,000 people in the audience! I talked for over four hours! I talked for two hours, then we took a break, and then I answered questions for two more hours. I showed all the slides. That's not what I would call a cover-up. No one was trying to hide anything, especially not Atomics International or DOE.

I told the audience what I thought. Everyone was interested; they stayed the whole time. I didn't hang onto those slides. I gave them back to the library which contained thousands of reports. Atomics International had a weekly newspaper and they had stories of what was being

done all over the site. Atomics International and Rocketdyne had very little to with each other back then.

I left the company in 1981 and took an early retirement. Right after I left, Atomics International and Rocketdyne merged one company and Atomics International was a part of Rocketdyne.

This page was intentionally left blank.

UNITED STATES DEPARTMENT OF ENERGY

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

INTERVIEW NOTES

Project/Subject: SSFL / HSA

Date / Time: 7/16/2010

Interviewee(s): 300

On July 16, 2010, I was interviewed in my home about my experience between 1958 and 1968 at the Sodium Reactor Experiment (SRE). This statement is based on my recollections.

From mid-1958 until mid-1968, I worked for Atomics International (AI) at SRE. SRE was located at AI's Nuclear Field Laboratory in the Santa Susana Mountains. During that time, I was employed successively as Senior Reactor Engineer, Senior Physicist, Experimental Supervisor, and Operations Supervisor. As an engineer, physicist, and the Experimental Supervisor, I planned, performed, and led the reactor physics work necessary to understand the performance of the SRE. As Operations Supervisor, I was responsible for operation of the reactor plant 24 hours per day, seven days per week. While I was a nonsupervisory employee, my immediate superior was LNO. As operations supervisor I reported first to GHJ, later to OQR, and finally to MOP. While I was Operations Supervisor, the Shift Supervisors and the maintenance foreman, NPQ, reported to me. Prior to joining AI, LNO had worked at the Hanford Engineer Works (HEW). After leaving SRE as Assistant Group Leader, OQR was promoted to Superintendent of the Hallam Nuclear Power Facility (HNPF) and later returned as Group Leader of SRE.

Prior to working at SRE, I was among 200 technical graduates hired by General Electric Company (GE) to work as Engineering Assistants at HEW. HEW produced weapons grade plutonium. During the 1940s and 50s, information related to the production of fissionable material was very highly classified, and no nuclear energy curriculum existed at any university. To prepare us to work in the nuclear field, GE trained us formally in their own Nuclear Training Program. While working at H Reactor, I received a 0.5 roentgen equivalent mammal (rem) dose of radiation during a refueling incident. Because of the training program, I understood the risk involved. The acute lethal dose is 500 rem (5 sieverts or 5 sv). After my exposure, I was required to submit collected urine for 24 hours and to stay out of radiation work zones for two weeks. Analysis of my urine indicated no ingestion radioactive material. My career dose is approximately 3 rem. Safety was paramount at HEW and at AI. Later, I would find safety paramount at Atomic Energy Commission (AEC) and Nuclear Energy Commission (NRC).

After leaving GE and before joining AI, I was commissioned in the United States Navy and served as an engineering duty officer. Most of my experience was in new ship construction in two commercial shipyards. All the work was nonnuclear. During the two years that I was stationed at Avondale Marine Ways, four workers died in the yard.

At the time I was hired by AI, I was qualified for the job based on my experience at HEW. I did however receive additional training at AI in supervision and management.

I left AI after AEC decided in September 1967 to retire SRE. By mid-1968, SRE staff had dwindled from 70 people to a chief operator, a reactor mechanic, and myself. Although AI offered employment to me in the Space Nuclear Auxiliary Program (SNAP), I elected instead to join the staff of AEC's regulatory arm that later became the Nuclear Regulatory Commission (NRC). During my time at AEC/NRC, I visited many licensed commercial power plants but rarely entered a radiation field. However, on one occasion, at the Robinson 2 nuclear power plant, during a plant outage, I did enter a 5 rem per hour field in the end bell of one of the steam generators. The purpose of my entry was to increase my awareness of the work in progress and working conditions.

I am a Registered Nuclear Engineer in the State of California.

The SRE reactor was located beneath the floor of the high bay in Building 4143. All of the primary reactor cooling systems and part of the secondary cooling systems were also located beneath the floor. The reactor and cooling systems were in heavily shielded concrete vaults. The reactor vault was designed to be physically inaccessible to personnel entry. After decay of sodium-24 during plant outages, entry to the cooling vaults was safe and necessary for system maintenance.

