FINAL
TECHNICAL MEMORANDUM
SUBAREA HSA-6
HISTORICAL SITE ASSESSMENT
SANTA SUSANA FIELD LABORATORY SITE
AREA IV RADIOLOGICAL STUDY
VENTURA COUNTY, CALIFORNIA

Prepared for:

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TABLE OF CONTENTS

Section Page

1.0 INTRODUCTION 1
1.1 TECHNICAL MEMORANDA AND THE RADIOLOGICAL HISTORICAL SITE ASSESSMENT...2
1.2 GOALS AND METHODOLOGY OF THIS TM 2
1.3 BRIEF DESCRIPTION AND HISTORY OF SSFL AREA IV AND THE NBZ...3
1.4 BRIEF DESCRIPTION AND HISTORY OF HSA-6..6
1.5 SITES IN HSA-6 6
1.6 SITE SUMMARY METHODOLOGY 6
1.6.1 Contents of EPA's Site-by-Site Analyses...8

2.0 FINDINGS...13
2.1 GROUP 1 13
2.1.1 Building 4003 Area..13
2.1.2 Building 4041 Area..25
2.1.3 Building 4143 Area..28
2.1.4 Building 4153 Area..76
2.1.5 Building 4163 Area..81
2.1.6 Building 4183 Area..88
2.1.7 Building 4184 Area..90
2.1.8 Building 4185 Area..92
2.1.9 Building 4505 Area..95
2.1.10 Building 4653 Area..97
2.1.11 Pad 4684 Area..101
2.1.12 Site 4686 Area..103
2.1.13 Site 4689 Area..106
2.1.14 Building 4695 Area..108
2.1.15 Site 4703 Area..111
2.1.16 Site 4714 Area..113
2.1.17 Site 4723 Area..115
2.1.18 Building 4724 Area..118
2.1.19 Site 4733 Area..121
2.1.20 Site 4743 Area..123
2.1.21 Building 4753 Area..125
2.1.22 Site 4773 Area..128
2.2 GROUP 2 133
2.2.1 Building 4063 Area..133
2.2.2 Building 4273 Area..135
2.2.3 Building 4283 Area..137
2.3 GROUP 3 140
2.3.1 Building 4014 Area..140
2.3.2 Building 4053 Area..142
2.3.3 Building 4064 Area..145
2.3.4 Parking Lot 4513 Area...154
2.4 GROUP 4 156
2.4.1 Building 4040 Area..156
2.4.2 Building 4114 Area..159
2.4.3 Parking Lot 4511 Area...161

TABLE OF CONTENTS

Section Page

2.4.4 Parking Lot 4540 Area....163
2.4.5 Site 4583-New Area....165
2.5 GROUP 5....167
2.5.1 Building 4320 Area....167
2.5.2 Site 4583-Old Area....170
2.5.3 Site 4731 Area....175
2.5.4 Site 4732 Area....177

3.0 RADIONUCLIDE LIST....181
3.1 U.S. ATOMIC ENERGY COMMISSION SPECIAL NUCLEAR MATERIAL LICENSE....181
3.2 U.S. ATOMIC ENERGY COMMISSION CRITICAL EXPERIMENTS FACILITY LICENSE....181
3.3 CALIFORNIA DEPARTMENT OF PUBLIC HEALTH RADIOACTIVE MATERIAL LICENSE....182
3.4 RADIONUCLIDE LIST TO BE USED IN SOIL SAMPLING....183

4.0 REACTOR/CRITICALITYFACILITIES/SIGNIFICANT SITES WORKS CITED....187
4.1 BUILDING 4003....187
4.2 BUILDING 4064....190
4.3 BUILDING 4143....193
4.4 SITE 4583-OLD....199
4.5 SITE 4773....201

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LIST OF TABLES

Table 1.1	Area IV Study Area Subarea Designations	1
Table 1.2	Research Reactors Located at the Santa Susana Field Laboratory	4
Table 1.3	Criticality Test Facilities at the Santa Susana Field Laboratory	5
Table 2.1	Damaged Fuel Elements	53
Table 3.1	Radioactive Materials Covered by License No. 0015-59	182
Table 3.2	Radioactive Materials Covered by License No. 0015-59, Amendment No. 39	183
Table 3.3	Summary of Subarea HSA-6 Sites	184

LIST OF FIGURES

Plate 1	Subarea HSA-6, Santa Susana Field Laboratory
Figure 1.1	Site Location Santa Susana Field Laboratory
Figure 1.2	General Site Layout for Area IV/HSA Subareas, Santa Susana Field Laboratory
Figure 1.3	Subarea HSA-6, Santa Susana Field Laboratory
Figure 2.1	Area IV Subarea 6-1, Santa Susana Field Laboratory
Figure 2.1.1a	Building 4003 Site Photograph
Figure 2.1.1b	Building 4003 Floor Plan
Figure 2.1.1c	Building 4003 Aerial Photograph 1974
Figure 2.1.1d	Building 4003 Hot Cave Layout
Figure 2.1.1e	Building 4003 Hot Cell (Cave) Floor Plan
Figure 2.1.1f	Building 4003 Plot Plan
Figure 2.1.1g	Building 4003 Sewage System
Figure 2.1.1h	Building 4003 Contaminated Waste Lines
Figure 2.1.1i	Building 4003 Excavation Area 2000
Figure 2.1.2a	Building 4041 Site Photograph
Figure 2.1.2b	Building 4041 Floor Plan
Figure 2.1.3a	Building 4143, 4153, 4695 Site Photograph
Figure 2.1.3b	Building 4143 Floor Plan
Figure 2.1.3c	Building 4143 Historical Photograph 1962
Figure 2.1.3d	Building 4143 Radioactive Liquid Waste and Vent System
Figure 2.1.3e	Building 4143 Hot Cells
Figure 2.1.3f	Building 4143 Fuel Rod Removal
Figure 2.1.3g	Building 4143 Reactor Core Removal 1977
Figure 2.1.3h	Building 4143 Excavation Area 2000
Figure 2.1.3i	Building 4143 Shielding Excavation 1979
Figure 2.1.3j	Building 4143 Fuel Storage Cell Concrete Excavation 1979
Figure 2.1.3k	Building 4143 Below-ground Excavation 1979
Figure 2.1.3l	Building 4143 Damage to Bottom and Midsection of Fuel Element in Channel 55
Figure 2.1.3m	Building 4143 Damage to Top of Fuel Element in Channel 55
Figure 2.1.4a	Building 4143, 4153, 4695 Site Photograph
Figure 2.1.4b	Building 4153 Site Layout
Figure 2.1.4c	Building 4153 Above-ground Demolition
Figure 2.1.4d	Building 4153 Below-ground Demolition
Figure 2.1.4e	Building 4153 Site After Demolition

Figure 2.1.5a	Building 4163, 4183, 4184, 4185, 4684 Site Photograph
Figure 2.1.5b	Building 4163 Floor Plan
Figure 2.1.5c	Building 4163 Aerial Photograph 1977
Figure 2.1.6a	Building 4163, 4183, 4184, 4185, 4684 Site Photograph
Figure 2.1.6b	Building 4183 Historical Photograph 1975
Figure 2.1.7a	Building 4163, 4183, 4184, 4185, 4684 Site Photograph
Figure 2.1.8a	Building 4163, 4183, 4184, 4185, 4684 Site Photograph
Figure 2.1.8b	Building 4185 Floor Plan
Figure 2.1.9a	Building 4505, Site 4714 Site Photograph
Figure 2.1.10a	Building 4653 Site Photograph
Figure 2.1.10b	Building 4653 Plot Plan
Figure 2.1.10c	Building 4653 Tank Removal 1977
Figure 2.1.11a	Building 4163, 4183, 4184, 4185, 4684 Site Photograph
Figure 2.1.12a	Site 4686 Site Photograph
Figure 2.1.13a	Site 4689 Site Photograph
Figure 2.1.14a	Building 4143, 4153, 4695 Site Photograph
Figure 2.1.14b	Building 4695 Elevation Views
Figure 2.1.14c	Building 4695 Below-ground Demolition 1978
Figure 2.1.15a	Site 4703 Site Photograph
Figure 2.1.16a	Building 4505, Site 4714 Site Photograph
Figure 2.1.17a	Site 4723 Site Photograph
Figure 2.1.18a	Building 4724 Site Photograph
Figure 2.1.19a	Site 4733, 4743 Site Photograph
Figure 2.1.20a	Site 4733, 4743 Site Photograph
Figure 2.1.21a	Building 4753 Site Photograph
Figure 2.1.22a	Site 4773 Site Photograph
Figure 2.1.22b	Site 4773 Pond
Figure 2.1.22c	Site 4773 1979 Photograph
Figure 2.1.22d	Site 4773 Pond in Foreground
Figure 2.2	Area IV Subarea 6-2, Santa Susana Field Laboratory
Figure 2.2.1a	Building 4063 Site Photograph
Figure 2.2.1b	Building 4063 Floor Plan
Figure 2.2.1c	Building 4063 Plot Plan
Figure 2.2.2a	Building 4273 Site Photograph
Figure 2.2.3a	Building 4283 Site Photograph
Figure 2.3	Area IV Subarea 6-3, Santa Susana Field Laboratory
Figure 2.3.1a	Building 4014, 4053 Site Photograph
Figure 2.3.1b	Building 4014 Floor Plan
Figure 2.3.2a	Building 4014, 4053 Site Photograph
Figure 2.3.2b	Building 4053 Floor Plan
Figure 2.3.3a	Building 4064 Site Photograph
Figure 2.3.3b	Building 4064 Floor plan
Figure 2.3.3c	Building 4064 Fenced Area
Figure 2.3.3d	Building 4064 Side Yard
Figure 2.3.3e	Building 4064 Plot Plan
Figure 2.3.3f	Building 4064 Sewage System
Figure 2.3.3g	Building 4064 Plumbing Layout
Figure 2.3.4a	Parking Lot 4513 Site Photograph
Figure 2.4	Area IV Subarea 6-4, Santa Susana Field Laboratory

LIST OF FIGURES (continued)

Figure 2.4.1a	Building 4040 Site Photograph
Figure 2.4.1b	Building 4040 Floor Plan
Figure 2.4.1c	Building 4040 Plot Plan
Figure 2.4.2a	Building 4114 Site Photograph
Figure 2.4.2b	Building 4114 Floor Plan
Figure 2.4.3a	Parking Lot 4511 Site Photograph
Figure 2.4.4a	Parking Lot 4540 Site Photograph
Figure 2.4.5a	Site 4583-New Site Photograph
Figure 2.4.5b	Site 4583-New Plot Plan
Figure 2.5	Area IV Subarea 6-5, Santa Susana Field Laboratory
Figure 2.5.1a	Building 4320 Site Photograph
Figure 2.5.1b	Building 4320 Floor Plan
Figure 2.5.2a	Site 4583-Old Site Photograph
Figure 2.5.2b	Site 4583-Old Historical Photograph 1963
Figure 2.5.2c	Site 4583-Old Plot Plan
Figure 2.5.3a	Site 4731 Site Photograph
Figure 2.5.3b	Site 4731 Demolition Details
Figure 2.5.4a	Site 4732 Site Photograph
Figure 2.5.4b	Site 4732 Demolition Details

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LIST OF ACRONYMS, ABBREVIATIONS AND SYMBOLS

AEC	U.S. Atomic Energy Commission
ACP	activation products
AETR	Advanced Epithermal Thorium Reactor
AI	Atomics International Division of North American Aviation, Inc.
ANL	Argonne National Laboratory
ANSI	American National Standards Institute
ARRA	American Recovery and Reinvestment Act
Boeing	The Boeing Company
ºC	degrees Celsius
CDPHE	California Department of Public Health and Environment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERF	Component Equipment Repair Facility
Ci	curie
COC	contaminants of concern
D&D	decontamination and decommissioning
DHS	Department of Health Services
DOE	Department of Energy
DOT	Department of Transportation
dpm/100 cm^2	disintegrations per minute per 100 square centimeters
DTSC	Department of Toxic Substances control
EPA	U.S. Environmental Protection Agency
EPIC	Environmental Photographic Interpretation Center
ESG	Energy Systems Group
ETB	Engineering Test Building
ETEC	Energy Technology Engineering Center
ºF	degrees Fahrenheit
gpm	gallons per minute
HSA	Historical Site Assessment
HGL	HydroGeoLogic, Inc.
HR	House Resolution
kW	kilowatt
$\mu Ci/cm^3$	microcurie per cubic centimeter
µR/h	microroentgen per hour
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MFP	mixed fission products
mrad/h	millirad per hour
MWd	megawatt days
NASA	National Aeronautics and Space Administration

NBZ	Northern Buffer Zone
NRC	Nuclear Regulatory Commission
ORISE	Oak Ridge Institute for Science and Education
pCi/cm^3	picocuries per cubic centimeter
pCi/g	picocuries per gram
rad/h	rad per hour
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
Rockwell	Rockwell International
SBZ	Southern Buffer Zone
SCE	Southern California Edison
SHEA	Safety Health and Environmental Affairs
SNAP	Systems for Nuclear Auxiliary Power
SRE	Sodium Reactor Experiment
SSFL	Santa Susana Field Laboratory
TM	technical memorandum
TO	task order

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1.0 INTRODUCTION

This technical memorandum (TM) presents a summary of the identified environmental concerns associated with past radiological operations within a portion of Area IV at the Santa Susana Field Laboratory (SSFL) site located in eastern Ventura County, California (Figure 1.1). The SSFL site consists of four areas: Areas I, II, III, and IV; and two buffer zones: the Northern Buffer Zone (NBZ) and the Southern Buffer Zone (SBZ). The U.S. Environmental Protection Agency (EPA) is conducting a radiological characterization study of SSFL Area IV and the NBZ pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). EPA's study consists of a Radiological Historical Site Assessment (HSA), gamma scanning of accessible areas, geophysical surveys, and soil and water testing. EPA's gamma scanning, geophysical, soil and water testing investigations are being developed and presented in separate work plans and data reports.

HydroGeoLogic, Inc. (HGL) has been tasked by EPA to conduct the radiological characterization study within SSFL Area IV/NBZ (hereafter called the "Area IV Study"). Figure 1.2 illustrates the location of Area IV and the NBZ. EPA has elected to subdivide the Area IV Study Area into subareas. Subarea boundaries are based on existing Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) areas for the SSFL site. EPA has further subdivided some RFI areas based on features such as roads, drainage pathways, building use, and number of buildings.

Table 1.1
Area IV Study Area
Subarea Designations

Area Designation	Number of Sites
HSA-3	1
HSA-5A	26
HSA-5B	46
HSA-5C	23
HSA-5D	21
HSA-6	38
HSA-7	18
HSA-8	8
BZ-NE	2
BZ-NW	2

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

This work is being executed by HGL under EPA Contract EP-S7-05-05, Task Order (TO) 0038 under the technical direction and oversight of EPA Region 9. In accordance House Resolution (HR) 2764, the Department of Energy (DOE) is funding EPA's Area IV Study. DOE elected to fund EPA's study with funding allocated under the American Recovery and Reinvestment Act (ARRA) of 2009. On December 6, 2010, the DOE and the State of California Department of Toxic Substances Control (DTSC) signed an Administrative Order on Consent (AOC) for cleanup of the Area IV and the NBZ. Under this AOC, radiological contaminants will be cleaned up to background concentrations as defined by EPA's July 2011 radiological background study.

1.1 Technical Memoranda and the Radiological Historical Site Assessment

This TM presents information relating solely to sites and buildings located within Subarea HSA-6. This TM, along with the other TMs prepared for the subareas identified in Table 1.1. Each TM has been made available in draft for review and informal comment by SSFL stakeholders and the general public. EPA responded to each comment via draft "Response to Comment" tables, which were also made available to SSFL stakeholders. Each draft was edited as described in the Response to Comment tables, and these edits along with any new information made available to EPA were compiled into EPA's official Radiological HSA for the Area IV Study Area.

The content of each TM is based on guidance provided in the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM, Revision 1, August 2000). MARSSIM is used as an investigative tool to gain an understanding of the nature and extent of radiological contamination left at a site. The TMs provide preliminary recommendations for MARSSIM classifications based solely on historical information, which may be incomplete. The preliminary classifications identified in the TMs will be used to guide the subsequent gamma scanning and multimedia sampling effort. Once more complete historical environmental data have been obtained, and the results of geophysical surveys, gamma radiation scanning surveys, field observations, and the results of soil sampling and laboratory analyses are available, the preliminary classifications presented in the TMs will be revised.

1.2 Goals and Methodology of this TM

This TM is focused on radiological information within subarea HSA-6 and the drainage channels that lead to and from this area. The location of subarea HSA-6 is shown on Figure 1.3. Plate 1 presents a summary of the features related to potential radiological sources identified within the HSA-6 subarea. Detailed information pertaining to the use of radioactive materials and the potential release of radionuclides at sites and buildings within HSA-6 are provided in Sections 2 and 3 of this TM. Preliminary findings specific to HSA-6 presented in this TM include:

- Descriptions and locations of potential, likely, or known activities that involved radioactive material, radioactive waste, or mixed waste;

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

As specified in MARSSIM, a "site" is defined as any installation, facility, or discrete, physically separate parcel of land, or any building or structure or portion thereof, that is being considered for survey and investigation (MARSSIM, Revision 1, August, 2000). MARSSIM guidance defines all sites as either "non-impacted," or "impacted" by radiological operations. All of the sites at the Area IV Study Area are considered to have a reasonable potential for residual contamination, so none is classified as "non-impacted." Impacted areas of the Area IV Study Area are divided into one of three classifications.[1]

- Class 1 Areas: Areas that have, or had prior to remediation, a high potential for radioactive contamination (based on site operating history) or known contamination (based on previous radiation investigations).
- Class 2 Areas: Areas that have, or had prior to remediation, a medium potential for radioactive contamination or known contamination.
- Class 3 Areas: Areas that have a low potential for radioactive contamination.

The information provided in this TM together with comments and recommendations provided by SSFL stakeholders and the general public will be used in the EPA's investigation strategy for sampling and analysis for residual radiological contamination in surface and subsurface soil within HSA-6. In addition to the HSA, information gathered by EPA's Area IV and NBZ gamma scanning program and targeted geophysical investigation will assist EPA in fine-tuning the overall investigation strategy for the Area IV Study Area, and in making the final determination of the appropriate MARSSIM classifications.

1.3 Brief Description and History of SSFL Area IV and the NBZ

The SSFL site occupies 2,850 acres of rocky terrain with approximately 700 feet of topographic relief near the crest of the Simi Hills. The Area IV Study Area comprises approximately 465 acres. Though some of the study area is relatively flat, some portions of the area exhibit steep relief and rugged terrain. The site elevation is between 1,880 feet and 2,150 feet above sea level. The overlying soils of the Area IV Study Area consist of weathered bedrock and alluvium that have been eroded primarily from the surrounding Chatsworth and Santa Susana formations. Several geological faults cross this area.

The climate in the vicinity of the SSFL site is classified as Mediterranean Subtropical, corresponding to an average temperature of 50 degrees Fahrenheit in the winter and 70 degrees Fahrenheit in the summer. Rainfall averages approximately 18 inches per year.

[1] *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), Revision 1*, NUREG-1575, Rev. 1, EPA 402-R-97-016, Rev. 1, DOE/EH-0624, Rev. 1, August 2000, pp. 2-5.

A shallow groundwater system exists in the surface soils at small isolated locations. A regional groundwater system exists in the deeper fractured Chatsworth Formation. In some areas, groundwater from the Chatsworth Formation flows through fractures in the rock and emerges at the ground surface as seeps or springs. Groundwater underlying the SSFL site is not currently used, or anticipated to be used, as a source of drinking water for the nearby communities or at SSFL, but nearby residents may in the future consume groundwater emanating from this site

In addition to rocket and small engine testing facilities in other portions of the SSFL, North American Aviation, Inc., had facilities at Area IV for researching, developing, and constructing equipment to use nuclear energy through its Atomics International Division (AI).[1] According to a 1959 company brochure, AI maintained a nuclear field test area covering approximately 300 acres at the SSFL site.[2] Under contract to DOE and private customers, AI supported the development of civilian nuclear power, as well as the testing of non-nuclear components related to liquid metals within 90 acres of Area IV of the SSFL site. The facilities within these 90 acres would later be referred as the Energy Technology Engineering Center (ETEC).[3]

Nuclear facilities at ETEC included 10 nuclear research reactors over the period July 1956 through February 1980. These research reactors are listed in Table 1.2.

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

Reactor Acronym	Building No.	Facility Name	Power Level (kW)	Period of Operation	Power Generated (MWd)	Radioactivity at End of Operation (10^3 Ci)
KEWB	4073	Kinetics Experiment Water Boiler	1	7/1956 to 11/1966	1	6
L-85/AE-6	4093	L-85 Nuclear Experimentation Reactor	3	11/1956 to 2/1980	2	18
SRE	4143	Sodium Reactor Experiment (SRE)	20,000	4/1957 to 2/1964	6,700	120,000
SER	4010	Systems for Nuclear Auxiliary Power (SNAP) Experimental Reactor Facility	50	9/1959 to 12/1960	13	300

[1] North American Aviation, Inc., *The North American Story*, December 1960, p. 7
[2] Atomics International, A Division of North American Aviation, Inc., *Atomics International*, December 1959, p. 5.
[3] http://www.etec.energy.gov/History/Area-IV-History.html
[4] Oldenkamp, R.D. and Mills, J. C., *Nuclear Operations at Rockwell's Santa Susana Field Laboratory – A Factual Perspective*, Rockwell International; Report No. N001ER000017, September 6, 1991, p. 23.

Table 1.2 (continued)
Research Reactors Located at the Santa Susana Field Laboratory[1]

Reactor Acronym	Building No.	Facility Name	Power Level (kW)	Period of Operation	Power Generated (MWd)	Radioactivity at End of Operation (10^3 Ci)
S2DR	4024	SNAP Environmental Test Facility	65	4/1961 to 12/1962	13	390
STR	4028	Shield Test Irradiation Facility	50	12/1961 to 7/1964	1	300
S8ER	4010	S8ER Test Facility	600	5/1963 to 4/1965	215	3,600
STIR	4028	Shield Test Irradiation Facility	1,000	8/1964 to /1974	28	3,714
S10FS3	4024	SNAP Environmental Test Facility	37	1/1965 to 3/1966	16	6,000
S8DR	4059	SNAP Development Reactor Facility	619	5/1968 to 12/1969	182	220

Seven criticality test facilities (i.e., facilities housing operations involving masses of fissionable material capable of sustaining a nuclear chain reaction) were also located on Area IV.[2] These are listed in Table 1.3. Other nuclear facilities within Area IV included the Radioactive Materials Disposal Facility and the Hot Laboratory, as well as the Sodium Disposal Facility, or Area IV burn pit. Each of these facilities have been addressed as a site within the appropriate TM along with supporting buildings and open areas.

According to the DOE ETEC web site, most nuclear research related programs and operations ceased in 1988 and were replaced with decontamination and decommissioning operations.[3]

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

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

[1] Oldenkamp, R.D. and Mills, J. C., *Nuclear Operations at Rockwell's Santa Susana Field Laboratory – A Factual Perspective*, Rockwell International; Report No. N001ER000017, September 6, 1991, pp. 23, 25.
[2] Atomics International, A Division of North American Aviation, Inc., *Atomics International*, December 1959.
[3] http://www.etec.energy.gov/History/Area-IV-History.html
[3] Oldenkamp, R.D. and Mills, J. C., *Nuclear Operations at Rockwell's Santa Susana Field Laboratory – A Factual Perspective*, Rockwell International; Report No. N001ER000017, September 6, 1991, p. 25.

The NBZ is a 175-acre parcel of land that abuts the SSFL property (Figure 1.2). The NBZ is a naturally vegetated area containing drainage channels that transport surface water from the SSFL downslope to surrounding populated areas.[1] The NBZ was purchased by the Rocketdyne Division of Rockwell International (Rockwell) in 1998 from the adjoining Brandeis-Bardin Institute (now known as the American Jewish University) because an environmental contractor found that the NBZ contains radioactive and chemical contamination that had migrated from the SSFL.

With the exception of 452 acres owned by the U.S. Government in Areas I and II, which are outside of the Area IV Study Area, the entire SSFL site, including the NBZ, is owned and operated by the Boeing Company.

1.4 Brief Description and History of HSA-6

Subarea HSA-6 is approximately 57 acres of predominantly flat land and land that had been flattened prior to construction. Over the years, 22 buildings have been located within HSA-6 together with open-air fenced areas, concrete pads, storage yards, oil storage tanks, and parking lots. Subarea HSA-6 includes E Street, the eastern part of G Street, 3rd, 10th, and 11th Streets. The drainage direction varies with the location within the subarea. The majority of operations in Subarea HSA-6 related to activities conducted in the SRE. The SRE was termed an "experiment" because it was the first nuclear reactor designed and constructed to use a sodium solution as reactor coolant. The SRE served as both a nuclear power plant and a reactor systems experiment. There was one retention pond in this subarea that received effluent from the SRE.

1.5 Sites in HSA-6

During the peak of operations, Subarea HSA-6 comprised 38 sites, most of which were buildings. This TM addresses each of these 38 sites within Subarea HSA-6. Of the 38 sites, 22 contained buildings, one of which was a reactor (Building 4143), while others housed operations involving radioactive materials. Of the 22 buildings in Subarea HSA-6, none remains today.

1.6 Site Summary Methodology

In preparing this TM, the following types of documents were reviewed:

- radiological characterization reports;
- previous radiological surveys;
- decontamination and decommissioning (D&D) reports;
- environmental monitoring reports;
- license termination reports;
- aerial photographs dating back 50 years;
- building floor plans;
- piping diagrams and construction drawings;

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

- RFI reports;
- unusual occurrence reports;
- incident reports;
- plant operating reports and logs;
- safety analyses reports;
- facility surveillance and maintenance reports; and
- information obtained from interviews with former workers or other persons.

Numerous documents were obtained through information requests sent to Boeing, DOE, and other parties. EPA sent formal information requests to Boeing, DOE, the Nuclear Regulatory Commission (NRC) and the California Department of Public Health and Environment (CDPHE) under § 104(e) of the CERCLA. In addition, EPA directed Boeing to identify and provide pertinent documents within a number of document databases comprising approximately 1.4 million documents relating to all areas of the SSFL site, including Area IV, as well as some off-site facilities. The information acquisition process is complete.

EPA sent Boeing its original information request letter on June 24, 2009. Boeing provided an initial response to this request on August 20, 2009, and a supplemental response on December 10, 2009. On June 8, 2010, Boeing provided relevant site drawings and maps as identified by EPA during a review of flat files at Boeing's Safety, Health, and Environmental Affairs (SHEA) building on site. Subsequently, on June 17, 2010, EPA sent Boeing a supplemental information request letter specifically requesting all maps, diagrams, and as-built drawings for past and current buildings in Area IV. On July 15, 2010, Boeing responded and provided additional documents, including maps and drawings. On November 15, 2010, Boeing provided a third supplementary group of documents. On December 23, 2010, and January 11, 2011, Boeing provided numerous additional documents in response to both EPA original information requests and EPA queries of Boeing's document database for the SSFL.

In October 2010, EPA also sent the National Aeronautics and Space Adminsitration (NASA) a formal information request letter. On November 22 and December 2, 2010, EPA received information responsive to this request.

EPA sent DOE its original information request letter on June 24, 2009. DOE provided an initial response to this information request on August 31, 2009. Subsequently, DOE provided supplemental responses to this initial information request on a monthly basis. Additional information responsive to the EPA's information request was received in September, October, November, and December 2009, as well as January through December 2010 and January through July 2011. On June 17, 2010, EPA sent DOE a supplemental request for information, specifically requesting maps, diagrams, and as-built drawings for past and current buildings in Area IV. Starting in its July 2010 supplemental response to EPA, DOE provided information that was responsive to both of the EPA information requests letters.

Other requests for information pertaining to the site have included § 104(e) information request letter sent to the NRC and CDPHE. The purpose of the inquiries to both the NRC and the CDPHE was to identify and obtain any nuclear materials licenses pertaining to the site that may not have been captured via the information requests sent to other parties.

In preparing the HSA-6 TM, 760 individual documents and photographs were reviewed. The review process was conducted by first screening over 80,000 documents amassed for the project. In addition, the documents requested from the document databases comprising approximately 1.4 million documents were reviewed. This screening effort produced 760 documents relevant to past operations at facilities within HSA-6 and was therefore determined to warrant in-depth evaluation. Each of these 760 relevant documents was thoroughly evaluated for information considered useful for carrying out the goals listed in Section 1.2 of this TM. In addition to screening and evaluating reports and other documents, a comprehensive aerial photograph analysis of Area IV was prepared. This analysis is provided in Appendix A of the HSA.

1.6.1 Contents of EPA's Site-by-Site Analyses

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

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

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

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

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

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

At the discretion of the Interviewee, each interview was conducted either by representatives of the EPA only, representatives of the DOE only or jointly by EPA and DOE representatives.

EPA's primary objective of the interview program was to help direct the soil sampling crews to potential source areas of radiological contamination identified during the course of each interview. All information on potential source areas, corroborated or not, was recorded in EPA's HSA process.

At the time of writing this TM, the EPA had completed forty-nine (49) interviews. Under the DOE/EPA joint interview program, eighteen (18) interviews have been conducted. Approximately 107 former employees have requested to be interviewed by DOE only and those interviews are complete. An additional eighty five (85) people were referred to EPA and DOE by interviewees during the course of the interviews, and of these, only twenty (20) could be located, which resulted in four (4) additional interviews. DOE has provided all of their interview transcripts to EPA for use in EPA TMs.

The interview information obtained to date relevant to this TM is depicted on the relevant Plate 1 figure. Appendix B of the HSA provides a summary of the interview process and completed interview summaries of each interview.

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

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

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

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

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

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

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

- December 22, 1952;
- August 19, 1957;
- August 21, 1959;
- Approximately 1960 plus or minus a year;
- March 1, 1965;
- August 13, 1967;
- April 20, 1972;
- May 16, 1978;
- October 21, 1980;
- August 21, 1983;
- October 10, 1988;
- June 19, 1995; and
- June 8, 2005.

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

Radionuclides of Concern
Radionuclides used/generated at the site. This description includes, at a minimum, the types of radiological material(s) managed at the site; radionuclides known or suspected to have been handled or generated on the site; and how the identified radionuclides impact the list of radionuclides of concern in the background study. If no information was available, the text "none found" was inserted. It is important to note that not every radionuclide listed in this HSA will have a sample analysis. The radionuclides are listed for completeness, indicating that they have been mentioned or discussed in a cited document or report. However, many of the facility and site reports reflect the conditions at the time, thus every mention of a specific radionuclide does not mean it would be present now, due to decay. For this reason, the Radionuclides of Concern sections described for each facility or site list those found in historical records. The Radionuclides of Concern (Table 3.3) lists radionuclides that will be analyzed and does not include those that would have decayed in the years since operations ceased.

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

Radiological Contamination Potential
The potential for radiological contamination was evaluated for each site. Evaluations included consideration of the completeness of past cleanup and remedial operations. Many past clean-up efforts likely did not achieve the requirements of the DTSC/DOE AOC dated December 2010 that generally requires a cleanup to background levels for both radiological and chemical contaminants. Background studies for the site have been completed with EPA leading the

radiological background study and the DTSC leading the chemical background study. The potential for radiological contamination is quantified in this TM by assigning a preliminary MARSSIM class describing the possibility for residual radiological contamination at the site based on all information collected to date. The basis for assigning the preliminary MARSSIM classification includes an examination of the following data elements:

- historical site operations;
- previous radiological investigations;
- reported incidents of releases;
- decontamination and remediation operations at the site;
- interviews with former workers;
- drainage pathways on or near the site;
- aerial photograph interpretation; and
- site reconnaissance.

Recommended Locations for Soil/Sediment Sampling

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

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

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2.0 FINDINGS

This section organizes the building areas within HSA-6 according to five groups based on operational characteristics and geographic locations. Plate 1 depicts the entire HSA-6 subarea and should be referenced while reading Section 2. Each HSA-6 group (discussed in Sections 2.1 through 2.5, below) is depicted in an accompanying group map, which serves as a guide for the text describing the building areas in that group and also as an index for the group's site photograph and building layout drawings.

2.1 GROUP 1

The Group 1 index map is presented in Figure 2.1. Following Figure 2.1, the site photograph and layout drawings for each building area within HSA-6 Group 1 are presented. HSA-6 Group 1 includes 22 sites containing the Building 4143 Sodium Reactor Experiment reactor and associated buildings.

2.1.1 Building 4003 Area

Site Description: The Building 4003 area comprises Building 4003, substation Building 4693, support Building 4825, and the land surrounding these three buildings located near the end of E Street. Building 4003 was constructed in 1957.[1, 2] Figures 2.1.1a through 2.1.1i provide a current photograph, historical photographs, and building-specific drawings.

Building Features: Building 4003 was a rectangular steel building with a high bay on the southern end and a low bay on the northern end. It was approximately 10,775 square feet in area. This includes a 2,400-square-foot addition that was added in 1958. The floor plan for Building 4003 is presented in Figure 2.1.1b. A 1974 aerial photograph of Building 4003 is presented in Figure 2.1.1c. Building 4003 contained offices, a change room, several laboratories, a Freon compressor, a concrete pit, a tank pit, a sump, an expansion tank, a boiler, and a cooling tower.[3, 4] Building 4003 also contained an exhaust system that included nine fume hoods, valves, ducts, blowers, filters, filter plenum chambers, and a stack. In addition, Building 4003 contained two radioactive waste sinks connected to 5-gallon bottles, and a highly shielded area designed for remote manipulation of radioactive materials. This area was known as the "Hot Cave" and contained identical east and west "hot cells," a pair of mechanical manipulators for each of the two cells, a transfer tunnel, liquid waste lines, east and west cell "small" radioactive liquid waste holdup tanks located below the Hot Cave, and a hot cell exhaust system with HEPA filters and two blowers located on the roof of Building. Each cell contained a stainless-steel pan about 3-feet by 3-feet by 8-inches deep. These pans served as a junction and distribution system for the exhaust air, electrical power, instrumentation, and radioactive waste. Reinforced concrete 18-inches thick was poured around the pans and the connecting ducts and conduits when constructed. Two 12-ton shield doors, located at the entrance to the Hot Cave structure, rolled

[1]ETEC website at: www.etec.energy.gov/History/Major-Operations/SRE.html
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[3] Montgomery Watson Harza, Table 1, *List of Historical Document Map Features at SRE*, August 1, 2003.
[4] Rockwell internal letter from C. D. Bingham to W. F. Heine, Re: *Application to Perform Radiochemical Operations in Building 003A (ETB Annex)*, December 10, 1970.

open and closed on a supporting steel structure.[1, 2] The documents reviewed do not state how the radioactive liquid waste was removed from holdup tanks and bottles or where it was sent. Each hot cell was 5.5 feet long, 6 feet high, and 4 feet deep. Each cell was connected to the transfer tunnel through a port (opening) that was 1 foot wide and 1.5 feet high. The port to each cell was opened and closed by a remotely operated lead door 4-inches thick.[3] A cut-away view of the Hot Cave is presented in Figure 2.1.1d. The hot cell (Hot Cave) floor plan is presented in Figure 2.1.1e.[4]

Building 4003, in conjunction with Buildings 4143 and 4163, also had a 2,700-gallon septic tank connected to a 600-linear-foot leach field. The leach field was down the hill on the flat area approximately 150 feet north of Building 4003.[5] The site plot plan is presented in Figure 2.1.1f.[6] The sewage system is presented in Figure 2.1.1g, and the contaminated waste lines are presented in Figure 2.1.1h.[7, 8]

Former Use(s): Building 4003 was known as the Engineering Test Building (ETB). It was used to assemble fuel elements for the SRE from 1957 through 1964. In this operation, uranium and thorium metal slugs were loaded into metal tubes, the remaining tube space was filled with sodium and the tubes were sealed. Fuel elements for three SRE cores were prepared in Building 4003, but only two cores were used. The third core was shipped off-site.[9] The Hot Cave was designed and constructed to investigate the chemistry of molten uranium, and to study the separation of fission products and plutonium from uranium systems. The west hot cell was used primarily for kilogram-scale processing experiments involving chemical reactions of irradiated reactor fuels at temperatures up to 1,800 degrees Celsius (ºC). The east hot cell was used primarily for mechanical operations, such as decladding, component disassembly, and inspection. The transfer tunnel was used for sample handling, waste removal, inter-cave transfer, and the storage of kilocurie sources.[10] Figure 2.1.1h shows that on the first and second floors of the high bay, there was a radioactive waste sink with a fume hood connected to a 5-gallon bottle. There was also a holding tank located on the southeast side of Building 4003, at the end of the contaminated waste lines. Decontamination reports mention that two "small" liquid waste holdup tanks were located below the Hot Cave. According to the Department of Energy, later

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[1] Majors, W. K., *Procedures for Decontamination of Building T003,* Atomics International Report No. DWP-704-990-001, January 20, 1975, pp. 6-16.
[2] Ureda, B. F., *Building 003 Decontamination and Disposition Final Report*, AI-ERDA-13158, February 25, 1976, pp. 7-21.
[3] Strausberg, S., Gardner, W. J., Guon, J., Luebben, T. E., and Mills, T. H., *Modified Hot Cave Facility for Reprocessing Experiments*, Atomics International Report No. NAA-SR-2687, June 30, 1958, p.14.
[4] Atomics International As-Built Drawing, *Separations Chemistry – ETB Hot Cell Installation Floor Plan*, Drawing No. 303-003-57, July 27, 1959.
[5] ICF Kaiser Engineers, *Current Conditions Report and Draft RCRA Facility Investigation Work Plan, Area IV Santa Susana Field Laboratory, Ventura County, California, Part 1 – Current Conditions Report Volume 1*, October 1993, pp. 4-82, 4-87.
[6] Atomics International As-Built Drawing, *Santa Susana Facility Plot Plan*, Drawing No. 303-GEN.-C-37, June 5, 1967.
[7] Atomics International As-Built Drawing, *Central Sewage System Plan & Topography*, Drawing No. 303-GEN.-C-17, February 26, 1960.
[8] Atomics International As-Built Drawing, *ETB High Bay Modifications – Contaminated Waste 1st & 2nd Floor*, Drawing No. 303-003-P21, October 19, 1964.
[9] Rocketdyne Environmental Affairs, *Engineering Test Building - Building 4003*, February 10, 2000.
[10] Strausberg, S., Gardner, W. J., Guon, J., Luebben, T. E., and Mills, T. H., *Modified Hot Cave Facility for Reprocessing Experiments*, Atomics International Report No. NAA-SR-2687, June 30, 1958, p.3.

activities involved bench-scale research into reprocessing of used (or irradiated) fuel assemblies. The research involved the removal of fission products from used fuel.[1]

Building 4003 was also used for the analysis of Systems for Nuclear Auxiliary Power (SNAP) fuel burn-up samples and the evaluation of irradiation experiments. Use of the Hot Cave facility ended when the SNAP program was terminated in 1973. At this time, AI found the inner surfaces of the Hot Cave to be "grossly" contaminated with mixed fission products. Containment of this high-level contamination required continuous operation of the radioactive exhaust system as well as filtering and sampling activities. Radioactive contamination was found to be on the internal surfaces of the hot cells, in the liquid waste lines, the liquid waste holdup tanks, the radioactive exhaust system ducting and on filter plenums. In 1974, the Building 4003 facilities were declared "excess" and a facilities dismantling plan was prepared.[2]

AI informed the U. S. Atomic Energy Commission (AEC) that the alpha-emitting radionuclides present were from enriched uranium; some transuranics may also have been present. The beta-gamma emitting radionuclides resulted from fission products and stainless steel activation products.[3] AI commenced decontamination and decommissioning in January 1975 and ended in June 1975. Dismantling of the Hot Cave was completed in April 1975. Because the exhaust system was needed during decontamination activities, it was the last system to be removed.[4] Between 1975 and 1992, Building 4003 was used as an excess equipment storage building.