Natural sodium is comprised of one isotope, sodium-23. In a reactor, sodium-23 absorbs neutrons to become sodium-24. This isotope is strongly radioactive, is a beta (electron) emitter and a gamma emitter, and has a15-hour half-life.

Storage cells for fuel and moderator elements and wash cells for fuel elements were also located below the high bay floor.

The high bay accommodated two overhead bridge cranes, one of large capacity and the other of lesser capacity for auxiliary work. The heavy-duty crane was capable of lifting the concrete shield blocks covering the cooling vaults and the reactor loading face shield. It was also used to position the heavy lead-shielded fuel and moderator handling machines. These were necessary to transport irradiated fuel and moderator elements from the reactor to storage.

In addition to the high bay, Building 4143 contained the reactor control room, electrical equipment rooms, a hot cell, health physics laboratory, and most of the SRE staff offices.

Power was piped via the main primary and secondary cooling systems to the steam generator. The steam generator was the interface between the secondary cooling system and the feedwater/steam system that served the electrical turbine generator. Southern California Edison (SCE) owned and operated the water system, the turbine generator, and power lines connecting the generator to SCE's electrical distribution grid.

The main and auxiliary primary and secondary cooling systems each had a motor driven, vertically oriented, centrifugal pump. Each pump had a shaft seal to prevent liquid sodium at temperatures up to 500° F from leaking out of the pump. Instead of using conventional seals, freeze seals were developed for this purpose. Tetralin cooling systems were designed and installed for the the freeze seals. They reduced the sodium temperature in the seal to less than 208° F, the melting point of sodium. Tetralin was selected because it is chemically similar to kerosene and compatible with sodium. However, tetralin is an organic and decomposes pyrolytically at liquid sodium temperatures. Carbon is a decomposition product of that process.

Radioactive liquid and gaseous effluents were piped to storage tanks buried on the hill behind Building 4143. The tanks were covered with backfill.

Nearby were Buildings 4003, 4043, 4153, and 4163. The remaining SRE staff offices were in 4003. That building also provided space for nonradioactive test work. Building 4043 was used exclusively for warehousing nonradioactive spare parts for SRE. Building 4153, the Sodium Service Building, contained the secondary sodium storage tank and the sodium melt station. One end of Building 4163 was used for disassembly and maintenance of radioactive and non-radioactive SRE components and equipment. The remainder of the building was a machine shop that served the Nuclear Field Laboratory (NFL).

The fuel and moderator handling machines, when not in service, were parked in a bay off one end of the high bay. A carriage on the bridge crane was used to pick up the moderator-handling machine from its parking bay and move it onto the crane. A second carriage was needed to expedite movement of core moderator elements. An engineer on the SRE staff, OQR, discovered parts in the NFL Conservation Yard that could be used to inexpensively build a second carriage for the moderator-handling machine. I had informally approved OQR's request to proceed, but before we could do so, it was necessary for me to get approval from the Division Director.

The reactor core was an array of hexagonal logs of graphite moderator 11 inches across flats and 10 feet long arranged on end in the reactor vessel. Fuel elements were positioned in cooling channels on the axes of the moderator logs The fueled portion of rods was six feet long. All fuel rods and graphite logs were metal clad – the former to prevent fission products from entering the sodium coolant and the latter to prevent sodium from entering the graphite.

The SRE Group Leader was the senior manager at SRE. The supervisors of the operations, experimental, analytical, and modifications units reported to him. However, there were two small groups at SRE that were independent of the Group Leader. They were health physicists

and hot cell operators. Health physicists were always at the reactor when it was operating or being maintained, and they reported to AI's health physics management. Their independence assured that operating objectives would not obscure safety considerations. Hot cell operators were there when they had work to do for SRE or other NFL clients.

Fuel elements for Core 1 each contained seven rods of uranium enriched to 2.778 atom percent uranium-235. Six of the rods were in a hexagonal array around the center rod.

There were 14 power runs with Core 1 separated by outages for maintenance and modifications and for operation at criticality (zero power) for testing. Power Run 1 started in July 1957 and design full power, 20 megawatts thermal (Mwt), was reached in June 1958. Power Run 14 ended in July 1959 after the fuel melting accident and subsequent diagnostic testing at criticality and low power.