Information from Interviewees: In 2010, a number of former workers were interviewed about their experiences at the SSFL. Four remembered Building 4003. Excerpts from their comments are presented below.

- "The remaining SRE staff offices were in 4003. That building also provided space for nonradioactive test work."[5] This former employee worked at the SSFL between 1958 and 1968.

- "The Building 3A hot cave was a shielded facility, holding up to 1,000 curies of radiological material."[6] This former employee worked at the SSFL from 1957.

- "Building 3A was decontaminated by people who worked in Building 20."[7] This former employee worked at the SSFL from 1957.

- "There was a building next to the SRE where the fuel rods were chopped up and cleaned, as they were transported there from the SRE. New cladding was put on the fuel rods there."[1] This former employee worked at the SSFL between 1959 and 1960.

[1] ETEC website at: www.etec.energy.gov/History/Major-Operations/SRE.html.
[2] Graves, A. W., *Facilities Dismantling Plan for Building (D+D) T003 Hot Cave*, Atomics International Report No. FDP-704-990-001, October 10, 1974, p. 2.
[3] Atomics International letter from W. F. Heine to R. L. Westby, U.S. Atomic Energy Commission, re: *Contamination Limits for Release of KEWB and Building 003 for Unrestricted Use*, November 21, 1974.
[4] Ureda, B. F., *Building 003Decontamination and Disposition Final Report*, AI-ERDA-13158, February 25, 1976, p. 11.
[5] Interview No. 300 of former worker conducted by the DOE and EPA on July 16, 2010, p. 2.
[6] Interview No. 117 of former worker conducted by the DOE, September 2010.
[7] Interview No. 270 of former worker conducted by the DOE, September 2010.

Radiological Incident Reports: There have been several incidents associated with Building 4003 that could have resulted in a release to the environment. The following table provides information presented in an incidents database provided by Boeing. Summaries of the incident reports are provided following the table, when available.

Building 4003 Incident Report Summary

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A0530	10/7/1959	ETB MAYBE		EMPLOYEE CONTAMINATED HIS HANDS WHEN HE FAILED TO WEAR PRESCRIBED PROTECTIVE CLOTHING.
A0423	12/22/1959	ETB	MFP	CONTRACTOR REMOVED R/A EXHAUST STACK WITHOUT HEALTH PHYSICS COGNIZANCE.
A0549	7/22/1960	ETB RM 160		EMPLOYEE CUT HAND IN CONTROLLED AREA.
A0295	2/1/1965	ETB & D004		VARIED WORK LOCATION & LATE RETURN OF FILM BADGE RESULTED IN EXCEEDING GUIDELINES.
A0438	9/15/1969	ETB HOT CELL	MFP	MULTIPLE PROJECTS RESULTED IN EMPLOYEE EXPOSURE ABOVE GUIDELINES.
A0048	9/2/1969	ETB CHEM LABS		ETB LAB EQUIPMENT AND FLOOR FOUND CONTAMINATED.

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

- On October 7, 1959, an employee performed maintenance on a radioactive contaminated sodium line with his bare hands. The employee was aware the line was contaminated. Both of his hands became contaminated to a level of 1.5 mrad/h. After 35 minutes of cleaning, the employee's hands were successfully decontaminated (Incident Report A0530).[2]

- On December 22, 1959, contract personnel were working on the exhaust stack of the radioactive vent systems at the ETB without the knowledge of the health physics department, without the proper permit, and without film badges. The contract crew was unaware the exhaust system was radioactive. No personnel contamination was discovered. Work was immediately stopped until the proper permit was filled out and film badges assigned (Incident Report A0423).[3]
- On July 22, 1960, an employee cut his hand during a drilling operation. No activity was found above background on his hand (Incident Report A0549).[4]

[1] Interview No. 207 of former employee conducted by the EPA only, September 2010.
[2] Bell, C. E., Internal Letter, re*: Violation of Health Phys. Practices*, October 8, 1959.
[3] Lang, J. C., Atomics International Internal Letter, re*: Notice of Rule Infraction*, December 31, 1959.
[4] Illegible Author, Atomics International Internal Letter, re*: Radiological Safety Incident Report, Room 160 ETB Annex, July 22, 1960*, July 27, 1960.

- In October 1965, a missing film badge belonging to a chemist was found. The badge had been missing since January 1965 and when processed indicated an exposure of 2,000 mrem gamma and 640 mrem beta. When added to the chemist's February and March exposures, the quarterly total exposure was 2,600 mrem gamma and 1,870 mrem beta. Review of the chemist's duties in January suggested that he did in fact receive the exposure indicated on the film badge, despite the possibility of other factors affecting the reading. The chemist's lifetime accumulated exposure through September 1965 was 28.4 rem, below the permissible exposure of 65 rem at that time (Incident Report A0295).[1]

- On September 15, 1969, film badges worn by an employee over the course of a calendar quarter were evaluated and the combined exposure from the badges was 6,065 mrem. This overexposure was found to be the result of multiple different operations at the ETB (Incident Report A0438).[2]

- On September 2, 1969, a smear survey was requested for the upstairs laboratory at the ETB because contamination had been found on the floor. The contamination was first noted on an employee's shoe (200 cpm). The employee smeared the stairs and found up areas of contamination up to 1,000 dpm/100 cm^2. This prompted him to smear the floor where he was setting up equipment. Repetitive smears of the floor brought forth "hotter" and "hotter" results. The employee eventually roped off the area and requested further surveying of the lab. Additional smear surveys found gross contamination on the bench top and covered sink. A couple of spots read up to 1.5 rad/h. This material was easily removable. Parts of two ring stands on the work bench indicated 0.5 rad/h and were bagged up. Another "hot" area of the lab was located on an adjacent bench top where a survey detected 30,000 cpm. Smear surveys taken on September 4 and 5, 1969 found contamination greater than 150,000 dpm/100 cm^2 (the counter detectibility limit) on the outside of a furnace, a balance, and a hot plate in the hood. The hot plate was measured to be 330 mrad/h. Also found in the hood, behind two lead bricks, was a bottle of liquid waste from earlier equipment, which read 5 rad/h. According to the incident report, the "episode was somewhat mysterious." It appears that there may have been two sources of contamination because gamma activity was missing from one set of smears. It was unknown whether a chemical or physical process had removed gamma emitters, such as cesium, from this area. As of September 8, 1969, the lab had been fairly well decontaminated and most items outside the hood were less than 100 dpm/100 cm^2 beta-gamma (Incident Report A0048).[3]

Current Use: Building 4003 was demolished in 1999. The extent of the Building 4003 excavation is shown in Figure 2.1.1i.

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

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[1] Correspondence from Remley, M. E., Atomics International, to Levy, J., U.S. Atomic Energy Commission, *Re: Apparent Type B Radiation Exposure*, November 5, 1965.
[2] Bresson, J. F., North American Aviation Internal Letter, re*: Film Badge Exposure – Contamination at the ETC, SS003, Bresson to Heine, 9/13/69*, October 15, 1969.
[3] Bresson, J. F., North American Rockwell Corporation Internal Letter, re*: Contamination at the ETC, S003*, September 15, 1969.

- Between January and June 1975, AI dismantled and removed the Hot Cave contents and structure. To provide access to the Hot Cave, the high bay in Building 4003 was cleared of unnecessary equipment, including the remains of a sodium experiment. The east cell of the Hot Cave was entered and decontaminated first. Restricted Access Entry Permit No. 17602 was issued by the Health, Safety, and Radiation Services Department. The manipulator, other equipment, materials, and structures were wrapped in plastic sheeting to contain removable contamination and placed in a U.S. Department of Transportation (DOT) shipping container for shipment to Beatty, Nevada for burial. AI decontaminated the east cell using a "foamer" to loosen the contamination, and a vacuum cleaner to remove the contamination. Following foaming, the cell was cleaned by wiping with "Big K,"[1] a caustic solvent. The vacuum cleaner was later decontaminated at the Radioactive Material Disposal Facility (RMDF), Building 4075. All other residue and wiping cloths were placed in a plastic bag and shipping container, and shipped to the RMDF.[2]

  As part of dismantling operations, AI opened the west cell and conducted a radioactivity survey; the cell was found to contain significantly higher levels of radioactivity than the east cell. The west cell contained test analysis equipment and experimental residue. Miscellaneous waste was removed including three trays (7 rad/hour [rad/h]) and two 1-gallon paint cans (approximately 25 rad/h). AI bagged this waste and placed it in a conduit with 6-inch concrete shielding, and sent it to the RMDF for disposal. The cell interior was wiped using the cell manipulators and vacuum cleaned. Five prefilters (250 mrad/h) from the lower section of the cell and a 30-gallon bag of solid waste (2 rad/h) were then removed, and the cell was vacuum cleaned again to remove most loose contamination. The roof shield blocks associated and the manipulators were removed while the openings in the roof were covered with plastic sheeting to contain loose contamination. The remaining items in the cell were then removed. These included a Lucite enclosure, a shelf, a table, and 90 gallons of solid radioactive waste. Dry uranyl salt solution (25 rad/h at 10 centimeters) was removed from the floor. A container of SNAP burnup samples was located in the transfer tunnel between the two cells. Using tongs, this container was transferred to a 5-gallon can and then into a lead cask. The cask was transferred to the RMDF.[3]

  AI removed contaminated materials (cask dolly, rails, push-pull rods) from the tunnel and packaged them for shipment to Nuclear Engineering Company for burial in Beatty, Nevada. AI also removed the shield blocks surrounding the tunnel together with the cell roof, wall shield, and floor blocks. These were disposed of as radioactive waste. AI's demolition contractor removed the square stainless-steel pans from the floor of each cell using explosives. He drilled several holes beneath the pans and set off charges. The force of the explosive charges was contained by sand bags over the pans and concrete. The two 12-ton shield doors and supporting steel structure were sold to a salvage

[1] Big K is a "safety solvent" manufactured by NCH Corporation, Irving, Texas. According to its material safety data sheet, its main ingredients are silicic acid and sodium metasilicate.
[2] Ureda, B. F., *Building 003Decontamination and Disposition Final Report*, AI-ERDA-13158, February 25, 1976, pp. 12-13.
[3] Ureda, B. F., *Building 003Decontamination and Disposition Final Report*, AI-ERDA-13158, February 25, 1976, pp. 13-15.

contractor who dismantled and removed them free of charge. Prior to removal, the doors were decontaminated by wiping them with "Big K"[1] solvent.[2]

AI removed the Hot Cave radioactive exhaust filters, exhaust ducts, liquid waste lines, and two liquid waste holdup tanks, wrapped them in plastic, and shipped them to Beatty, Nevada for burial. Nine fume hoods were removed from the Building 4003 laboratories. Two were contaminated and were sent to the RMDF for decontamination and later sent to salvage for unrestricted use. The exhaust ducting associated with the fume hoods was also removed. About 30 feet from the high bay were found to be contaminated and were sent to the RMDF for packaging and subsequent off-site burial. One radioactive waste sink in the high bay and one in the upstairs laboratory were removed and packaged for shipment to Beatty, Nevada, for burial. The drain lines were removed by breaking through the concrete floor for a distance of about 60 feet and excavating. In the removal process, the soil became contaminated when pieces of pipe came into contact with the soil. In the areas where radioactivity was found, the soil was removed, packaged in 55-gallon drums, and shipped to Beatty, Nevada, for burial. The holdup tank at the end of the drain line (located on the southeast side of Building 4003) was removed and the trenches were then backfilled and paved with concrete and sent to Beatty, Nevada, for burial.[3]

After the Hot Cave contents and structure were dismantled and removed, AI excavated the floor beneath the Hot Cave to a depth of 35 feet for a mockup construction of the SRE. AI planned to simulate water shielding anticipated for SRE dismantling by using a 15-foot diameter by 31-foot-deep tank to represent the core cavity liner depth and diameter.[4] Soil samples from the excavation contained alpha and beta activity concentrations of 0.75 picocurie per gram (pCi/g) and 24.8 pCi/g, respectively. Rockwell considered alpha and beta background concentrations to be 0.60 pCi/g and 25.0 pCi/g, respectively. During the excavation, groundwater seeped into the hole. Analysis of a water sample indicated alpha and beta activity concentrations of 7.9×10^{-10} microcurie per cubic centimeter ($\mu Ci/cm^3$) and 1.2×10^{-8} $\mu Ci/cm^3$, respectively. Rockwell considered these values to be lower than the 1975 site background activity concentrations in groundwater. Removal of the drain lines from the radioactive sinks involved excavating about 60 feet of concrete floor and soil cover. Rockwell collected 15 soil samples from the excavated trench. Rockwell reported that radioactivity concentrations ranged from 0.38 to 56.3 pCi/g for alpha activity, and 20.3 to 408.2 pCi/g for beta activity. Additional soil was excavated from the trench in the regions where four soil samples exhibited concentrations significantly above average background levels according to Rockwell. A total of 4,235 cubic feet of radioactive waste was shipped to the Nuclear Engineering Company for burial in Beatty, Nevada.[5] After completion of the

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[1] Big K is a "safety solvent" manufactured by NCH Corporation, Irving, Texas. According to its material safety data sheet, its main ingredients are silicic acid and sodium metasilicate.
[2] Ureda, B. F., *Building 003Decontamination and Disposition Final Report*, AI-ERDA-13158, February 25, 1976, pp. 15-19.
[3] Ureda, B. F., *Building 003Decontamination and Disposition Final Report*, AI-ERDA-13158, February 25, 1976, pp. 19-21.
[4] Brengle, R. G. and Phillips, D. A., *SRE Mockup Operations Test Plan*, Atomics International Report No. N704-TP-990-005, October 9, 1975, p. 6.
[5] Ureda, B. F., *Building 003Decontamination and Disposition Final Report*, AI-ERDA-13158, February 25, 1976, pp. 27-28.

removal and excavation, the U.S. Energy Research and Development Administration recommended that Building 4003 be released for unrestricted use in March 1976.[1]

- During September and October 1981, the DOE directed Argonne National Laboratory (ANL) to survey Building 4003 using new instruments that were sensitive to lower count rates. ANL found several areas contaminated above then-acceptable limits. Rockwell decontaminated the majority of the hot spots as they were located. When the duct system leading to the blowers on the roof was determined to be contaminated, cleaning was halted to develop a work plan and cost estimate. On February 11, 1982, work commenced on removing the exhaust system in Room 180. The blowers and access structure on the roof showed beta activity readings of between 250 and 1,000 counts per minute (cpm) above local background. Rockwell regarded local background measured using Eberline PAC-4G-3 survey instruments to be between 75 and 125 cpm. The blowers and access structure were removed and packaged as low-level waste. The metal roof under the blower exhaust showed beta activity readings of between 250 and 1,250 cpm above background. The metal roof area was cleaned and resurveyed to verify removal. The ducting in Room 101 was removed to the absolute filter plenum and packaged as low-level waste. The high bay and low bay in Room 180 were cleaned and resurveyed to verify removal. A total of 248 cubic feet of contaminated material and equipment were packaged into containers and sent to the SRE to await shipment for burial. The Eberline survey instruments were adjusted to have an efficiency factor of 2, and the area of the probe was 50 square centimeters. Net cpm were multiplied by 4 to get disintegrations per minute (dpm) per 100 square centimeters (cm^2). Removable contamination levels were reduced to below 50 dpm per 100 cm^2 for beta-gamma contamination.[2, 3]

- In April 1982, ANL conducted a final post-remedial action survey. Those areas of Building 4003 that had been found contaminated in 1981 were found to be free of detectable radioactive contamination. A sludge sample collected from the sewer sump showed elevated levels of enriched uranium (314 µg). Mass spectrometric analysis of this uranium indicated that the material was slightly enriched in U-235. Subsequently, Rockwell removed all sewer lines within Building 4003 in September 1982. This involved the removal of the cold sink line in Room 180 through Rooms 160 and 165 to the sewage sump tank. The restrooms were located at the northwest corner of Building 4003. Rooms 160, 165 and 180 were located on the west side of the high bay. See Figures 2.1.1b and 2.1.1h. The sewer line was packaged as radioactive waste for shipment to offsite land burial.[4] In May 1983, ANL recommended that Building 4003 be released for unrestricted use. However, the sewer lines exterior to Building 4003, which remained in place, were considered to be potentially contaminated and subject to

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1 Letter from S. R. Stamp, U.S. Energy Research and Development Administration, to W.F. Heine, Atomics International, March 3, 1976.
2 Rockwell International Internal Letter from J. F. Lang to B. F. Ureda, *Decontamination of Building 003*, March 9, 1982.
3 Rockwell International Internal Letter from F. E. Begley to Mailing List, *Radiation Survey of Building T003 – Santa Susana*, March 15, 1982.
4 Wallace, J. H., *Radiological Survey Results – Release to Unrestricted Use, Building 003*, Rockwell International Report No. N704TI990063, November 9, 1982, pp. 3-7.

restricted use. See Figure 2.1.1g. ANL recommended that effluent from the outfall of this sewer system be periodically monitored for radionuclides.[1, 2]

Use of the sewage treatment plant began in the 1950s to collect sanitary waste from Areas II, III, and IV. In addition to sanitary waste, the plant also received cooling tower discharges from non-chromated cooling tower systems and treated groundwater from various site groundwater recovery systems. The treatment plant had a capacity of 35,000 gallons per day and consisted of a source aeration unit, clarifier, anthracite coal filter, and chlorine contact chamber. The treated plant discharge was allowed to flow into the R-2A Discharge Pond. Use of the treatment plant was discontinued in 2001 and domestic waste was treated off site.

- In June 1982, Rockwell reported that the cleanup of Building 4003 was complete because ANL had indicated that its "overcheck" found no contamination above its acceptable limits. Consequently, Rockwell's Energy Systems Group renewed a previous offer to take title to the DOE portion of Building 4003.[3]

- In July 1982, Rockwell reported that enriched uranium was identified in the sewer sump outside of Building 4003 in the range of 23 to 32 µg/g. Rockwell concluded that ANL would object to the unrestricted use of Building 4003, but cleanup was impractical and almost impossible.[4]

- In November 1983, the DOE reported that the levels of contamination in the sanitary and/or storm sewer systems exterior to Building 4003 were below the proposed Formerly Utilized Sites Remedial Action Program (FUSRAP)/Remote Surplus Site Criteria and the criteria tacitly agreed to between the State of California and the DOE.[5] Furthermore, the DOE stated that the sewer was completely buried and, as used at that time, posed no radiological hazard to personnel or the environment. Therefore, the proposed American National Standards Institute (ANSI) 13.12 standard or the NRC Regulatory Guide 1.86 notwithstanding, the DOE believed that there was no need to place a restriction on the sewer lines as noted in the ANL interim report on this facility, based on the cleanup criteria noted above. However, the DOE recommended to periodically check the sewer lines where appropriate for radiological contamination further downstream.[5]

[1] Wynveen, R. A., Smith, W. H., Sholeen, C. M., Justus, A. L., and Flynn, K. F., *Interim Radiological Survey Report for Building 003, Santa Susana Field Laboratory, Rockwell International*, Argonne National Laboratory Report, May 1983, pp. 1-6.
[2] Wynveen, R. A., Smith, W. H., Sholeen, C. M., Justus, A. L., and Flynn, K. F., *Post Remedial Action Survey Report for Building 003, Santa Susana Field Laboratories, Rockwell International, Ventura County, California*, Argonne National Laboratory Report, DOE/EV-0005/44, ANL-OHS/HP-83-109, October 1983, pp. 1-6.
[3] Rockwell International Letter from R. W. Hartzler to L. Lanni, DOE, re: *Santa Susana Laboratory, Building 003*, June 4 1982.
[4] Rockwell International Telephone Conversation Record from W. Smith to B. F. Ureda, Re: *Building 003 Contamination*, July 2, 1982.
[5] U.S. Department of Energy Memorandum from A. J. Whitman to E. Keheley, Re: *Remedial Action Certification on the Sodium Reactor Experiment (SRE) and the Hot Cave (Bldg. 003, Santa Susana Field Laboratory*, November 15, 1983.