During the last few power runs with Core 1, tetralin leaked into the primary coolant through the freeze seal on the main cooling pump. When SRE was taken to criticality for Power Run 14 enough carbon had deposited in the lower part of fuel cooling channels to seriously degrade fuel cooling. While attempting to take the reactor from criticality to full power, the operator lost control of the reactor. Power increased by approximately 50% in perhaps 100 seconds. The operator reacted by inserting the control rod to regain control. He recovered control at low power where the reactor performed normally. He then attempted to increase power again and again lost control. This time power increased more rapidly to about 14 Mwt. The operator pressed the scram button which dropped the safety rods into the core and simultaneously drove in all control rods.

The reactor became unstable because of voids in the sodium coolant caused by boiling of sodium in the fuel elements, which was caused in turn by carbon blockages in the fuel cooling channels, which was caused in turn by pyrolytic decomposition of tetralin during preceding power runs. Thirteen fuel elements were partially melted, and the cladding on several moderator elements failed. Fission products were released to the primary coolant and to the helium cover gas above sodium pool in the reactor vessel.

All Core 1 fuel and all damaged moderator elements were removed from the reactor. New replacement moderator elements were loaded in the reactor. New freeze seal cooling systems were installed on all the sodium cooling pumps. The coolant for the seals was sodium potassium eutectic alloy. The eutectic alloy is molten at room temperature and is compatible with sodium. SRE personnel were not evacuated from Building 4143 during the melting accident or at any other time except for one practice drill. The cost of recovery was 1.25 million 1959 dollars and required 15 months for repairs and modifications. New fuel would be loaded for Core 2 operation. PRS was operations supervisor during the Core 1 power runs.

At one point during cleanup after the accident, the Group Leader required all SRE personnel including supervisors and himself to participate for one shift in the physical decontamination of the high bay. Most horizontal surfaces were cleaned by mopping. Most vertical surfaces were

cleaned by swabbing with Kotex® because of its absorbency. Operating and maintenance personnel continued the cleanup effort until Health Physics could release the high bay for unrestricted access by plant personnel. Health physicists used survey patches similar to gun cleaning patches to collect 100 square centimeter swipes of surfaces. Radiation counters were used to determine the amount of radioactive contamination collected on each swipe.

The fuel for Core 2 was thorium uranium alloy enriched to 7.1 weight percent uranium-235. The fuel elements were five-rod bundles surrounding a center unfueled support rod. Initial criticality with Core 2 was achieved in September 1960. Low-power physics tests were performed, and in January 1961 while increasing power for Power Run 15, the reactor performance was unstable. QST, Director of AI's Sodium Reactor Department, ordered shut down of the reactor pending review by AI's Sodium Reactor Review Committee. The committee provided an advisory function while necessary testing was performed to identify the cause of the problem.

RTU and SUV used an analog computer obtained from Systron-Donner Corporation to model the performance of the reactor. In this way, they demonstrated that the power coefficient of reactivity was positive, in other words that reactor had fast positive feedback. This led to the theory that fuel rods were bowing away from the axis of the bundles and into higher neutron flux. Testing verified the theory. Each fuel bundle was restrained with a spiral wire wrap and positive feedback was eliminated. The spiral wrap was installed in the SRE hot cell.

Reactor operation was resumed, and in October 1963 during Power Run 41A, the SRE returned to full power for the first time since Power Run 13. During that interval, various other problems were addressed including core temperature oscillations, several ruptured moderator elements, and gas inleakage in the main primary cooling pump. These problems were corrected.

In February 1964, the reactor was shut down for the Power Expansion Program (PEP). PEP increased the power output capability from 20 Mwt to 30 Mwt. New moderator elements, control and safety rods, and sodium pumps were designed, fabricated, and installed in SRE. Core 3 fuel elements were received and stored in the high bay. PEP modifications were completed. The fuel was uranium carbide, a ceramic capable of operating at considerably higher temperature making possible the production of high quality steam for more efficient production of electrical power. The fuel was enriched to 6.5 weight percent uranium-235. However, the fuel was not loaded in the reactor. AEC refused to continue funding operation of SRE. Shift operations ceased in September 1967. AI-AEC-12572 (see Bibliography) presented seven plans considered by AEC for the future of SRE. It was initially retired, and sometime after mid-1958, it was demolished.