- Based on a review of the 1983 remedial action project report, the DOE, San Francisco Operations Office, released Building 4003 for unrestricted use on July 23, 1985, and removed it from the DOE's radiologically contaminated Surplus Facilities Program.[1]

- In 1996, Rockwell located the septic tank previously connected to Buildings 4003, 4143 and 4163 by a vent pipe, which extended above ground level. Using a backhoe, Rockwell dug a transverse trench about 15 feet from the tube in the direction of the expected location of the leach field. See Figure 2.1.1g. An unperforated clay pipe was uncovered. Rockwell considered this to be the supply pipe to the leach field. A second transverse trench dug about 15 feet further downstream, uncovered perforated clay pipe resting on a gravel bed at a depth of about 4 feet. This was a continuation of the pipe in the first trench and apparently extended from the center of the septic tank. No evidence of branch lines was found. Rockwell collected a soil sample from the gravel and wet soil mixture under the clay pipe in the second trench. Rockwell dug a third transverse trench about 6 feet further downstream and again found the perforated pipe and gravel. Rockwell collected a second leach field sample from this location. Rockwell also collected two soil samples from the area surrounding Building 4003. Analytical results from one of these samples showed an elevated soil activity level for cesium-137 (Cs-137) of 0.44 pCi/g.[2] The septic tank, leach field, and contaminated soil were not removed at this time.

  As stated above, use of the sewage treatment plant began in the 1950s to collect sanitary waste from Areas II, III, and IV. In addition to sanitary waste, the plant also received cooling tower discharges from non-chromated cooling tower systems and treated groundwater from various site groundwater recovery systems. The treatment plant had a capacity of 35,000 gallons per day and consisted of a source aeration unit, clarifier, anthracite coal filter, and chlorine contact chamber. The treated plant discharge was allowed to flow into the R-2A Discharge Pond. Use of the treatment plant was discontinued in 2001 and domestic waste was treated off site.

- In July 2000, Boeing excavated, removed, and surveyed for radiological contamination the drainage lines, septic tank and leach field. Instrument measurements and wipe samples were collected from the septic tank and associated piping. Boeing found no man-made gamma emitting radionuclides from gamma spectroscopy of concrete debris from the septic tank. The septic tank was full of a mixture of debris and soil. Boeing collected seven samples from the debris within the septic tank, its inlet pipes, and its outlet pipes. Using gamma spectroscopy, Boeing detected Cs-137 in the inlet pipes and inlet chamber in concentrations up to 2.5 pCi/g. These materials were packaged as radioactive waste per Boeing's policy. Boeing also collected four soil samples from beneath the septic tank, but no man-made radionuclides were identified in these samples. Boeing collected seven soil/gravel samples along the length of the leach field lines. The highest concentration detected was Cs-137 at 0.65 pCi/g, which Boeing considered to be

[1] Voigt, W. R., Jr., *Certification for Unrestricted Use of the Sodium Reactor Experiment (SRE) Complex and the Hot Cave Facility (Building 003)*, U.S. Department of Energy, July 23, 1985.
[2] Rutherford, P., *Area IV Radiological Characterization Survey Final Report*, Energy Technology Engineering Center Report No. A4CM-ZR-0011, August 15, 1996, pp. 35, 39-40, 61-62, 65.

consistent with its local background level in 2001. Other than the soil samples, no soil was removed from the area.[1]

- In October, November, and December 2000, Pacific Materials Laboratory, Inc. provided compaction tests during the backfill of two 20-foot deep cavity structures that remained at the conclusion of the demolition and removal of Buildings 4003 and 4143. Rough grading activities were conducted by engineering contractors Standard Industries of Ventura. Prior to fill placement using heavy grading equipment, minor isolated depressions and irregularities within the bedrock surface were backfilled with ¾-inch gravel to less than 1 foot in thickness to create a nearly flat surface in the bottom of each excavation. Fill soils placed in the excavation consisted of imported soils exported from an off-site borrow site as well as on-site native soils local to the building sites. The limits of the excavation for Building 4003 are shown in Figure 2.1.1i.[2]

- In March 2001, CDM Engineers & Constructors, Inc. (CDM) excavated and removed an inactive 1,500-gallon steel underground diesel tank located at the northwest corner of the footprint of former Building 4003. The tank was found to be in good condition without holes, but filled with saturated clay material, which was vacuumed into a truck. No odor was detected in the excavation and no groundwater was encountered. Three soil samples were collected and analyzed for total petroleum hydrocarbons (TPH) and volatile organic compounds (VOCs), but none were detected. No radioactive monitoring or sampling for radioactive contaminants was conducted.[3]

Radiological Use Authorizations: At various times, the following radiological use authorizations were assigned to Building 4003.

- Use Authorization No. 2 for water corrosion tests of SNAP fuels (authorization missing).

- Use Authorization No. 31 for radiochemical use (authorization missing).

- Use Authorization No. 85, issued January 16, 1975, for the Decontamination and Disposition of Facilities Program, applied to the Hot Cave. Authorized materials were uranium and transuranic elements of various isotopic compositions, activation products, and mixed and separated fission products distributed through the Hot Cave in unknown quantities.[4]

Former Radiological Burial or Disposal Locations: Until 1961, Building 4003 was connected to a leach field system, which was located downhill on a flat area approximately 150 feet north of Building 4003. Building 4003 was connected to a site-wide sewage treatment system after that time. In 1982, the sewer lines were found to be radioactively contaminated.[1]

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[1] Letter from B. D. Sujata, The Boeing Company, to J. Evans, County of Ventura, re: *Information Regarding Permit – Septic Tank and Leach Field*, October 23, 2001.
[2] Pacific Materials Laboratory, Inc., *Final Compaction Test Report – Structural Backfill of Former Buildings 4143 and 4003 Test Cells, Area IV Rocketdyne, Santa Susana Field Laboratory, Ventura County, CA*, January 2, 2001.
[3] Sierra Geoscience, Inc., *Report on UST Closure, Tank UT-74, The Boeing Company Building 4003, Rocketdyne Propulsion and Power, Santa Susana Field Laboratory, Ventura County, California*, April 6, 2001, pp. 1-5.
[4] Atomics International Use Authorization No. 85, issued January 16, 1975, in effect until January 16, 1976.

Aerial Photographs: Aerial photographs show undeveloped land until a 1957 photograph in which a large rectangular building is observed that is identified as Building 4003. In the 1959 photograph, Building 4003 appears about 40 percent larger in area. The building does not change in size in photographs from approximately 1960, 1965, 1967, 1972, 1978, 1980, 1983, 1988, and 1995. A possible pipeline is identified extending southwest from Building 4003. In the 2005 photograph, a ground scar appears where Building 4003 was located. In the 2009 photograph, a parking lot appears where Building 4003 was formerly located.[1]

Radionuclides of Concern: This facility was used to examine spent fuel, research reprocessing of such, and to study molten uranium fuel. Radioactive materials managed at Building 4003 included uranium, thorium, transuranic elements, mixed fission products, and activation products. Possible radionuclides include natural and enriched uranium (U-238, U-234, U-235, U-236), isotopes of plutonium (Pu-239, Pu-240, Pu-241, Pu-242), americium-241 (Am-241), thorium-228 (Th-228), Th-232, Th-234, activation products (tritium (H-3), carbon -14 (C-14), sodium-22 (Na-22), Na-24, chromium-51 (Cr-51), manganese-54 (Mn-54), nickel-59 (Ni-59), Ni-63, iron-59 (Fe-59), cobalt-60 (Co-60)) and fission products (krypton-85 (Kr-85), strontium-89 (Sr-89), Sr-90, antimony-125 (Sb-125), iodine-129 (I-129), I-131, cesium-134 (Cs-134), Cs-137, cerium-144 (Ce-144), barium (lanthanum)-140 (Ba (La)-140), niobium-95 (Nb-95), ruthenium-103 (Ru-103), Ru-106, xenon-133 (Xn-133), Xe-135, promethium-147 (Pm-147), samarium-151 (Sm-151), europium-152 (Eu-152), radium-226 (Ra-226), actinium-228 (Ac-228).[2, 3, 4] All radionuclides of concern listed with the exception of Na-24, Cr-51, Mn-54, Fe-59, Kr-85, Sr-89, I-131, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xe-133, Xe-135, Pm-147 and Sm-151 are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives except for Sm-151 for which no analytical method is available. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Based on general site topography, surface water from Building 4003 flows northeast into the SRE retention pond. From 1957 to 1959, outflow from the retention pond was onto the NBZ and Brandeis-Bardin Institute land. In 1959, a 6-foot diameter overflow pipe and a pumped sump were installed at the confluence of the two main drainage channels upstream of the pond. Water was then pumped through a 4-inch diameter overland pipe to a channel connecting to the Area II ponds. The overflow from these ponds is into Bell Canyon and thence to the Los Angeles River.[5]

Radiological Contamination Potential: The preliminary MARSSIM classification for the Building 4003 area is Class 1, due to its former use as an SRE support building, and its proximity to SRE Building 4143.

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[1] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[2] Hart, R. S., *Distribution of Fission Product Contamination in the SRE*, Atomics International Report No. NAA-SR-6890, March 1, 1962, pp. 8-27.
[3] Kinzer, J. and Crawford, A. C., *SRE First Core Fuel*, Atomics International Technical Data Record No. 5301, May 16, 1960, pp. 1-7.
[4] Letter from Heine, W. F., Atomics International, to Proctor, J. F., E. I. du Pont de Nemours & Company, re: *Fission Product and Fissile Content of SRE Fuel*, July 2, 1975.
[5] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.

Recommended Locations for Soil/Sediment Sampling:

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

Previous characterization studies for the Building 4003 area were focused on delineating the extent of contamination to standards that were applicable at the time. Therefore, additional characterization is recommended for the Building 4003 area. This includes the following Building 4003 areas and appurtenances:

- The flat and low-lying areas surrounding the footprint of Building 4003. Radionuclides originating from the Hot Cave may have migrated to these areas via surface water flow or airborne releases.

- The general area of the former Hot Cave, particularly on the western side, within the footprint of Building 4003. Two radioactive liquid waste holdup tanks were located below the Hot Cave. It is not clear that this area was thoroughly investigated and decontaminated.

- The middle of the southern end of Building 4003 where a 5-gallon bottle collected contaminated liquid from a radioactive waste sink.

- The septic tank and leach field areas located 150 feet north of Building 4003. Boeing excavated, removed, and surveyed these features in 2000, but it is not clear that these areas were thoroughly investigated and decontaminated.

- The contaminated liquid waste lines in the highbay near the Hot Cave and the contaminated waste sump (tank pit) located outside the east side of the high bay near the former Hot Cave. See Figure 2.1.1h.

- The sanitary sewer lines located northeast of the site. If radionuclides were released into the sanitary sewer system, residual contamination may exist in the materials surrounding the sewer lines.

- It should be noted that testing in the Northern Buffer Zone subarea, where subarea HSA-6 drains, will be addressed in the TM pertaining to the Northern Buffer Zone.

2.1.2 Building 4041 Area

Site Description: The Building 4041 area comprises Building 4041, its loading dock designated Building 4687, concrete pad 4896, and the land surrounding these located immediately west of Building 4143. Building 4041 was constructed in 1958 as a steel prefabricated Butler building.[1, 2] Figures 2.1.2a and 2.1.2b provide a current photograph and a floor plan. The location of Building 4041 in the SRE complex is presented in Figures 2.1.1f and 2.1.1g.

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[1] Wallace, J. H., *Radiological Survey Results-Release to Unrestricted use, SRE, Building 041*, Rockwell International Report No. N704TI990037, November 9, 1982, pp. 3, 5, 8.
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.

Building Features: Building 4041 was a long narrow building located at the west end of the SRE complex. Building 4041 was constructed with a steel frame, corrugated sheet metal siding and roofing, anchored to a concrete slab and measured approximately 132 feet long by 27 feet wide and 15 feet high.[1] Building 4687, a rectangular concrete pad also constructed in 1958, was used as a pad for helium bottle storage. Figure 2.1.2b presents a floor plan of Building 4041 in 1982.[1]

Former Use(s): Building 4041 was the SRE Component Storage Facility. From 1959 until 1964, the north portion of Building 4041 was used for interim storage of radioactive waste prior to shipment for disposal. The south portion was used for storage of controlled items. The HSA team assumes that these were SRE components and spare parts. In May 1962, AI reported that approximately 2/3 of Building 4041 was filled with spare parts and radioactively contaminated components from the SRE that required cleaning before reuse.[2] No additional information was found about the use of Building 4041. In the early 1980s, during decommissioning of the SRE, Building 4041 was initially decontaminated.[3] Building 4041 was released for unrestricted use on July 23, 1985. After this time, Building 4041 was used for non-radioactive Energy Technology Engineering Center (ETEC) equipment storage.

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: Building 4041 was demolished in 1998.[3] The dimensions of the Building 4041 excavation are unknown because no building demolition documents have been located.

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

- In August 1982, Rockwell began decontamination and disposition of Building 4041. Rockwell collected 200 smear samples on surfaces throughout the interior of the building. Results were documented at less than 5 dpm/100 cm^2 alpha contamination and less than 30 dpm/100 cm^2 beta-gamma contamination. The only major operation performed was scabbling of the floor area to remove surface radioactive contamination. At the conclusion of this decontamination effort, Rockwell recorded an average background reading of 0.03 mrad/h inside the middle of Building 4041. All radioactive material was packaged for shipment to offsite land burial; the location of the burial site was not identified in the report reviewed. Rockwell designated Building 4041 to be available for unrestricted use on September 17, 1982.[1]

- In July 1982, ANL conducted a post-remedial-action survey. Four areas of Building 4041 were found to exceed ANL's acceptable limits of 20 dpm/100 cm^2 for removable alpha contamination, and 200 dpm/100 cm^2 for removable beta-gamma contamination.

[1] Boeing letter from P. B. Ramirez to R. Laughlin, Resource Management Agency, Ventura County, re: *Buildings 4041, 4687 and 4662 Demolition Project, Area IV, ETEC, Santa Susana Field Laboratory*, January 26, 1998.
[2] Atomics International letter from J. F. Trevillyan to J. V. Levy, U.S. AEC, re: *Sodium Components Cleaning Facility*, May 28, 1962.
[3] Rockwell International, *Sodium Reactor Experiment Decommissioning Final Report*, ESG-DOE-13403, August 15, 1983, pp. 166, 175, 195.

Two areas of Pad 4687 behind Building 4041 were found to have activity above these limits. Rockwell subsequently decontaminated these areas before termination of ANL's post-remedial-action survey. In September 1982, ANL conducted an independent verification survey and found Building 4041 and its surrounding area to be below the limits specified in the draft American National Standards Institute (ANSI) Standard N13.12 and NRC guidelines dated 1982.[1]

- In 1983, Rockwell conducted a radiological survey in the area of Building 4041. The survey areas were designated as SRE Regions VIII and IX. Survey results indicated an average reading of 0.04 mrad/h for surface gamma radiation, and 108 soil samples were found to have an average of 33 pCi/g of gross detectable beta activity, with a maximum of 98 pCi/g. Rockwell's acceptable limit for soil was 100 pCi/g of gross detectable beta activity. All survey results were below Rockwell's applicable limits for release for unrestricted use.[2, 3]

Radiological Use Authorizations: On July 23, 1985, the DOE released the SRE complex, including Building 4041, for unrestricted use and removed it from the DOE's radiologically contaminated Surplus Facilities Program.[4]

Former Radiological Burial or Disposal Locations: Building 4041 was an interim disposal location.

Aerial Photographs: Aerial photographs show undeveloped land until a 1959 photograph when a rectangular building observed that is identified as Building 4041. Building 4041 appears to have expanded by about 100 percent in the 1965 photograph. Building 4041 remains unchanged in the 1967, 1972, 1978, 1980, 1983, 1988, and 1995 photographs. A possible container is identified on the northeast side of Building 4041 in the 1980 photograph. Vegetation and an unpaved road are seen in the location of Building 4041 in the 2005 and 2009 photographs.[5]

Radionuclides of Concern: Building 4041 was used for the interim storage of radioactive waste from the SRE reactor in Building 4143. Possible radionuclides include U-238, U-234, U-235, U-236, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Th-228, Th-232, H-3, Na-22, Na-24, Cr-51, Mn-54, Fe-59, Co-60, Kr-85, Sr-89, Sr-90, Sb-125, I-129, I-131, Cs-134, Cs-137, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xn-133, Xe-135, Pm-147, Sm-151.[6, 7, 8] All radionuclides of concern listed with the exception of Na-24, Cr-51, Mn-54, Fe-59, Kr-85, Sr-89, I-131, Ce-141,

[1] Argonne National Laboratory, *Post Remedial Action Survey Report for the Sodium Reactor Experiment (SRE) Facility*, DOE-EV-0005-46, February 1984, pp. 10-15.
[2] Wallace, J. H., *Radiological Survey Results – Release to Unrestricted Use, SRE Region VIII*, Rockwell International Report No. N704TI990034, May 13, 1983, pp. 3-8.
[3] Wallace, J. H., *Radiological Survey Results – Release to Unrestricted Use, SRE Region IX*, Rockwell International Report No. N704TI990035, May 31, 1983, pp. 3-8.
[4] Voigt, W. R., Jr., *Certification for Unrestricted Use of the Sodium Reactor Experiment (SRE) Complex and the Hot Cave Facility (Building 003)*, U.S. Department of Energy, July 23, 1985.
[5] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[6] Hart, R. S., *Distribution of Fission Product Contamination in the SRE*, Atomics International Report No. NAA-SR-6890, March 1, 1962, pp. 8-27.
[7] Kinzer, J. and Crawford, A. C., *SRE First Core Fuel*, Atomics International Technical Data Record No. 5301, May 16, 1960, pp. 1-7.
[8] Letter from Heine, W. F., Atomics International, to Proctor, J. F., E. I. du Pont de Nemours & Company, re; *Fission Product and Fissile Content of SRE Fuel*, July 2, 1975.

Ba (La)-140, Nb-95, Ru-103, Ru-106, Xe-133, Xe-135, Pm-147 and Sm-151 are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives except for Sm-151 for which no analytical method is available. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Based on general site topography, surface water from Building 4041 likely flows northeast into the SRE retention pond. Outflow from the retention pond was initially onto the NBZ and Brandeis-Bardin Institute land. In 1959, a 6-foot diameter overflow pipe and a pumped sump were installed at the confluence of the two main drainage channels upstream of the pond. Water was then pumped through a 4-inch diameter overland pipe to a channel connecting to the Area II ponds. The overflow from these ponds is into Bell Canyon and thence to the Los Angeles River.[1]

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4041 area is Class 1, primarily due to the proximity with SRE reactor Building 4143 and because radioactive waste from this reactor was stored in Building 4041.

Recommended Locations for Soil/Sediment Sampling:

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

Previous characterization studies for the Building 4041 area were focused on delineating the extent of contamination to standards that were applicable at the time. Characterization was not conducted to delineate the extent of contamination consistent with the DTSC/DOE December 2010 AOC. Therefore, additional characterization is recommended for the Building 4041 area. This includes the following Building 4041 areas and appurtenances:

- The flat and low-lying areas surrounding Building 4041. Radionuclides originating from the Building 4041 and/or Building 4143 may have migrated to these areas via surface water flow or airborne releases.
- The site of the possible container identified from aerial photographs on the northeast side of Building 4041. It is unclear whether radioactive components, pending shipment, were stored outside Building 4041.
- The storm drain located on the west, north, and south sides of the site that connects to the SRE retention pond.
- The loading dock 4687 and concrete pad 4896 adjacent to Building 4041. It is unclear whether radioactive components, pending shipment were stored in these areas.

2.1.3 Building 4143 Area

Site Description: The Building 4143 area comprises Building 4143, concrete pads Nos. 4413, 4894, 4895, 4896, 4897, and 4898, electrical substation Building 4683, and the land surrounding these facilities located at the end of E Street. Building 4143 was constructed between April 1955

[1] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.

and February 1957 and was operated as a nuclear reactor until February 1964.[1, 2] Figures 2.1.3a through 2.1.3m provide a current photograph and historical photographs and drawings.

Building Features: Building 4143 was approximately 20,000 feet in area and included below-grade vaults and galleries for radioactive materials, a high bay, ground floor and mezzanine offices, rooms housing support equipment, a paved area surrounding the building, several out-buildings, and drainage channels.

The Building 4143 superstructure was a low-air-leakage building with ventilation and exhaust systems designed to control leakage and air flow paths. The interior of the building was maintained at a lower pressure than the exterior, so that air would flow into the building. This was designed to prevent radioactive particulates from escaping. The SRE was equipped with three independent radioactive exhaust systems. Two identical units were mounted on the roof and exhausted air from the high-bay area. A separate single exhaust system for the hot cells was located west of the high bay. Exhaust filters were installed to trap particulates (including radioactive particulates) generated during reactor operations. No information was found about their effectiveness or filter changeout frequency. The reactor and components containing radioactive materials were enclosed in below-grade vaults and galleries sealed from the outside atmosphere.[1] A floor plan is presented in Figure 2.1.3b. A 1962 photograph is presented in Figure 2.1.3c.

The reactor core was enclosed in a stainless steel cylindrical core tank, which was contained within two steel enclosures forming the outer tank and the core cavity liner. A helium cover gas blanket filled the space between the sodium and the top shield. The primary radioactive sodium system piping and equipment external to the reactor were contained within two galleries, one for the main loop and one for the auxiliary loop, and within three vaults for the primary drain pump, primary sodium service system, and primary storage tank, respectively. These were located at the northeast corner of Building 4143. Large shield blocks made from a minimum of 4.25-foot thick dense concrete were placed over the vaults and galleries.[1]

A total of 99 storage cells were constructed for the storage of irradiated core elements. These cells were arranged in a 6 by 16 array and were imbedded in concrete on 1-foot centers. Each cell comprised a carbon steel tube about 25 feet in length with a 4-inch minimum internal diameter and a wall thickness of 0.25 inch. The tube was closed except at the upper end where a gas seal and biological shielding were provided. A total of 79 tubes were attached to kerosene cooling lines. A helium atmosphere was supplied to the storage cells. Three moderator storage cells were constructed for the handling or storage of moderator or reflector cans. These were approximately 22 feet long and 20 inches in diameter, with a 0.5-inch wall thickness.[1]
Two hot cells were used to inspect or modify irradiated core elements remotely and to can fuel clusters for transfer to shielded transport casks. Access to each cell interior was through heavily shielded doors. All operations in the cellswere performed with manipulators and remotely operated equipment. The cell interiors were designed to; be maintained at negative pressure of -0.5-inch water pressure.[1]

[1] Rockwell International, *Sodium Reactor Experiment Decommissioning Final Report*, ESG-DOE-13403, August 15, 1983, pp. 1-3, 7-15, 162.
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.

The building ventilation system was designed and operated to move air toward potentially contaminated rooms and areas. Makeup air was brought in from the outside and combined with recirculated air within the administration areas with the purpose of maintaining positive pressure relative to the contaminated areas. Fresh air at the rate of five air changes per hour was supplied to the reactor room by independent supply fans. Exhaust fans and high-efficiency filters on the reactor room roof were designed to control the reactor room pressure below all contiguous regions, which included the administration areas, the hot cell, and the outdoors. The pipe and equipment vaults were maintained in an atmosphere of dry nitrogen from the recirculating nitrogen cooling system. They were designed to exclude air from the vaults and thereby avoid sodium-oxygen reactions in the event of a sodium leak. Blowers with exhausts to the dilution stack were also designed to maintain a negative pressure in the SRE hot cells. Per AI's design, the hot cell personnel area was designed to maintain a positive pressure relative to both the hot cell chambers and the reactor room. According to AI, air from the hot cell chambers was filtered before it left the cell and was filtered for a second time by the radioactive vent system filter banks, prior to dilution in the stack.[1] No information was found about air monitoring results at the stack.

The SRE reactor core was a matrix of moderator elements containing the fuel elements, control rods, neutron source, and instruments for measuring temperature and sodium level. Because the SRE was an experimental reactor, the core geometry changed as test elements changed. Of the 119 moderator elements in the core, 86 were hexagonal shaped and clad with Zircaloy-2. Stainless-steel clad graphite logs were inserted in spaces at the core reflector periphery. There were 57 process channels, 33 of which contained 6-foot-long fuel elements, 15 contained instrument devices, and 1 contained a neutron source. The main and auxiliary sodium coolant inlet lines and the moderator coolant inlet line were brought through the core tank wall and the core tank liner at an elevation slightly above the top of the moderator elements. The coolant inlet lines were routed down to their respective inlet plenums through holes in the outer ring of moderator elements.[1]

The thermal shield was located between the core tank wall and the outer tank. A structure of concentric rings above the bottom of the cavity liner supported the outer tank. The volume between the outer tank and the cavity liner was filled with block thermal insulation. Outside the cavity liner was a high-density concrete biological shield. Overheating of the shield was controlled by cooling coils attached to the exterior of the cavity liner through which kerosene from the kerosene cooling system was pumped. The cavity liner extended upward to the reactor floor.[1]

There were two complete circuits in the reactor coolant system. The main circuit consisted of a primary and secondary loop. Included in the primary loop were an intermediate heat exchanger, a free-surface mechanical pump, an electromagnetic brake, a valve flow controller, instrumentation, controls, and sodium service connections. In the secondary loop, the main secondary pump and expansion tank were integrated into a single unit and were located in the cold area of the system. The expansion tank provided space for sodium volume changes and a free surface for the release of entrained gas. Sodium was pumped through the main intermediate heat exchanger where it was heated and then passed to the Edison Plant steam generator, where thermal energy was used to produce steam. The sodium exited from the steam generator and

[1] Rockwell International, *Sodium Reactor Experiment Decommissioning Final Report*, ESG-DOE-13403, August 15, 1983, pp. 1-3, 7-15.

passed through an electromagnetic brake prior to returning to the main secondary pump and expansion tank.[1]

The major portion of the radioactive liquid and gas system was located on the hillside north of Building 4143. This area was designated as Building 4653 (discussed later in this section).[2] In March 1964, in preparation for a power expansion program (PEP) at the SRE, a new radioactive liquid waste storage system was installed outside the north end of the SRE building. The system comprised one used tank (T-1) and two new storage tanks (T-2 and T-3). T-1 was a 150-gallon tank. T-2 was a 350-gallon tank installed alongside T-1 in the sump pit 40 feet below ground level. T-3 was a 3,200-gallon tank installed at ground level. The radioactive liquid waste and vent system are presented in Figure 2.1.3d, the Hot Cells in Figure 2.1.3e, and a photograph of rod removal is presented in Figure 2.1.3f.

Former Use(s): Building 4143 housed a high-temperature reactor with a slightly enriched uranium metal fuel (Core I) and sodium-cooled, hexagonal zirconium clad graphite moderator elements. After an accident in 1959, the enriched uranium fuel was replaced with a 93 percent uranium-thorium metal alloy fuel (Core II). The SRE was developed to demonstrate a sodium-cooled, graphite–moderated reactor for civilian use. The reactor reached full power in May 1958 and provided 37 gigawatt hours of power to the Southern California Edison Company (SCE) grid before it was shut down. The SRE did not operate as a nuclear plant after February 15, 1964. Between May 1965 and September 1967, Building 4143 was used for the SRE PEP program. AI operated the main primary sodium system for 4,386 hours at 700 ºF and 13,196 hours at 350 ºF. The objective of this program was to raise the sodium operating temperatures to 1,200 ºF and thermal power levels to 30 MW with a stainless-steel-clad uranium carbide fuel loading. In September 1967, the primary sodium system was shut down and the sodium was drained into the primary fill tank while the secondary sodium was drained into drums. AI’s deactivation plan involved a “stored-in-place” configuration, but nonessential equipment was removed and the steam generator and uncontaminated support facilities were not maintained. AI completed deactivation activities in 1968. Decommissioning began in 1974 with the objective of removing all significant radioactivity from the site and releasing the facility for unrestricted use. Rockwell decided to retain the SRE building superstructure, primarily to provide containment for airborne contamination released by the decontamination operations. Rockwell made arrangements for the collection, packaging, and burial of radioactive waste, first at Beatty, Nevada, and later at Hanford, Washington.[3, 4] After decontamination activities were completed, Building 4143 was used for ETEC component storage. Figure 2.1.3g is a photograph of reactor core removal taken in 1977.

Information from Interviewees: In 2010 and 2011, a number of former workers were interviewed about their experiences at the SSFL. Several remembered the SRE. Excerpts from their comments are presented below.

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[1] Ureda, B. and Heine, W., *Facilities Dismantling Plan for SRE*, Atomics International Report No. FDP-704-990-003, June 26, 1975, pp. 15-18.
[2] Gallegos, A. N., *Disposal of Radioactive Waste Systems at Building 653 and Building 143,* Rockwell International Report No. N704-DWP-990-054, April 7, 1977, p. 3.
[3] Ureda, B. and Heine, W., *Facilities Dismantling Plan for SRE*, Atomics International Report No. FDP-704-990-003, June 26, 1975, pp. 9, 13, 17-18.
[4] Rockwell International, *Sodium Reactor Experiment Decommissioning Final Report*, ESG-DOE-13403, August 15, 1983, pp. 1-15.

- "The SRE was a 20 megawatt thermal sodium cooled, graphite moderated thermal nuclear facility. The plant was built as a "proof of principle" experiment and as a fuel test bed. Various fuel combinations and configurations were tested. The experimental fuel elements were loaded, the reactor started up and operated to expose the fuel to a pre-determined neutron exposure. The reactor was then shut down, the experimental fuel elements were extracted, transported to the fuel wash cell, sprayed with water to remove residual sodium, transported to the hot cell, disassembled, and examined. The original plant design provided for the heat to be removed by an air cooled heat exchanger. SCE installed a steam/electric generating plant, about 6.7 megawatt electric, to utilize our waste heat. As you can imagine, the SCE operators were not pleased with our intermittent operation. Their objective was to generate electricity; our primary objective was to evaluate fuel technology."[1] This former employee worked at the SSFL from 1955.

- "The SRE reactor was located beneath the floor of the high bay in Building 4143. All of the primary reactor cooling systems and part of the secondary cooling systems were also located beneath the floor. The reactor and cooling systems were in heavily shielded concrete vaults. The reactor vault was designed to be physically inaccessible to personnel entry. After decay of sodium-24 during plant outages, entry to the cooling vaults was safe and necessary for system maintenance. Storage cells for fuel and moderator elements and wash cells for fuel elements were also located below the high bay floor. The high bay accommodated two overhead bridge cranes, one of large capacity and the other of lesser capacity for auxiliary work. The heavy-duty crane was capable of lifting the concrete shield blocks covering the cooling vaults and the reactor loading face shield. It was also used to position the heavy lead-shielded fuel and moderator handling machines. These were necessary to transport irradiated fuel and moderator elements from the reactor to storage. In addition to the high bay, Building 4143 contained the reactor control room, electrical equipment rooms, a hot cell, health physics laboratory, and most of the SRE staff offices…SRE personnel were not evacuated from Building 4143 during the melting accident or at any other time except for one practice drill. The cost recovery was $1.25 million 1959 dollars and required 15 months for repairs and modifications. At one point during cleanup after the accident, the Group Leader required all SRE personnel including supervisors and him to participate for one shift in the physical decontamination of the high bay. Most horizontal surfaces were cleaned by mopping. Most vertical surfaces were cleaned by swabbing with Kotex® because of its absorbency. Operating and maintenance personnel continued the cleanup effort until Health Physics could release the high bay for unrestricted access by plant personnel. Health physicists used survey patches similar to gun cleaning patches to collect 100 square centimeter swipes of surfaces. Radiation counters were used to determine the amount of radioactive contamination collected on each swipe."[2] This former employee worked at the SSFL between 1958 and 1968.

- "I have read accounts of what happened at the SRE. It didn't make any impression on me at the time so if I knew about the SRE incident at the time I had since forgotten about it. After reading these accounts, I can see why I would have forgotten about it because it wasn't really something people that worked there would have thought was unusual. It

[1] Interview No. 206 of former worker conducted by the DOE, September 2010.
[2] Interview No. 300 of former worker conducted by the DOE and EPA on July 16, 2010, p. 3.

was an experimental reactor. You operate the reactor to find out what is wrong with your design. Well they found out one thing that was wrong with their design. The lubricating oil for the pump motors leaked into the sodium. This plugged up some of the coolant tubes. As a result, the fuel elements overheated and burst. This was a problem because we had to go in and fish the fuel elements out. It was a job to get them out and we had to develop special tools to do it. But, it was the sort of thing we expected to happen because the SRE was not a finished design. We were experimenting and this was one of the things we found out we had to change. I'm not exactly sure how they fixed the issue with the lubricating oil, but it was fixed. Some people are insistent on calling this a partial meltdown, which does not seem correct to me. To me a partial meltdown would involve melting of the coolant tubes themselves so that the whole reactor core would have been useless afterward. This certainly did not happen at the SRE. They were able to continue running the reactor with the damaged fuel elements. They finally realized something was wrong with the reactor and shut it down. I am familiar with this because I have read all the reports about the SRE incident."[1] This former employee worked at the SSFL between 1955 and 1966.

- "I am aware of the incident at the SRE that occurred in about 1959, which has been mischaracterized in the community. It was a fuel element failure, not a meltdown."[2] This former employee worked at the SSFL between 1952 and 1957.

- "We did have a partial meltdown in the reactor when I was working there. It wasn't a full meltdown, but some of the fuel elements melted. We spent a lot of time looking at the core. We corrected the problems and put the reactor back into service."[3] This former employee worked at the SSFL from 1957 until 1999.

- "In reference to the SRE accident, radioactive iodine could not have been released. Iodine reacts strongly with sodium, so if it were released, it would have bonded with the sodium and it would not have gone anywhere. I would believe it if there were some noble gases (krypton, xenon, etc.) released in that accident. They would not have chemically combined with anything so they would have been sure to escape. If they were released, they would have begun decaying immediately. Radioactive isotopes of those elements could, after escaping, have decayed to radioactive isotopes of halogens."[4] This former employee worked at other nuclear facilities and visited the SSFL, but did not work there.

- "I don't think there was a cover-up at the SRE because after the accident I was asked to give a talk at the last minute. I asked IJL if I could talk about the accident and use the slides I had been given and he said I could…It was an annual meeting of East Coast utilities. There were 1,500 to 2,000 people in the audience. I talked for over four hours. I talked for two hours, then we took a break, and then I answered questions for two more hours. I showed all the slides. That's not what I would call a cover-up. No one was

[1] Interview No. 2 of former employee conducted by the EPA only, September 2010.
[2] Interview No. 45 of former employee conducted by the DOE and EPA, September 2010.
[3] Interview No. 63 of former worker conducted by the DOE, September 2010.
[4] Interview No. 8 of former employee conducted by the DOE and EPA, September 2010.

trying to hide anything, especially not AI or DOE."[1] This former employee worked at the SSFL from 1957.

- "In 1959 I was hired as a trainee operator and mechanic at the SRE, as referred by a family friend, who also was my supervisor. I worked there approximately one year, and it was during that time there that the fuel element failure occurred. I was on site a few hours after it occurred, and was involved in the clean up. When the SRE shut down, that reduced the need for personnel, so being low in seniority, I was laid off.

  All my training was on the job. I don't recall any specific training courses or training meetings, but I was working towards becoming a certified operator on the reactor, which was not accomplished due to the layoff. I was quite fortunate in that the person who hired me took care to make certain I was involved in safe activities. I don't remember any safety meetings, but my coworkers were aware of safety issues and passed along those concerns to me.

  I wore cotton coveralls and cotton gloves to work in, and on several occasions had to wear a respirator. I wore a film badge, but shortly into the clean up, AI took the film badges back. The levels of radiation were high enough that the badges would have shown high exposure, resulting in people having to cool off and not get any work done. The employees were willing to accept the risk in working in those risky conditions to maintain their job, and to hopefully get the SRE back running so that everyone could continue working. Safety was a concern, but it was overlooked in this instance. Some areas were so hot that it was off the Geiger counter, and those areas were roped off.

  My cleanup activities went from approximately July to November, and I was involved with cleaning up various levels of contamination. I remember lying on the floor on plastic working on some of the reactor repairs. We used buffing machines on the floor as well as sponges and mops, also on the walls, but determined those efforts moved the contamination around more than clean it up, so we went to use Kotexes. Those were used to wipe and then discard. All items that were used in the clean up, as well as contaminated items, were stored outside in back of the SRE. It was there when I was laid off, so I am unaware of how it was eventually disposed. All the office equipment and supplies ended up there as well.

  We used chemicals in the cleanup process, such as various cleaning agents purchased at the store, acetone, paint thinner, etc. We experimented with TCE to see if that would be effective in the radiation cleanup. There was a lot of TCE on site as it was used to flush out the rocket motors after Rocketdyne did testing."[2]

  This interviewee also provided additional details about specific events that occurred during his tenure at the site and, specifically, during the sequence of events that took place during the SRE incident. These details are as follows:

  "On July 13th, the SRE Reactor had a power esscursion about 6:30 pm. The reactor started escalating in temperature so fast, it was with in seconds of going critical and blowing up. To stop the reactor from going critical they had too release all the cover gas from the reactor core very quickly to stop it. The cover gas from the reactor core was

[1] Interview No. 296 of former worker conducted by the DOE, September 2010.
[2] Interview No. 207 of former worker conducted by the EPA, only, September 2010.

highly radio active. At the time of the release of the cover gas, the wind was blowing toward the San Fernando Valley, and Los Angles, California.

I came to work on July, 14th on the graveyard shift 12:00am just a few hours after the power esscursion (meltdown) had happened. When I arrived at work I found my shift supervisor talking with the shift supervisor of the previous shift and his workers. What made it different this time was other men standing around in their suits and ties of the higher level of supervision, I knew something was wrong; these men were never there at this time of the night, or morning. Seeing the looks on the men's faces and hearing what they were talking about and the fear and emotion in their talk, it was not good.

After standing there listening; they noticed me standing there and put me to work masking, or taping up the cracks around the doors and windows that led to the High bay area where the reactor was housed to help keep out the radioactive contamination from the reactor control room where everyone was standing. While I was taping, I over heard them talk about which way the wind was blowing and how the wind had blown the Radiation over their own personal homes and family. They lived in the San Fernando Valley. I thought to my self how lucky I was, because I lived in Moorpark, the opposite direction.

Over the next few weeks after the accident they started up and shut down the reactor trying to see what had caused the reactor to over heat and the cause of the nuclear accident. They would run the reactor for a short time at a low level watching gauges and charts then shut it down and release more cover gas each time they shut it down. This cover gas would be released on the graveyard shift when the wind was blowing toward the Ocean and Ventura County; this was direction they preferred to release the cover gas because of the smaller population.

In the mean time the High Bay area where the reactor was housed was getting more contaminated. At times the contamination got so high it was off the scale of measurement. Finally after almost 2 weeks of starting and stopping the reactor, they settled on the idea that tetraline had leaked into the Sodium line through the seals on the Sodium pump. On the last run of the reactor on July 26th they almost did not get the reactor shut down because of the damage to the fuel rods and had to release the cover gas once again most likely toward Ventura County, the direction they preferred. The reason I know this; one of my duties on my work shift was to check the weather station to see which way the wind was blowing before they made a release. I am sure all the other 3 shifts followed the same rule.

Once the reactor was shut down, plans were made to inspect the reactor to see what damage occurred to the reactor; and see if it could be repaired. At this time everyone wondered how long our job would last with the reactor broken. Remember this was all new to everyone; no one had experienced a reactor power excursion. This was a reactor operator's worst night mare; to have a power excursion (nuclear accident); No one knew where to start. No one had ever cleaned a large contaminated building. Everything we did from this time forward was a new experience. We were willing to try what we need to do to save our jobs.