Sodium is a soft metal at room temperature. It melts at 210°F and boils at 1620°F. Its thermal capacity is one-third and its thermal conductivity is 10 times that of water. Because of its high boiling point and high thermal conductivity, it is an attractive heat transfer medium for nuclear power plants. However, sodium reacts violently in water, can ignite spontaneously in moist air,

and, if ignited, burns in dry air. In high school and college chemistry laboratories, it is stored in kerosene.

Sodium was received at SRE in sealed 55-gallon drums and taken to the Sodium Service Building. Individual drums were connected to appropriate sodium piping. The drum was wrapped with electrical strip heaters and thermal insulation. Temperature was increased above the sodium melting point, and the sodium was transferred to the appropriate reactor cooling system.

Residual sodium from fuel elements was washed away by steam or water in the wash cells. The cells were needed to remove residual sodium from irradiated fuel elements prior to shipment for reprocessing. TVW continued to do developmental work on the wash cell process after the reactor went on line.

Sodium pumps, valves, and intermediate heat exchangers were examined and repaired as necessary in Building 4163. The work there involved components from both radioactive and nonradioactive systems. The building was decontaminated as necessary so that personnel access was generally unrestricted.

On one occasion, a reactor mechanic, in violation administrative and maintenance procedures tried to clean a sodium valve with toilet bowl cleaner. Toilet bowl cleaner is acidic; sodium is an alkali metal. He immersed the valve in a bucket of the cleaner. The chemical reaction was immediate and violent. Fortunately, the mechanic was not injured, but did receive a three-day suspension without pay for his violations. A liquid stain on the ceiling of the building remained as a reminder of what had happened.

On another occasion, a sodium leak developed at the steam generator with the reactor at zero power and the cooling systems hot. The leakage was collected in a pan that, to the best of my recollection, contained calcium carbonate. Atmospheric humidity was very low, and a fire watch was maintained until the secondary cooling system could be drained to the sodium storage tank. Had a fire developed, AI's Fire Department would have responded.

Large canisters of Ansul®, a powder for fighting fires including sodium fires, were available in the high bay and elsewhere.

SRE used copious amounts of nitrogen in the vaults for the primary cooling systems and in the sodium service vault. This provided protection against combustion of high-temperature, radioactive, liquid sodium leakage. The gas was stored in liquid form in an outdoor storage tank adjacent to the high bay. Helium gas was stored in 2200 psig bottles manifolded together. Helium was used as the cover gas in the reactor vessel and the fuel and moderator handling machines.

The sodium burn pit was an outdoor facility located on Jackass Flat. It consisted of a small, relatively deep pool of water constructed of concrete surrounded by a concrete deck. The deck

was at grade. At one end of the deck, was a single strong bulkhead with a few portholes in it. The portholes were glazed with high-strength glass. The bulkhead also had a hand hole to accommodate a hose nozzle. Debris, including scrap sodium system piping, bearing residual sodium-23 was washed with water from a fire hose. The reaction was violent, and the bulkhead provided protection for the operators. The reaction product was sodium hydroxide. When cleaned of residual sodium, the sodium hydroxide and debris were washed or pushed into the pool for later disposal.

After the AEC decided to decommission SRE, the primary sodium was shipped in drums to Hanford where the Fast Flux Test Facility, a sodium-cooled fast reactor would be built. The secondary sodium was shipped by rail in its storage tank to HNPF in eastern Nebraska. The speed of the train was limited to 35 mph, and an experienced sodium systems engineer from AI's NFL accompanied the shipment.

Personnel at SRE were required to wear carry pocket dosimeters and wear film badges. The dosimeters were collected daily and reissued the next. The allowable daily dose and the range of the dosimeters was 50 mrem. The wearer could read the accumulated dose as necessary during the day. Film badges, as I recall, were collected weekly and were capable of recording a considerably higher dose. Health physicists were responsible for issuing, collecting, and processing dosimeters and film badges. In addition to these measures all persons exiting the site used the hand and foot counter in the lobby of Building 4143.