It was decided to clean up as much radioactive contamination that we could in the High Bay area that housed the reactor. We started at a door leading into theHigh Bay area trying to clean up the contamination with out much success. The normal ways of cleaning did not work for cleaning up radio active contamination. Soap & water and mops, sponges did not work; all, it did was spread it around and make it worse, and contaminated all the cleaning equipment, and had to be thrown away out in the trash pile out behind the building. They even tried floor scrubbers and all it did was contaminate them where they had to be thrown out in the trash pile. They finally came up with the idea of using feminine sanitary napkins (Kotex) and chemicals. We used chemicals and Kotex to dab and absorb up the contamination small areas at a time. This was a hands and knee job, and took time. To keep from re-contaminating the area that we cleaned we put a number of layers of clear plastic sheeting over those areas. So if the plastic got contaminated we could remove it and replace it to save time.

After a few days and 3 shifts working on the cleanup we finally reached the reactor so we could start working on removing the fuel rods to see what damage had occurred. We started on the outside or far side of the reactor where we felt that no damage fuel rods would be found. The first fuel rods came out quickly. The closer we got to the fuel rods we felt were damaged they become harder to remove. We had to pull and wiggle them to break them free. We used the fuel transporter (we called it the coffin) to remove the fuel rods. The last 13 fuel rods took a number of days to remove with using 3 shifts (worked 24-7). We finally got down to the last two fuel rods in the reactor; they were the ones that got the hottest. They were stuck solid and would not move. So this took a number of shifts working on them to try to get them free. When they finally got one of the fuel rods to free up a little on another shift than mine; while pulling on it, it broke off in the reactor core. The upper half of the broken fuel rod came up inside the fuel rod transporter; as it came up the operator saw that it was broken and panicked; wanting to stop it; he pushed the wrong button and lifted the lead safety protection shield up off the reactor face and exposed the High Bay area, and the complete building with radioactive contamination from the reactor core. When he seen what he had done, he panicked again, and ran and sounded the alarm for every one to get out of the building. Luckily it was on a night shift and not many people in the building. Once they were all outside and knowing the lead safety shield was still up and releasing radiation out of the reactor one of them volunteered and went back inside to push the button to put the shield down. By that time enough radiation had been released from out of the reactor core that it contaminated the whole building and they had to block off roads leading to the SRE building in about a mile radius. One road was blocked at the Fire station. I was called by my shift supervisor not to come into work. I was off work for about 2 weeks before I could go back.

When I returned to work I found all the office furniture, filing cabinets full of records and desk draws full of files and personal things in a pile out back of the building in a large pile about 15 feet high on top of all the other contaminated trash that had been thrown there from previous other clean ups.

They had brought people in to clean up the office area while I was gone. Also in the pile of trash there were about 50 floor scrubbers that were contaminated from cleaning the office and control room areas. The office area was never cleaned to a point that it was safe to be used again. No one used the office area because of all the contamination that was continually in the building; they were still vacant when I left in November 1959. Many records were lost during that time, and records were not keep that well from that time forward because of the reactor no longer running. All thought was placed on how do we save the reactor and get it up and running.

All the men that were running experimental tests at the SRE reactor prior to July 26th were now in the repair mode, and records were not kept like they had before the nuclear accident on July 13th.

Note: About this time they decided to start draining the reactor core and the sodium lines (the main hot loop of Sodium) to make it safer and easier to work on the reactor. They pumped the sodium into 55 gal drums. Once they were full they would haul them out to the "Pond" and dump them in the Pond. Then they took a 22 rifle and shot holes in the drums so they would catch fire and burn up the radioactive sodium to dispose of it; this was done on the graveyard shift. I did take part in it; I was always left behind at the SRE reactor building to keep an eye on things there until they returned. I was never out to the Pond I did not know where it was at. I would see them leave in a pick-up truck with two 55 galdrums sodium in the back. They went up the road in front of the building that went up hill. I thought to my self it would be terrible if on of those drums fell off going up the hill. On my shift they all stayed on, with no accidents.

After we got the Sodium level down in the reactor we were able to see better, had a better view of the last fuel rod. They used the TV camera from the newer fuel rod transporter; it was on the end of a long cord/cable. The TV camera was small enough to fit down into the reactor core in the hole /channel of the first broken off fuel rod Also a drop light was placed down the same hole. (the one that contaminated the whole building) This channel/hole did not have a plug in it. They put two lead blocks over the hole and some sand bags. So all they had to do was move them off the hole and place the small drop light and the TV camera down the hole. With the Sodium level down they were able to get the TV camera just above the level of the sodium. Note they had to leave some sodium in the core until they removed the last fuel rod. They had to keep the sodium hot so it would help in removing the last fuel rod.

Note: before using the TV camera we used a mirror to look into to look down into the reactor core with a droplight. Then we got the idea of using the TV camera. The bad idea of using the TV camera it got it highly contaminated. This is why we used a mirror at first. This was dangerous looking down into the reactor viewing off the mirror, with an open hole in the reactor. That is where the lead blocks came in handy again; where we were able to move them off the hole and put them back on again. After the inspection with the mirror, we had to clean up more contamination. This is why we laid a number of layers of clear plastic down on the floor so it could be removed quickly and take the contaminated plastic outside and dump it in dump pile behind the building. And lay new plastic down. It saved a lot of scrubbing. This was my job; and I would get contaminated from removing all this plastic.

So with the ability to have an open hole / channel in the reactor core; things got contaminated once again. With the TV camera and drop light in the hole they were not able to seal it up that well. They used the lead blocks the best they could and the sandbags on top of them. The sand bags did not keep the radiation in the core as well as what they had hoped for. So, all of us men were exposed to radiation directly out of the reactor core while we worked around the reactor. It came time to start removing the last fuel rod. The TV camera and drop light were removed and the lead blocks were place over the hole, with no sandbags; they sit to high for the fuel transporter to go over the top of them. Once we got over the top of the reactor and lined up with the last fuel rod to be removed and let the lead safety shield down we were ready to remove the last fuel rod.

We started pulling the last fuel rod out of the reactor. It was the hardest of all the fuel rods to pull out. We spent many shifts trying to remove this fuel rod and about to give up when it broke off in the reactor like the previous one. This time when it broke off, the upper part got wedged in the reactor core and they were not able to get it to go up, or down. There they were stuck on top of the reactor not able to remove this fuel rod. I was there at the time; it happened on my shift. They worked on it for most of the shift to try to un-stick the broken fuel rod. It was such a problem they decided to lift the lead shield a little bit to try to see under the lead shield to see if they could see why it was stuck. There were three men working on it while I was in the control room watching. With the lead shield up about two inches one man laid on the floor with flashlight looking under neath while another man at the controls tried lifting up and down and wiggling the fuel rod transporter back and forth. It looked very dangerous so I got the Polaroid camera that was in the control room, and took a picture through the control room window of all three of them working on trying to free this fuel rod. Two of them were wearing a gas mask, and the one laying on the floor was not because it got in his way to see. So he was exposed the radioactive contamination coming out of the reactor core with out a gas mask. I also took another picture from in the High Bay area where I should not have been because of the contamination. I felt I needed to record what was going on and did it anyway very quickly. I have those pictures this day, after 50 years.

They did finally get the fuel rod out of the reactor after some time and a lot of exposure of radiation to them selves. It also re-contaminated the High Bay area once again and it had to be cleaned up. This was my job cleaning up radioactive contamination, and was exposed to a lot of it; and exposed to a lot of chemicals in cleaning it up.

Now they had the last broken upper part of the fuel rod out of the reactor, leaving the bottom half in the reactor core. There we were with the bottom half of two broken fuel rods left in the reactor core. These two broken fuel rod ends still needed to be removed. At this time we were in a predicament; we had both fuel rod transporters, with broken fuel rods stuck in them and they could no longer be used. They tried to remove the broken fuel rods from the fuel rod transporters without success, and were exposed to more radiation trying to dislodge them.

Note: the reason we were able to be exposed to so much radiation is that our film badges were taken away from us and put into the safe. This is why our dose count on all of us employees was very low; for this reason I am speaking up for me, and all the other employees I worked with. The dose count that Atomics International has for all of us is incorrect; because we were not wearing film badges (after July 26th) through the dangerous times I have described.

They now had to come up with an idea how to remove the two broken and stuck fuel rod ends that was left in the reactor core. These two fuel rod holes / channels had two lead blocks laid over them to keep the radiation from coming out of the reactor core. They were not able to plug them properly because of the broken fuel rods stuck in the fuel rod transporter. This came in handy once they decided to try removing the broken fuel rod ends still in the reactor. With removing the lead blocks they could look down into the reactor with a TV camera that was taken off the newer fuel rod transporter. It had a long cord on it and the camera was small enough to fit down in the fuel rod hole /channel. They were able to put a small drop light down the other hole/channel by removing the lead blocks too. So there we were two open holes in the reactor looking down into the reactor core.

Note: before the TV camera was used they took a mirror off the bathroom wall and use it to look down into the reactor core and found that it did not work that well; and got the idea of using the TV camera.

After inspecting the two broken fuel rods; they came up with the idea of making a tool from a pair of vice grips to reach down into the reactor core to grab a hold of the broken fuel rod. Once they got a hold of it they used a cherry picker, (small crane) to pull it out. It took some time to do this; between getting a hold of the broken fuel rod with the tool they made, and working the stuck fuel rod loose. This exposed the workers again with radioactive contamination from out of the core of the reactor, plus re-contaminating The High Bay area again. It took a number of shifts and days, to be able to free and remove both of the stuck fuel rod ends in the reactor core. This was one of the most dangerous jobs we did repairing the reactor. There was a lot exposure to radiation coming out of the reactor core while the two broken fuel rods were being removed.

Once the broken fuel rods were free they left them loose in the reactor core until they could figure out what they were going to do with them, when they pulled them out. They came up with the idea to bring in a lead lined cask with a fork lift to put them in. So the men practiced for a number of days on how they would go about getting them out of the reactor core and into the lead lined cask.

Note: I watch them practice with large metal tongs that they would use to pick up the radiated fuel rod end once they got it out of the reactor core onto the floor. They practiced with a piece of pipe about the size of the fuel rod. It was my job to time them as they practiced.

I was there when they pulled the first broken fuel rod end out. I watched them from the control room. They took the Cherry picker as planed and lifted it out onto the floor and grabbed the large metal tongs, one at each end and tossed it into the cask and shut the lid in record time. This is one more time where the men were exposed to a large amounts of radiation handling this hot fuel rod end. It also contaminated the High Bay area one more time and needed to be cleaned up.

Note: While the men were using this cherry picker to pull the stuck fuel rod ends the company started building the large equipment you can see in the 1959 SRE Training film that was used to remove all the small pieces of fuel rod out of the bottom the reactor core. While this equipment was being built; we had to use improper tools in removing these stuck fuel rods and getting exposed to a lot of radiation in doing it.

Now it comes time to remove the second broken fuel rod end out of the reactor core; this was done by another crew; I was not there at the time. I was there on the next shift. These men did the same thing as we did in removing the broken fuel rod end, but they accidentally dropped theirs on the floor and it broke into pieces and made it difficult to pick up; to put it in the lead lined cask. So it took them longer with more exposure time of radiation; they never did get it all cleaned up. I was on the next shift to come in and I helped in finish cleaning up the small pieces and put them in the cask. So I and another man were exposed to the contamination that was left behind. We also had to remove the plastic sheeting on the floor that was contaminated and put down new plastic sheeting. The plastic sheeting was thrown out into the trash pile.

Note: We had plastic sheeting on the floor in the High Bay area so we could clean up contamination easier than all the scrubbing. We had a number of layers down and we would put more layers down when they were removed. All this plastic sheeting was thrown out in the back of the build in the contaminated trash pile that was about 15 feet high and about 75 to 100 feet long and 25 feetdeep. This is the same trash pile all the office furniture and filing cabinets were in. It was a big mess.

After all the removal of all the fuel rods in the reactor, and a lot of radiation exposure. It was now decided that all the small broken pieces of fuel rod now needed to be removed from the bottom of the reactor core. The new equipment that they had been building would be used to help remove those broken pieces.

Now they had to finish draining the rest of the sodium out of the reactor core and the main loop so they could see all the small fuel rod pieces in the bottom of the reactor. They brought in a pump truck to finish draining the last of the sodium out of the reactor core and main loop to speed things up. It took to long to pump it into 55 gal drums and hauling it out to the Pond. While the sodium was being drained. We cleaned up the High Bay area and tools were made to look down inside the reactor. They made a scope that would attach to the top of the reactor and go down inside of the reactor for inspection. (These scopes are seen in the Training film being used)

While they were finishing up this new equipment, we still had to use crude equipment to gather up the small pieces of fuel rod into piles in the bottom of the reactor core. They made grappling hooks, and other types of tools out of vice grip's, to reach down into the reactor core through the two open holes in the reactor to reach the small pieces and place them into piles in the bottom of the reactor core. This was done by making a scope to see down into the reactor core, and also using a TV camera. They had to put a drop light also down into the reactor core to light it up to see what they were doing. With a drop light down into the reactor through a fuel rod hole/channel and installing the grappling hooks and scope to see with; this give the men more exposure to radio active contamination from out of the reactor core. The men were on top of the reactor for long periods of time while gathering up all the small pieces, and being exposed to radio active contamination.

Note: you can learn about this by watching the 1959 SRE Reactor Training Film, that was made showing the tools they used and scope to gather up the broken pieces in the bottom of the reactor core. When they first came up with the Idea before making the film; experimentation was used to figure out how to make the tools and try them out. While doing this the men were exposed to more radiation from the reactor core while they worked through the two open holes in the reactor. This period of time is not shown the training film, and not recorded.

Finally the reactor core was fully drained of sodium and small pieces of fuel rod parts were gathered up in piles in the reactor core. They decided to see if they could remove the broken sodium pump that had caused the reactor to have a power excursion, or meltdown. It was not an easy job to do. With it pumping sodium any residue of sodium left in the pump, or piping could catch fire, or could have an explosion. Then you have the radiation that would come from the reactor core, piping and the broken pump.

The pump was down in the floor, under a grading that could be removed. They devised a tent over the area where the pump was by using scaffolding and wrapping it with clear plastic sheeting to make the tent. Then they put a cover gas in the tent to remove all the air so the sodium would not catch fire, or explode. They had one of the men go down in the hole to unbolt and remove the sodium pump. With the gas in the hole the man wore an oxygen mask so he could breath. This hole was a very contaminated area with radiation and asbestoses, because it had not been cleaned. It would have been very difficult area to clean because of the piping in the hole. So the man was exposed to more radioactive contamination and asbestoses. The pump was only about 3 feet from the reactor core.

Note: When the sodium pump was removed this was on my work shift. I was there helping and was exposed the radioactive contamination along with the other men.

When the man got the pump unbolted and came out of the tented area it allowed air to get into the tented area and caused an explosion and fire. The man just got out of the tented area about a foot or two and it exploded; we other men were about 6 to 10 feet away. We thought we were dead when it happened, but we were lucky and did not get hurt some how. The man that stepped out of the tent his cover-alls were singed but was ok. We had a big fire for a short time and it settled down. This fire was about 3 feet from the reactor core. About the time it had settled down a fireman came running through the door into the high bay area with a fire extinguisher in his hand to help put out the fire. We yelled at him to get out because the high levels of radioactive contamination. He also had the wrong fire extinguisher; it was water filled. If he would have used it on the fire he could have blown up the building. Water and Sodium you do not mix, the two together it will cause an explosion. Luckily the fire did burn out.

Note: we all had to take a shower that night before we went home to remove the radioactive contamination that had gotten all over us from the explosion. Luckily I had some extra cloths to wear home I keep in a locker.

Note: we were not wearing any type of breathing mask, and our lungs were exposed to all that radioactive contamination. Plus all the asbestoses that blew out of that hole.

The next day or two we worked on installing the new pump. They brought in a film crew to start taking pictures of us. They could only stay for a short time and would have to leave because of the radiation. They took a picture of me working on the new pump putting a coat of sealer over the asbestoses that had been placed over the new pump and piping that went into the reactor core. The sealer was to help the asbestos from flaking off.

Now comes the time they start bringing in the big new equipment that they had been working on to remove the small pieces in the bottom of the reactor core. They first brought in a large spoke wheel looking thing that would attach to the top cover of the reactor, so they could lift it enough to rotate the top cover of the reactor. To do this they had to cut, break the seal all around the top cover that prevented the radiation from coming out of the reactor core. They had to cut this seal while lifting up on the top cover face of the reactor, with a large overhead crane. It was difficult to do with the top cover weighing over 60 tons. Once the seal was cut and broken, we started rotating the top cover. It took about 12 men to rotate the top cover with two come-a-longs and the other men pushing. In the mean time while these men along with me were getting exposed again with radiation on of the reactor core with the broken seal allowing it to escape. The top cover had to be raised about a two inch’s so we could turn it. A 60 ton top cover was not easy to turn; it took a while to break the seal and get it to turn.

Note: you can see all this in the 1959 SRE Reactor Training Film; a group of men all around a large spooked wheel pushing. I am there with them. I was helping on the come-a long with another man helping. This was dangerous with the exposure of radioactive contamination coming out of the broken seal around the reactor top cover. This is where everyone helping had their feet right over this broken seal.

The reason for rotating the top cover was to align the large plug in the top cover with the pile of small broken pieces in the bottom of the reactor core. Once it was aligned where they wanted it, they removed the large spoke wheel and brought in the other large equipment they had built to remove the small broken pieces in the bottom of the reactor core; this equipment was very large. Once they got the new equipment attached to the top of the reactor cover they started removing the small pieces from the reactor core.

Note: this can be seen in the 1959 SRE Reactor training film. I was there in the film helping on removing the small pieces. The equipment worked quite well and safe to use.

Once all the small pieces were removed from the reactor core; this was about the last week of October, or the first week of November 1959. Now it was the matter of putting the reactor back together and cleaning up all the radioactive contamination. Fill the reactor core with new sodium and install new fuel rods back into the reactor. To do this they would have to remove the broken fuel rods in the fuel transporters or have to bring in new ones. At this time they were not sure what they would do next. They had been through a lot in dismantling the reactor over the past 4 months, with large expenses in building new equipment and manpower; and the reactor was still not up and running. They had done the impossible, with more to go to get it up and running.

My last day working for Atomics International was November 9th 1959." This former employee worked at the SSFL between 1959 and 1960.

- "When the SRE was finally shut down, they ripped all the instrumentation out and got rid of a lot of stuff. In 1975, they found some residual sodium in the reactor vessel. They asked me to go over to the SRE and figure out where and how to hook up the existing thermocouples and heaters…I became the lead man on that project and worked on dismantlement of the SRE. We needed to heat up the reactor vessel to melt the sodium to a liquid so it could be removed. Because they had ripped the old instrumentation out of the control room, I had to go find and install the instruments and figure out the electrical wiring for heating elements located on the outside of the reactor vessel…Once this was done we could heat the vessel to 230 degrees Fahrenheit (ºF) to melt the sodium. Just to be clear, we did not run the reactor. We just reconnected the heating elements on the outside of the reactor vessel to heat the sodium to its melting point so we could remove it. Before we could even get to the reactor vessel though, we had to dig out the dirt around it because the reactor was buried in the ground. We removed the 4-foot thick magnetite concrete, which was a concrete with steel shavings in it that surrounded the reactor vessel. When I was working on SRE dismantlement, I also had to deal with the "dip-leg tube." The "dip-leg tube" was a tube that went down 20 or 30 feet into the ground. It was located in a separate pipe gallery beside the reactor vessel. We found radiation at the bottom of that hole and it gave me terrible fits getting that cleaned up. I worked on the dismantling the SRE from 1975 to 1980...Originally, we were supposed to save the SRE building. It was going to be used as a building for the Saturn rocket. There were three areas where water would pool at the bottom of the SRE when we were dismantling it and we had to put pumps in those pools to take the water to the SRE pond. We had alarms go off when the pond got too full."[1] This former employee worked at the SSFL between 1957and 1989.