Health physicists were responsible for surveying the SRE and environs for radioactive contamination, roping off contaminated areas, and establishing portals with stepoff pads to prevent tracking of contamination into clean areas. Health physicists issued Special

Work Permits (SWPs) to operators, mechanics, and others to enter contaminated areas and/or radiation fields. The SWP specified the protective clothing required, breathing apparatus, and the time permitted in the protected area. In high radiation areas, a health physicist carrying a radiation meter capable of measuring low, intermediate, and high level fields always accompanied the work party. The health physicists reported to separate management and their orders were absolute. In addition to these duties, health physicists monitored effluents from SRE.

On one occasion, and only one occasion, was I aware of health physicists not neglecting their duties, but rather establishing the wrong priority. There had been an inadvertent spill of radioactive liquid on the asphalt surface outside Building 4143. The two health physicists on duty were decontaminating shoe soles of two truck drivers from offsite instead of determining the extent of radioactive contamination and roping off the area. This problem was promptly corrected.

On another occasion, an operator's dosimeter was reading higher than expected based on the fact that no high radiation fields or contaminated areas were known to exist in the high bay at the time. Surveying disclosed a fine collimated beam of radiation exiting from a slight gap

between the concrete shield blocks above the vault for the primary cooling system. Packing the gap with lead sheet corrected the problem.

The SRE had two large liquid waste tanks buried in the earth a few hundred feet from Building 4143. The bottom surfaces of the tanks had severely corroded. The tanks were entered, decontaminated to the extent necessary, repaired and returned to service. To the best of my knowledge, this was done during the Power Expansion Program.

Solid and liquid waste from SRE was taken to the radioactive waste handling facility at NFL. It was managed by UWX.

I have no knowledge of toilets being used for disposal of chemicals or radioactive materials. I believe that the culture at AI in general and SRE in particular would not have tolerated such behavior.

AI had a training department that was responsible for the training and certification of Sodium Graphite Reactor (SGR), Organic Moderated Reactor (OMR), and SNAP reactor operators. SRE had an engineer, VXY, whose principal activity was assisting and cooperating with the training department in their work with SRE operators. VXY did much of the work in writing the SRE training manual and presented many of the classroom lectures. The classroom was located in Building 4143. Lectures covered layout, design, and operation of the various systems and the physical principles underlying their operation. On satisfactory completion of the training program, operators were granted certificates documenting their competence. All operators, chief operators, and shift supervisors held valid certificates.

The SRE training and operating manuals were, in my view, the two most important documents at SRE. The SRE Operations Manual was edited and maintained by WYZ of the SRE staff. It was an evolutionary document that depended on input from shift supervisors and other staff members for it technical content. The manual contained detailed procedures that identified valves, pipes, and other components by specific name or identification number.

During shift operations, a log was always maintained by shift supervisors to facilitate transfer of responsibility for the plant to the relieving crew. Management used the log books to stay abreast of plant operation and maintenance. The Group Leader, Supervisors, and Maintenance Foreman initialed the log after reading it. The Shift Supervisor on day shift prepared the Night Orders for the Operations Supervisor's approval. The Friday day shift supervisor prepared orders for the weekend. Holidays were covered in like manner. Each of the Unit Supervisors and the Maintenance Foreman prepared a weekly report of their unit's activities, and the reports were combined for documentation of the Group's activities. They also met as a group with Group Leader to discuss the week's activities.

For a time, we experienced thefts from SRE. Vacuum tube voltmeters, gloves, and gasoline were disappearing. To the best of my knowledge no radioactively contaminated tools or

materials were removed from the site. We asked security to inspect cars leaving the site. Security did this on a random basis at the NFL gate. We believe that this stopped the thefts.

During my time at SRE there was no sodium fire at the facility. Furthermore, I am not aware of any sodium fire at SRE before or after my tenure. However, near the end of my tenure, a brush fire burned through the Rocketdyne Test Facility and AI's NFL. This occurred on a weekend. The AI and Rocketdyne Fire Departments fought the fire as did departments from local jurisdictions. To the best of my knowledge, the fire started in Box Canyon and off property controlled by Rocketdyne and AI.

SCE owned the redwood cooling tower which was necessary for operation of their turbine generator and hence was essential for distribution to SCE's grid of the power produced by SRE. Although we believe that the automatic sprinklers designed to maintain the moisture content of the redwood functioned sometime in the preceding 24 hours, the cooling tower burned and was totally destroyed.

I spent some 19,000 hours of my life at SRE. I am now 82 years old, have four children, and six grandchildren. Neither I, nor my family, have suffered any ill effects from my employment.

This page was intentionally left blank.

Index

A

accident, 2, 4, 7, 18, 24, 30, 31, 78, 84
AEC, 2, 5, 36, 37, 51, 77, 81, 82, 85, 87
AI, 1, 2, 4, 9, 10, 11, 12, 13, 14, 16, 26, 27, 36, 37, 38, 39, 42, 45, 46, 51, 52, 57, 59, 71, 81, 82, 84, 85, 86, 87, 88, 89, *See* Atomics International
Area IV, 5, 7, 9, 10, 11, 12, 13, 14, 15, 37, 38, 69
Atomics International, 1, 2, 4, 6, 7, 8, 9, 10, 23, 25, 26, 29, 30, 34, 35, 41, 42, 47, 51, 63, 64, 68, 75, 76, 78, 79, 81, *See* AI

B

beryllium, 2, 4
Boeing, 9, 11, 12, 27, 29, 34, 51
Building 10, 35, 66
Building 12, 35
Building 20, 41, 45, 46, 52, 55, 56, 57, 58, 59, 61
Building 24, 35
Building 28, 35, 37
Building 4005, 63, 64, 67, 69
Building 4027, 68, 69
Building 4032, 66, 68
Building 4059, 63, 64, 66, 67, 69, 70
Building 4143, 82, 83, 84, 87, 88
Building 4163, 83, 86
Building 4356, 69
Building 4463, 68
Building 5, 24, 25, 26, 27, 51, 52, 59
Building 59, 24, 25, 26, 27, 57, 67
burn pit, 5, 49, 73, 86
Burn Pit, 12, 14, 17, 18, 25, 27, 59, 65

C

chemicals, 1, 10, 11, 12, 14, 15, 17, 20, 31, 33, 39, 44, 45, 49, 52, 55, 56, 57, 58, 59, 67, 68, 88
cleaned, 18, 20, 30, 33, 50, 53, 55, 57, 63, 64, 65, 66, 67, 68, 69, 73, 75, 84, 87
cobalt, 64, 66, 69
contaminated, 12, 15, 20, 24, 25, 30, 38, 44, 45, 49, 51, 55, 58, 59, 63, 64, 66, 67, 68, 72, 77, 87, 88
contamination, 9, 10, 11, 12, 23, 50, 52, 55, 57, 59, 60, 65, 67, 73, 85, 87

D

debris, 57, 59, 87
discharged, 2, 46
disposal, 5, 12, 13, 14, 15, 21, 33, 38, 39, 44, 45, 46, 52, 53, 56, 57, 58, 59, 64, 66, 69, 73, 76, 87, 88
Disposal, 44
disposed, 1, 3, 5, 8, 12, 14, 15, 16, 20, 21, 25, 30, 38, 39, 44, 55, 57, 59, 66, 67, 68, 77
DOE, 11, 12, 26, 36, 47, 48, 73, 77, 78
dosimeter, 8, 17, 25, 52, 56, 57, 65, 66, 87
drainage, 5, 8, 24, 39, 46, 64, 69, 73, 77
drains, 3, 5, 8, 16, 21, 39, 45, 59, 72, 77

E

ETEC, 10, 47, 48, 49, 50, 64, 68, 69, 76

F

film badge, 4, 14, 26, 47, 52, 57, 65, 66, 72, 75

fire, 19, 21, 32, 49, 52, 58, 69, 86, 87, 89

H

hazardous, 11, 12, 14, 20, 31, 38, 43, 44, 45, 46, 47, 48, 49, 67, 68
hazardous materials, 14, 47, 48
HEPA, 55, 60
hot, 2, 23, 26, 53, 54, 56, 57, 68, 69, 72, 82, 84, 85, 86
hot cell, 41, 42, 44, 45, 46, 53, 54, 57
Hot Lab, 52, 54, 55, 56, 57, 61, 66

I

Idaho, 4, 35, 38, 39, 64, 65, 71
incident, 7, 11, 15, 18, 21, 31, 36, 38, 43, 45, 55, 59, 65, 77, 81

K

KEWB, 75, 76, 77
krypton, 2

L

laundry, 53, 56
leach field, 15, 39, 56, 57
leach fields, 5, 21, 46, 49, 59, 69, 73, 77
leak, 31, 47, 63, 66, 69, 86
LMEC, 10, 13, 14, 68, 69, 76, 77
logbook, 7, 26