- "When I worked at the SRE, we took the facility apart. I was there for 1½ or 2 years, working 30 feet below ground surface and using a jackhammer. We would take a radiation reading and when we found contamination, we would dig it up, box it up in special lined boxes, and they would ship it away. I do not know where it was shipped to, but everything went off-site. I think it went to Beatty, Nevada. I do not know where it was stored on-site before it was shipped away."[2] This former employee worked at the SSFL between 1976 and 1982.

- "Back to the SRE building. The testing verified to our complete satisfaction and to those overseeing the project that we had met all requirements for unrestricted use of the building. We began to refurbish the building for the test program. One day while driving from the DeSoto facility, the Program Manager and I noticed road construction at the northwest corner of Topanga Canyon Boulevard and Plummer Street, where the hill that used to be there was being carved up. We talked with the construction supervisor there and asked where they were transporting the dirt to, and lo and behold it was a long way away. It was mutually beneficial for them to bring that dirt up to the SRE to use as fill in the basement that had already been excavated. We wouldn't let them dump any rocks larger than 10 inches in diameter, so they broke them up rather than take the dirt back down the hill. The quality engineer rejected 3 or 4 of the loads because they had rocks in them that were too big. Then the Fast Flux Test Facility program was cancelled and funding for the steam generator program was terminated."[3] This former employee did not state when he worked at the SSFL.

Radiological Incident Reports: There have been several incidents associated with Building 4143 that could have resulted in a release to the environment. The following table provides information presented in an incidents database provided by Boeing. Summaries of the incident reports are provided following the table, when available.

Building 4143 Incident Report Summary

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A0374	6/13/1958	SRE HIGH BAY		EMPLOYEE DID NOT WEAR PRESCRIBED RESPIRATORY PROTECTION.
A0478	2/6/1959	SRE HIGH BAY	MFP	TWO EMPLOYEES HANDLED CONTAMINATED EQUIPMENT WITH OUT PROPER USE OF PROTECTIVE GLOVES.
A0315	6/4/1959 - 6/5/1959	WASH CELL	MFP	EXPLOSION BLEW FUEL ELEMENT UNDERGOING SODIUM CLEANING OUT OF THE WASH CELL.

[1] Interview No. 254 of former employee conducted by the DOE and EPA, September 2010.
[2] Interview No. 78 for former employee conducted by the DOE and EPA, September 2010.
[3] Interview No. 30 of former employee conducted by the DOE and EPA, September 2010.

Building 4143 Incident Report Summary (continued)

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A0274 **(MAJOR INCIDENT)**	7/12/1959 - 5/21/1960	REACTOR CORE	MFP	SRE FUEL ELEMENT DAMAGE
A0351	9/10/1959	R/A STORAGE	MFP	EMPLOYEES ENTERED CONTROLLED AREA WITHOUT APPROPRIATE AUTHORITY.
A0390	11/21/1959	SRE HIGH BAY	MFP	EMPLOYEE CONTAMINTATED DURING MODIFICATION OF SRE CORE RECOVERY TOOL.
A0548	12/7/1959	SRE HIGH BAY		EMPLOYEE ENTERED CONTROLLED AREA WITH OUT PRESCRIBED PROTECTIVE CLOTHING.
A0391	12/18/1959	SRE HOT CELL	MFP	EMPLOYEE ENTERED CONTROLLED AREA W/O REQUIRED HOOD AND EXITED W/O A SURVEY.
A0510	4/11/1960	SRE HIGH BAY	MFP	LEAKAGE AROUND VIEWING GLASS CAUSED CONTAMINATION OF EMPLOYEE.
A0394	5/15/1960	SRE HIGH BAY	MFP	SRE SODIUM FIRE IN THE HIGHBAY.
A0393	5/25/1960	SRE HIGH BAY	MFP	EMPLOYEE CONTAMINATED BY CORE COVER GAS EXCAPING DURING CORESCOPE REMOVAL.
A0460 Incident report missing	6/2/1960	SRE HIGH BAY	MFP	MAN SLIGHTLY INJURED AND CONTAMINATED WHILE WORKING ON SRE FUEL COFFIN.
A0005	6/9/1960	SRE HIGH BAY	MFP	CORE COVER GAS LEAK CONTAMINATED EMPLOYEES.
A0442	7/7/1960	SRE HIGH BAY	MFP	REACTOR COVER GAS ESCAPED CONTAMINATING EMPLOYEE.
A0305	12/15/1960	TENT	Cs/Sr	IMPROPERLY SEALED RESPIRATOR CAUSED HIGH INTERNAL AND EXTERNAL CONTAMINATION.
A0435	5/17/1961	SRE HIGH BAY	MFP	PROTECTIVE BOOT LEAKED CONTAMINATING SHOES.
A0515	11/4/1961	SRE HIGH BAY	MFP	EMPLOYEE EXPOSED TO AIRBORNE ACTIVITY WHILE REMOVING SAMPLES IN HIGH BAY.

Building 4143 Incident Report Summary (continued)

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A0472	12/23/1961	SRE HIGH BAY	MFP	CONTROLLED AREA ENTERED W/O PROPER AUTHORITY, PROTECTION AND PROCEDURE.
A0534	2/6/1962	SRE HP OFFICE	MFP	UNAUTHORIZED EMPLOYEE USED HEALTH PHYSICS EQUIPMENT WITH FAULTY RESULTS.
A0015	4/4/1962	SRE HIGH BAY	MFP	AIRBORNE ACTIVITY IN SRE HIGH BAY.
A0373 Incident report missing	6/13/1962	SRE HIGH BAY	MFP	OPERATOR ENGULFED IN FIRE DURING TRANSFER OF CORE HEATERS.
A0404	7/30/1962	SRE WEST PAD	Sb124	SRE SOURCE TRANSFER OPERATION CAUSED EMPLOYEE EXPOSURE ABOVE GUIDELINES.
A0379	10/20/1962	SRE WEST PAD		THREE EMPLOYEES SIZE REDUCING SRE CORE HEATERS BECAME CONTAMINATED.
A0030	3/19/1964	SRE & SURFACE DRAINAGE	MFP	R/A LIQUID PUMPED ONTO GROUND AS CLEAN.
A0409	6/13/1964	SRE FHM PIT	MFP	AIRBORNE ACTIVITY IN FUEL HANDLING MACHINE PIT CONTAMINATED EMPLOYEES.
A0493	6/17/1964	SRE FHM PIT	MFP	HIGH AIRBORNE ACTIVITY IN FUEL HANDLING MACHINE SERVICE PIT CONTAMINATED TWO EMPLOYEES.
A0380	6/21/1964	SRE HIGH BAY	MFP	EMPLOYEES AND AREA CONTAMINATED FROM IMPROPER DOFFING.
A0382	9/18/1964	POOR MAN'S CELL		WORK IN THE POOR MAN'S HOT CELL CAUSED AIRBORNE EXPOSURE TO EMPLOYEES.
A0545	12/1/1964	SRE HIGH BAY	MFP	GAMMA SURVEY OF CONTROL ROD THIMBLE CONTAMINATED PROBE AND SURVEYOR.
A0371	12/18/1964	SRE HIGH BAY		SIZE REDUCTION OF REACTOR COMPONETS CAUSED EXPOSURE AND CONTAMINATION OF EMPLOYEES.

Building 4143 Incident Report Summary (continued)

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A0296	1/14/1965	SRE HIGH BAY		MOVEMENT OF TEMPERATURE PROBE CAUSED EXPOSURE IN EXCESS OF GUIDELINES.
A0386	2/20/1965	SRE HIGH BAY		CORE LIGHT REPLACEMENT CONTAMINATED EMPLOYEES WHEN R/A GAS WAS RELEASED.
A0416	2/27/1965	SRE HIGH BAY	MFP	SERVICING MODERATOR CASK RESULTED IN EMPLOYEE CONTAMINATION.
A0444	4/24/1965	SRE HIGH BAY	MFP	EMPLOYEE DRILLED THROUGH FINGER DURING OPERATION IN SRE HIGHBAY.
A0445	5/22/1965	NA PIPE GALLERY	MFP	EMPLOYEE LACERATED THUMB DURING OPERATION IN SRE HIGHBAY.
A0041	8/19/1966	TAB EXPOSURE FACILITY	MFP	PERSONNEL EXPOSED TO PRIMARY SODIUM IN TAB EXPOSURE FACILITY.
A0321	12/8/1967	MAINTENANCE CELL	MFP	R/A WATER DISCOVERED IN 8" PIPES THAT PENETRATED MAINTENANCE CELL FLOOR.
A0289	10/23/1976	SRE HIGH BAY	MFP	CORE GAS ESCAPED DURING REMOVAL OF INSTRUMENT THIMBLE.
A0059	8/1/1977	SRE HIGH BAY		THE BOTTOM OF A COLD TRAP FELL OFF DURING MOVEMENT CONTAMINATING FLOOR.
A0414	8/10/1977	SRE – WATER PIT	MFP&CP	REACTOR VESSEL SEGMENTS STORAGE PIT LEAKED WATER TO THE SOIL.
A0458 A0683	9/23/1977	SRE HIGH BAY	MFP	EMPLOYEE EXPOSED TO AIRBORNE ACTIVITY DURING D&D OPERATION.
A0578	6/24/1978	SRE		EMPLOYEE INJURED WHEN HE TRIPPED ON CULVERT.

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

- On June 13, 1958, three employees failed to wear the respirators recommended and supplied by the health physicist while working beneath the fuel handling coffin. The incident report notes that compliance with health physics recommendations is expected. No other information about the incident is provided (Incident Report A0374).[1]

- On February 6, 1959, two AI personnel handled contaminated equipment without the proper use of protective gloves. The men were replacing a television camera that had been used on the reactor loading face with a movie camera. After handling the television

[1] Fisher, W.L., Internal Letter, re*: Non-Compliance with Health Physics Recommendation*, June 16, 1958.

camera and its component parts, the television camera was removed. One man asked for the SRE Polaroid camera to take a picture of the camera setup. He received the Polaroid camera with contaminated gloves and when he was not able to make the camera adjustments he wanted, he removed the gloves by placing the fingers of the gloves between his teeth and withdrawing his hands. After continuing to have difficulty, both men handled the camera, one with gloves on and one without gloves. The picture was taken and the camera was returned to the SRE operations department. Both men then handled the movie camera and mounted it on the old television camera brackets. Again, one man had gloved hands and the other did not. The men then walked off the potentially contaminated plastic sheeting on the floor before removing their shoe covers. Smears of the plastic sheeting showed less than 30 dpm beta-gamma and smears of the television camera ranged from 1 to 200 dpm beta-gamma. The Polaroid camera and movie camera were not significantly contaminated. When questioned, the men stated they had used the hand and foot counter before leaving the building. No personnel contamination was found. One of the men was found to be new and had little knowledge of the hazards of radiation contamination (Incident Report A0478).[1]

- On June 4, 1959, a fuel element (R-56) was removed from the SRE reactor core for transport to Wash Cell B for sodium cleaning. The operator noted that the fuel element appeared “quite dirty.” After cooling, the operator felt the fuel rod “appeared better, however, a dark material was noted near the upper part of the hanger rod, near the lower end of the hanger rod, at [the] top of [the] fuel cluster and at the lower extremity of the fuel cluster.” The dark material was not definitively identified in the incident report; however, it is implied to be the hydrocarbon coolant and lubricant tetralin or one of its decomposition products.

  The fuel element was lowered into Wash Cell B by the transfer cask. A vacuum was started on the cell and wash water was pumped into the cell. When the vacuum was decreased to about 2 inches of mercury, the vent valve was opened. Some “pops” were heard, but that was typical of the sodium-water reaction that occurred in the cleaning process. At approximately 6:55 a.m., an abnormal rise in pressure occurred leading to an explosion, which blew the fuel element shield plug and hanger rod out of the wash cell and onto the reactor room floor. The fuel element cluster itself remained in the wash cell. Flames and smoke erupted from the wash cell, the radiation air monitor sounded, and the building was evacuated.

  A survey reading taken through a buckled door measured 125 mrad/h approximately 10 feet from the hanger rod. Absolute filter banks on the SRE building roof were surveyed. Results were 250 mrad/h for the west filter bank and 150 mrad/h for the east filter bank. Personnel entered the high bay to collect samples. Liquid material, presumed to be sodium hydroxide, found on the floor measured 2.5 rad/h at 6 inches. The hanger rod measured 5 rad/h at 6 inches and the core plug measured 2.5 rad/h at 6 inches. The SRE control room, mezzanine area, and health physics office were surveyed, but only minor contamination was detected and these areas were quickly decontaminated. A high volume air sample was taken in the high bay near the wash cells at 2:00 p.m. and airborne activity was found to be 3×10^{-9} μCi/cm^3 beta-gamma.

[1] Young, C. L., Atomics International Internal Letter, re*: Potential Contamination of Personnel*, February 19, 1959.

On June 5, 1959, the core plug and hanger rod were placed into a moderator can storage well. Measurements taken at that time found the core plug to be 1 rad/h at 6 inches, the hanger rod to be 2.5 rad/h at 6 inches, and the lid of the moderator can to be 30 mrem/h at the surface. A high volume air sample was taken at 11:25 a.m. and results showed airborne activity to be 2×10^{-9} µCi/cm^3 beta-gamma. Decontamination and re-surveying of the high bay began.

An investigation board noted the most probable cause of the incident was a hydrogen-oxygen reaction. Oxygen from the wash cell vent pipe combined with hydrogen resulting from the sodium-water reaction that occurs in the cleaning process to create the pressure build-up and explosion. Additionally, a new wash cell procedure had just been put into place, and the “hold down” clips used to keep the fuel element components in place in the event of a pressure surge were not installed. Other areas for improvement were also noted in the incident report.

A smear survey of the high bay area found results ranging from 1,700 dpm beta-gamma near the center of the high bay to 214,000 dpm beta-gamma at the north end of the building near the wash cells. A smear survey of equipment in the high bay found contamination ranging from 719 dpm beta-gamma on an equipment panel to 469,836 dpm beta-gamma on the transfer cask vent hose. A 1961 AI report titled *SRE Fuel Element Damage: Final Report, NAA-SR-4488*, states that the maximum contamination level detected as a result of the incident was 700,000 dpm/100 cm^2 taken 24 hours after the incident and found on the fuel handling cask located 25 feet from Wash Cell B. An environmental survey of the area surrounding the SRE showed results ranging from 0.03 mrad/h northwest of the building to 0.20 mrad/h at the southwest corner of the SRE perimeter. Normal background for the survey meter was between 0.03 and 0.05 mrad/h. Soil samples collected on June 5 ranged from 9.36×10^{-6} µCi/g outside the Santa Susana Field Lab boundary line to 1.65×10^{-5} µCi/g inside the SRE perimeter fence. The June 5 soils samples were comparable to samples taken two months earlier.[1, 2, 3]

July 12, 1959 Major Incident

- On July 12, 1959, power run 14 of the SRE began, which resulted in the melting of 13 fuel elements. However, circumstances involved in the July 12, 1959 incident extended over the entire period of time from November 29, 1958 to July 26, 1959. AI reports describe the following sequence of events related to power runs 8 through 14 at the SRE (Incident Report A0274):
    - Run 8 began on November 29, 1958 after a shutdown of two months in which considerable repairs and modifications were made to the primary sodium system. During this work, the primary sodium was pumped back and forth several times between the primary loop and the primary fill tank, which was known to contain a large amount of sodium oxide. A substantial amount of oxide was thus

[11] Investigating Board, Atomics International Internal Letter, re*: SRE Wash Cell Incident of June 4, 1959,* June 19, 1959.
[2] Borg, G., *Wash Cell Incident at the Sodium Reactor Experiment, AI Memo 5155*, Atomics International, April 6, 1960.
[3] Ashley, R. L., Beeley, R. J., Fillmore, F. L., Hallett, W. J., Hayward, Jr., B. R., and Jarrett, A. A., *SRE Fuel Element Damage, Final Report, NAA-SR-4488 (suppl.*), Atomics International, 1961.

introduced into the primary sodium. At the beginning of run 8, an unusually large spread in the fuel channel exit temperature was detected and attributed to the high oxide content of the sodium. The reactor was shut down to reduce the oxide in the sodium by cold trapping. On December 12, 1958, two fuel elements that were excessively hot and had black foreign material on them were removed and washed. Washing the fuel elements proved to be the most successful to reduce the temperature spread. Reactor operations continued intermittently. Some improvement in fuel channel exit temperature spread was found in running the reactor at elevated temperatures as well as by jiggling the fuel element one inch or less. On December 23, 1959 the reactor was shut down to inspect the fuel elements. Fifteen fuel elements were washed and additional cold trapping was done to reduce exit temperature spreads. The reactor was started again and the spread in the fuel channel exit temperatures continued to improve until the end of run 8 on January 29, 1959. During the shutdown, the sodium was cold trapped to less than 5 parts per million of oxygen content. No reactivity anomalies were observed during the run, but a cover gas sample indicated that the hydrocarbon coolant and lubricant tetralin had entered the primary sodium.[1] The presence of tetralin indicates that the system was not functioning properly.

- Run 9 began on February 14, 1959, but continued difficulties with the fuel channel exit temperatures forced a shutdown four days later to wash fuel elements and do further cold trapping. Reactor operations resumed and the temperature spread improved. Reactivity increased ½ percent during this run. Two reactor scrams (automatic dropping of control rods into reactor core to shut down reactor) occurred because of an excessive temperature drop across a moderator can and several other scrams occurred because of power line transients. Run 9 ended February 26, 1959. A fuel element was removed for routine examination in the SRE hot cell and was found to have a thin black deposit. The element was washed and placed back in the reactor.[1]

- Run 10 lasted from March 6 to March 7, 1959. This run was conducted as a temperature test on a uranium oxide fuel element. No unusual circumstances were noted. A thimble was replaced at the end of the run. Later examination showed that a loss in reactivity of ¼ percent occurred at the start of run 11.[1]

- Run 11 began on March 16, 1959. Difficulties with the fuel channel exit temperatures were still being experienced, but the reactor continued to operate up to 20 megawatts (MW). On March 27, 1959, several reactor scrams occurred caused by fluctuations in the main primary sodium flow due to helium leaking into the primary sodium. The reactor returned to power and ran at 19 to 20 MW until the run ended on April 6, 1959. An increase in reactivity of 1 percent occurred during the run. A reduction in fuel channel exit temperatures was noted. Twenty-one fuel elements were examined by television camera in the fuel handling cask and found to be in good condition. Ten days after the run, the radiation level in the main gallery was higher than expected. This was not surprising because it was realized that some fission product contamination had

[1] Ashley, R. L., Beeley, R. J., Fillmore, F. L., Hallett, W. J., Hayward, Jr., B. R., and Jarrett, A. A., *SRE Fuel Element Damage: An Interim Report, NAA-SR-4488,* Atomics International, November 15, 1959.

occurred in the primary sodium. A filter was installed in the primary system, which collected considerable carbon-containing (decomposed hydrocarbon coolant and lubricant tetralin) material.[1]

- Run 12 lasted from May 14 to May 24, 1959. The reactor performed normally during this entire period. A fuel element was examined after shutdown and there was no measureable change in fuel dimensions.[1]

- Run 13 lasted from May 27 to June 3, 1959. Prior to run 13, the core gas radioactivity was found to be 1.7 x 10^{-3} µCi/cm^3. It was assumed to be Xe-133 and considered normal. Xe activity had been observed after reactor operations for many months and was attributed to small pin hole leaks in the cladding of a few elements or to uranium contamination from the outside of new fuel elements. The filters were designed to remove particulates from the air; they did not stop noble gases from being released from the reactor building. With the exception of a scram caused by abnormal sodium flow rate, run 13 proceeded smoothly until May 30, 1959. At this time, several abnormalities in temperature measurements occurred. By June 2, 1959, it was clear that something occurred to impair the heat transfer characteristic of the reactor system. A tetralin leak was detected and the run was terminated on June 3, 1959. On June 4, 1959, an attempt was made to wash a fuel element from the core and that resulted in the incident described above. In order to remove the tetralin from the primary system, a nitrogen gas stripping operation was used. About 3 pints of tetralin and 1,500 cm^3 of naphthalene crystals (assumed to be a breakdown product of tetralin) were removed from the primary sodium system.[1]

- Run 14 lasted from July 12, 1959 to July 26, 1959. The SRE was brought to criticality on July 12, 1959, at 6:50 a.m. with rod positions at 46 inches as expected. At 8:35 a.m., as the reactor was increasing power to 0.5 MW, large temperature fluctuations were noted among the fuel channels. Fluctuations were about 10 ^{o}F compared to less than 5 ^{o}F fluctuation under normal operating conditions at 20 MW. Fuel channel exit temperatures also started to diverge more than normal.