M

meltdown, 4, 18, 48, 78

N

NaK, 37, 39, 43
NAK, 19, 20, 21
NASA, 10, 11, 12, 26
Nevada, 11, 23, 38, 39, 64, 65
nuclear, 10, 13, 14, 15, 24, 27, 30, 32, 35, 36, 37, 53, 76, 81, 82, 85

O

Old Conservation Yard, 39, 46, 60, 69

P

plutonium, 2, 35, 38, 72, 81
pond, 12, 15, 37, 39, 44, 49, 58, 59, 60
problems, 2, 8, 11, 16, 18, 30, 34, 44, 46, 61, 63, 70, 77, 85

R

radiation, 3, 4, 7, 10, 11, 13, 15, 23, 24, 26, 30, 37, 38, 43, 45, 46, 52, 54, 55, 58, 59, 60, 64, 65, 66, 67, 72, 76, 81, 82, 87
radioactive, 1, 2, 3, 20, 23, 25, 27, 41, 51, 52, 53, 55, 56, 60, 63, 64, 65, 66, 67, 68, 71, 75, 76, 77, 81, 82, 83, 85, 86, 87, 88
radiological, 3, 14, 15, 17, 23, 30, 37, 39, 44, 47, 48, 51, 52, 53, 55, 57, 60, 64, 65
Radiological, 37, 38
reactor, 2, 3, 4, 7, 8, 10, 11, 13, 19, 24, 26, 27, 30, 35, 36, 37, 38, 48, 54, 55, 57, 63, 64, 65, 66, 67, 68, 69, 71, 72, 73, 75, 77, 78, 81, 82, 83, 84, 85, 86, 87, 88
RMDF, 51, 54, 55, 56, 57, 60, 61
RMDU, 38

S

S8ER, 35, 37
Santa Susana, 17, 27, 29, 30, 31, 36, 63, 69, 75, 81
Santa Susana Field Lab, 27, 69
Santa Susana Field Laboratory, 17, 63, 69, 75
septic, 5, 16, 39, 49, 59, 69, 73
septic tanks, 46

sewer, 5, 45, 46, 59, 60, 73
Shield Test and Irradiation Reactor, 35
Shield Test Reactor, 71
SNAP, 1, 2, 4, 7, 8, 24, 26, 35, 37, 54, 71, 76, 77, 82, 88
sodium, 2, 4, 5, 10, 12, 13, 14, 17, 18, 19, 20, 21, 24, 25, 29, 33, 37, 39, 43, 44, 47, 48, 49, 54, 59, 65, 68, 73, 76, 77, 82, 83, 84, 85, 86, 87, 89
Sodium Burn Pit, 12, 14, 15, 21, 23, 25, 26, 27, 33, 44, 46, 59, 69, 77
spill, 38, 55, 56, 57, 65, 87
spills, 2, 12, 21, 48, 55, 56, 66, 67
SRE, 1, 2, 7, 23, 41, 46, 54, 55, 56, 57, 60, 61, 64, 65, 66, 69, 70, 75, 78, 81, 82, 83, 84, 85, 86, 87, 88, 89, *See* Sodium Reactor Experiment
SSFL, 1, 2, 3, 4, 9, 10, 11, 12, 13, 15, 23, 26, 27, 29, 33, 38, 39, 42, 43, 44, 45, 47, 49, 50, 51, 56, 61, 71, 72, 75, 76, 77, 78
STIR, 35, 36, 37, 38, 39

T

tank, 32, 33, 34, 48, 49, 55, 57, 58, 59, 65, 66, 68, 69, 78, 83, 86, 87
tanks, 5, 8, 16, 17, 25, 31, 33, 34, 39, 46, 47, 49, 59, 60, 68, 69, 73, 83, 88
TCE, 57
tetralin, 83, 84
trash, 7, 8
trichlor, 31, 55
Trichlor, 10, 11, 57
trichloroethylene, 10, 25, 30, 38, 43, 44, 51
tritium, 2
Tritium, 2

U

unusual, 38, 43, 45, 72
uranium, 38, 69, 71, 84, 85

V

vault, 24, 56, 82, 86, 88

W

waste, 8, 20, 38, 44, 45, 52, 53, 54, 56, 57, 58, 76, 77, 88

X

xenon, 2, 3

This page intentionally left blank.