  Operation continued until 11:42 a.m. when a reactor scram occurred due to loss of auxiliary primary sodium flow. The reactor outlet temperature at the time of the scram was 485 ^{o}F. Criticality was re-established at 12:15 p.m. and rod-positions were still at 46 inches, indicating no change in reactivity during the scram. Operation continued at slowly increasing power levels and temperatures.

  At 3:30 p.m. both reactor room air monitors detected a sharp increase in activity. To reduce the activity level, the reactor pressure was lowered from 2 to 1 pounds per square inch gauge (psig). A survey of the reactor loading face shield revealed excessive radiation over the sodium level coil thimble in core channel 7. The initial reading was 500 mrad/h. A high bay air sample showed activity of 3 x 10^{-7}

[1] Ashley, R. L., Beeley, R. J., Fillmore, F. L., Hallett, W. J., Hayward, Jr., B. R., and Jarrett, A. A., *SRE Fuel Element Damage: An Interim Report, NAA-SR-4488,* Atomics International, November 15, 1959.

µCi/cm^3 after 15 minutes of decay and 4.5 x 10^{-8} µCi/cm^3 after 90 minutes of decay.

At 4:20 p.m., it was noted that the filter from the air sampler showed an activity level of 160,000 cpm. At 5:00 p.m., a sharp increase in the stack activity to 1.5 x 10^{-4} µCi/cm^3 was noted. This returned to normal by 10:00 p.m. Also at 5:00 p.m., the radiation level over core channel 7 reached 25 rad/h and a decision was made to shut the reactor down and replace the thimble in channel 7 with a standard plug. At 8:57 p.m. the reactor was shut down. The sodium level was checked and found to be normal.

The reactor was brought to criticality again at 4:40 p.m., on July 13, 1959. Rod positions were 49.5 inches out. No significant activity was noted in the high bay. At 5:28 p.m., the reactor power was at 1.6 MW and a planned increase was started. The power level persisted in rising faster than expected and at 6:25 p.m., the reactor was manually scrammed. The peak power was about 14 MW.[1] After the scram, rod positions were 52 inches out as compared with 49.5 inches prior to the scram, but it was decided that the power excursion had not affected the reactor adversely. The reactor was brought up to criticality.

At 9:00 a.m. on July 14, radioactivity in the high bay increased to 14,000 cpm on the air monitor. Two hours later, the source of activity had been localized to channels 29 and 50 in the core loading face. Seal rings were placed on the channels and the contamination levels dropped. Another scram occurred at 1:00 p.m. when a short circuit was introduced into the demand circuit for the main primary pump. Rod positions were an average of 51.1 inches prior to the scram at a power level of 3.7 MW. The reactor was quickly brought back to criticality. Rod positions were an average of 51.9 inches at 3.5 MW after recovery from the scram.

On July 15, 1959, the reactor was pressurized and vented to reduce the radioactivity level caused by Xe in the reactor cover gas. This appears to have been released to the atmosphere. The filters were designed to remove particulates from the air; they did not stop noble gases from being released from the reactor building. It was then decided to shut the reactor down because it would not be able to reach the maximum power level necessary to continue getting the Edison turbine generator online while circulating through the steam generator. During the shutdown, the Edison loop was drained, the main airblast heat exchanger was filled, the reactor sodium level coil was reinstalled in core channel 7 and a complete helium leak check was conducted on the core loading face.

On July 16, 1959, the reactor again achieved criticality. The average rod position was 57 inches out, which indicated a substantial loss in reactivity (about 1.2 percent in the four days since the start of run 14). Intermittent operation continued at low power (less than 2 MW) until July 20, 1959. During this time, measurements of primary sodium plugging temperatures were made, the effects of

[1] The 1961 SRE Fuel Element Damage Final Report notes that the 1959 SRE Fuel Element Damage Interim Report stated a peak power of 24 Mw was reached. However, this value was obtained from a linear extrapolation, which was not valid.

core cover gas pressure on reactivity was studied, and the reactor outlet temperature was gradually raised to see if this improved reactor operating conditions (as it did on run 8).

On July 21, 1959 at 2:10 a.m., a scram was caused by a fast period indication. It is worth noting that "the reactor ha[d] a history of spurious scrams due to apparent period transients….Many so-called period scrams have been traced to voltage and frequency instability in the power suppl[y]."[1] The reactor was critical at 2:25 a.m. at an average rod position of 49 inches. Operation continued at 2.5 MW. At 6:45 a.m., radioactivity in the reactor started building up as indicated by continuous air monitoring system installed to protect personnel. At 10:00 a.m., two air monitors were reading 15,000 and 18,000 cpm. By 2:00 p.m., a high bay air sample found activity at 2 x 10^{-9} µCi/cm^3.

On July 21, 1959 at 9:45 a.m., a reactor scram was manually initiated when flow was lost in the main secondary loop. This loss-of-flow-scram was caused by a low sodium level in the secondary expansion tank resulting from a faulty level coil. After the scram, fuel channel exit temperatures dropped. When the main secondary loop was restored to service, temperature swings were noted in the reactor cold leg. At 11:30 a.m., the reactor was again critical at an average rod position of 54 inches. The spread of fuel channel temperatures was still present, but AI's safety limits were not exceeded.

On July 22, 1959, the fuel temperature recorder on the element in core channel 55 showed fluctuating temperatures from 1,100 to 1,200 ^{o}F. This channel was composed of various experimental fuels and the point recording instrument found channel temperatures higher than recording instruments in the control room. The point recording instrument was felt by AI staff to be unreliable so no attempt was made to reduce the temperature. An instrument recorded a maximum temperature of 1,465 ^{o}F for the experimental fuel element on July 23, 1959. Operation continued at power levels up to 4.5 MW with sodium flow rates up to 1,500 gallons per minute (gpm), and reactor outlet temperatures up to 790 ^{o}F.

On July 23, 1959, it was decided to shut the reactor down in view of the high fuel temperature for the element in channel 55 and because the fuel channel exit temperature spread was not improving noticeably. Reactor outlet temperature was kept between 700 and 800 ^{o}F, although a few fuel channel exit temperatures reached 900 to 1,000 ^{o}F. At 9:50 a.m. on July 23, 1959, a reactor scram occurred due to a fast period indication, but the reactor was critical again at 10:15 a.m. Between midnight and 8:00 a.m. on July 24, fuel elements were jiggled in an attempt to dislodge any foreign material and lower the fuel channel outlet temperature. During this time it was noted that elements in core channels 10, 12, 35, and 76 were stuck in place. Another scram occurred at 12:50 p.m. on July 24, 1959. The reactor was critical again at 1:14 p.m. At 3:40 p.m., another scram was caused by loss of auxiliary primary flow. Criticality was reestablished at 3:56 p.m. Rod positions were an average of 54 inches out.

[1] Ashley, R. L., Beeley, R. J., Fillmore, F. L., Hallett, W. J., Hayward, Jr., B. R., and Jarrett, A. A., *SRE Fuel Element Damage: An Interim Report, NAA-SR-4488,* Atomics International, November 15, 1959, p. III-17.

On July 26, 1959, it was noted that elements in channels 12 and 35 were no longer stuck and the element in channel 76 was somewhat freer. On July 26, 1959, at 11:20 a.m., the reactor was shut down after a total of 16 megawatt-days (MWd) on run 14. The shutdown was made to examine each fuel element that had been running hot and clear away any obstructions in the channels.

The first damaged fuel element was observed at 5:15 p.m. on July 26, 1959. By August 2, 1959, six parted fuel elements had been removed from the reactor and taken to the fuel storage facility before a parted fuel element from core channel 12 became lodged in the fuel handling cask forcing the suspension of operations. After it was determined that "a considerable amount of radiation exposure and contamination in the high bay area was resulting from the attempts to dislodge the jammed fuel element," the plan shifted to modifying a moderator handling cask for fuel removal instead. The removal of the 19 remaining fuel elements began on October 8 and ended on October 19, 1959. The status of the fuel elements are shown in the Table 2.1 below.[1] This is AI's summary of events as of November 15, 1959. AI did not issue a press release regarding the fuel element damage until August 29, 1959.[2]

Table 2.1
Damaged Fuel Elements

Fuel Cluster	Description
R-25	On July 26, 1959 at 5:15 p.m., the element was being viewed by using the portable television camera when it was noted that the cladding appeared to be split open on one of the fuel rods. The element was lowered back into the core, rotated 180 degrees and viewed again showing an additional ruptured fuel rod. The fuel element was stored in storage cell 56.
R-31	On July 27, 1959 at 2:00 a.m., this fuel cluster was found broken in two with approximately one-half of the fuel remaining in the fuel channel. The shield plug and broken section of fuel cluster were stored in storage cell 68.
R-35	On July 27, 1959 at 5:00 p.m., this fuel cluster was found broken in two with approximately one-half of the fuel remaining in the fuel channel. The shield plug and broken section of fuel cluster were stored in storage cell 68.
R-10	On July 27, 1959 at 10:00 p.m., this fuel cluster was found broken in two with approximately two-thirds of the fuel cluster remaining in the fuel channel. The shield plug and broken section of the fuel cluster were stored in storage cell 69.[3]

[1] Ashley, R. L., Beeley, R. J., Fillmore, F. L., Hallett, W. J., Hayward, Jr., B. R., and Jarrett, A. A., *SRE Fuel Element Damage: An Interim Report, NAA-SR-4488*, Atomics International, November 15, 1959.
[2] Atomics International News Release, *During Inspection of Fuel Elements – SRE – Parted Fuel Element…*, August 29, 1959.
[3] According to one stakeholder's recollection of events: "We found only damaged fuel rods, not broken in two."

Table 2.1 (continued)
Damaged Fuel Elements

Fuel Cluster	Description
R-55	On July 28, 1959 at 7:00 p.m., this experimental fuel element was found to be broken in two with approximately one-half of the fuel cluster remaining in the channel. The broken section of the fuel cluster was examined and photographed in the hot cell and then the remains of the cluster were removed from the shield plug section and placed in a container and left in the hot cell. The shield plug was placed in storage cell 73.[1]
R-68	On August 1, 1959 at 11:00 p.m., this fuel cluster was found broken in two with approximately two-thirds of the fuel cluster remaining in the channel. The shield plug and broken section of the fuel cluster were stored in storage cell 72.[2]
R-12	On August 2, 1959 at 5:45 p.m., this cluster was found broken in two with approximately two-thirds of the fuel cluster remaining in the channel. The shield plug and broken section of fuel cluster were contained within the fuel transfer cask awaiting transfer to a storage cell.[3]
R-21	On October 10, 1959 at 10:45 p.m., this cluster was observed in the SRE hot cell. Lower one-third of fuel cluster had broken off and likely remained in the core channel. The portion of the cluster that was removed was canned and stored.[4]
R-23	On October 11, 1959 at 2:13 p.m., this fuel element was removed from the core. It became momentarily stuck in the fuel channel after about 4 feet of upward travel. The element was broken with the lower one-third remaining in the channel. The portion of the cluster removed from the core was canned and in storage.[5]
R-69	On October 14, 1959 at 10:30 p.m., this fuel element was withdrawn from the reactor. The fuel cluster was broken in half and the portion of the cluster that was removed was canned and stored.[6]
R-43	On October 15, 1959 at 7:05 p.m., this fuel cluster was removed from the core. The fuel cluster was broken in half and the portion that was removed was canned and stored.
R-24	Date unknown. Immediate attempts to remove this cluster failed. This cluster and its moderator can was raised and blocked-up after 1 inch in an attempt to free the fuel cluster from the moderator can. No change was noted.[7]
R-76	Date unknown. Immediate attempt to remove this cluster failed. Observations in the core indicate that attempts to remove the fuel element also lifted the moderator can. The fuel cluster and its moderator can were raised and blocked-up after 1 inch in an attempt to free the fuel cluster from the moderator can. No change was noted.[8]

[1] According to one stakeholder's recollection of events: "We found only damaged fuel rods, not broken in two."
[2] According to one stakeholder's recollection of events: "We found only damaged fuel rods, not broken in two."
[3] According to one stakeholder's recollection of events: "Note: broke off when pulling out of the reactor core and contaminated the whole building. The lead safety shield was lifted up by the operator by accident and contaminated the whole SRE building. It was not transferred to the storage cell, because we could not remove it from the fuel transfer cask."
[4] According to one stakeholder's recollection of events: "This is not correct; it was never placed in the hot cell. Not Correct; it was still in the fuel transporter until I left in November of 1959. I do not know how they ever got the stuck fuel rod out of the transporter; we were not able to."
[5] According to one stakeholder's recollection of events: "This is not correct; all fuel rods were out of the reactor core by the first part Sep. The last two were pulled out with a Cherry Picker. All incorrect information."
[6] According to one stakeholder's recollection of events: "No fuel rods were withdrawn in October; they were already removed."
[7] According to one stakeholder's recollection of events: "I think this is when we tried to pull to pull out the two last broken off fuel rods with a Cherry Picker. We failed a number of times until we were able to pull the broken fuel rods out of the moderator can."
[8] According to one stakeholder's recollection of events: "Notice they have no date. There was very little said about what we did in getting those broken fuel rod ends out of the reactor core and the timing we did it."

- Fuel element examination showed that 13 of the 43 fuel elements in the SRE during power run 14 exhibited substantial damage. Figure 2.1.3l shows fuel damage to the bottom and midsection of the fuel element in channel 55. Figure 2.1.3m shows the fuel damage to the top of the fuel element in channel 55.[1] The following sequence of events led to fuel element failure:

    - Tetralin slowly leaked into the primary sodium via a freeze seal on the main primary pump. The tetralin leaked into 1,000 ^{o}F sodium for a period of five days and into 350 ^{o}F sodium for another nine days when the reactor was shut down to repair the pump.

    - A nitrogen purge was used to remove tetralin and decomposition products from the sodium.

    - Carbon, other tetralin decomposition products, and oxides were still present in the core, despite being undetected. Partial plugging of several fuel channels was evident from the spread in fuel channel outlet temperatures. The plugs were located randomly in the core and in the channels and it is possible some of the elements were plugged before run 14 began.

    - The fluctuation in coolant flow produced severe thermal cycling of the fuel, which caused the fuel to swell until the cladding ruptured.

    - Local heat transfer was disrupted by plugged coolant lines and high temperatures (above 1,400 ^{o}F) were reached even at low power. These high temperatures led to the diffusion of uranium into the stainless steel cladding forming a low-melting iron-uranium eutectic alloy.[2]

- Reactivity changes in power run 14 were also attributable to the presence of tetralin decomposition products in the reactor. The reactivity loss of 1.2 percent during the first four days of run 14 was caused by sodium entering the R-10 and R-42 moderator cans likely caused by abnormal temperature conditions in the core. The reactivity increase of 0.3 percent, which produced an excursion to about 70 percent full power, was likely the result of sodium expulsion from several fuel channels in quick succession. The general conclusion of the 1961 *SRE Fuel Element Damage* report is that “no important change in [the SRE’s] physical condition [has occurred] as a result of the fuel element damage to the first core.[2]

- Following removal of the fuel elements, inspection of the core began. The radiation level at the bottom of the loading face shield was measured at 43 rad/h. The fuel slugs and cladding fragments remaining in the core were picked up by articulated grapples, canned, and then stored with other damaged fuel. Removal of damaged moderator cans showed that sodium had leaked into cans R-10 and R-42. Later sodium leak checks found cans

[1] Ashley, R. L., Beeley, R. J., Fillmore, F. L., Hallett, W. J., Hayward, Jr., B. R., and Jarrett, A. A., *SRE Fuel Element Damage: An Interim Report, NAA-SR-4488*, Atomics International, November 15, 1959, pp. IV-A-17 – IV-A-18.
[2] Ashley, R. L., Beeley, R. J., Fillmore, F. L., Hallett, W. J., Hayward, Jr., B. R., and Jarrett, A. A., *SRE Fuel Element Damage, Final Report, NAA-SR-4488 (suppl.)*, Atomics International, 1961.

R-32, R-44, and R-45 also contained leaks. A total of 16 cans were replaced. As a result of the fuel cladding failures during power run 14, an estimated 5,000 to 10,000 Ci of fission products were released to the primary coolant system.[1]

Although conducted after the end of the major incident, a gamma spectrometer scan of an air sample identified Xe-133 and Kr-85 as the principle remaining contaminants. AI extrapolated the decay of these two isotopes back to the date of the SRE shutdown on July 26, 1959, and estimated contamination levels of 7.4 $\mu Ci/cm^3$ for Xe-133 and 0.016 $\mu Ci/cm^3$ for Kr-85. Through radioactive decay of the Xe-133 and cover gas purging operations, the fission product contamination level in the reactor cover gas was estimated at 4×10^{-3} $\mu Ci/cm^3$ Kr-85 by September 29, 1959. Fixed contamination of the primary sodium piping was found. Isotopes detected were Sr-89, Sr-90, zirconium-niobium-95 (Zr-Nb-95), Ce-144, and Cs-137. The cold trap (vapor condenser) was also found to collect radioactivity with dose rates ranging from 50 to 80 rad/h at 2 inches from the cold trap surface.[1] There are many caveats to interpreting sample results following the SRE fuel cladding failures. Limited sampling opportunities and reactor recovery efforts imposed restrictions on the quantitative value of data collected.

- Constant monitoring for airborne contamination in the reactor room occurred during recovery efforts. The highest level recorded was 3×10^{-8} $\mu Ci/cm^3$ during core inspection on May 21, 1960 and operations had to be suspended for one hour. General contamination on the walls, floors, tools, etc. in the reactor room ranged from 100 to 1,500 dpm/100 cm^2 of beta-gamma activity. Occasional high counts of 150,000 dpm/100 cm^2 were detected and reportedly cleaned up.

  Several instances of minor contamination of the asphalt blacktop were reported just outside the SRE access door. These areas were reportedly cleaned up. According to the AI 1961 *SRE Fuel Element Damage* report, with the exception of the inert gases Xe-133 and Kr-85, all of the fission fragments remained in the sodium or were absorbed by the metal surfaces of the cladding or the piping. The principle fission products found in SRE primary piping were Sr-90, Ce-144, and Cs-137. During SRE recovery operations, several modifications were made to the reactor system. Tetralin was eliminated as a coolant in favor of NaK, nitrogen gas, and kerosene. The sodium heat transfer system was modified. Instrument monitors were added to the system and the fuel element geometry was altered to provide more clearance between the fuel element and channel.[2]

Incidents after the July 12, 1959 Major Incident

- On September 10, 1959, two AI employees entered a radioactive storage area west of the SRE without permission. The area contained highly radioactive, contaminated equipment and was normally barricaded with yellow and black rope and signs stating: "No Entry Without Tagged Entry Permit," "Contact Health Physics Before Entering," and "Contaminated Equipment." Two AI health physicists discovered the barricade had been removed, a large trailer truck was parked 50 feet inside the barricade, and three outside contractors were loading radioactive waste onto the truck. These contractors were

[1] Hart, R. S., *Distribution of Fission Product Contamination in the SRE, NAA-SR-6890*, Atomics International, March 1, 1962.
[2] Ashley, R. L., Beeley, R. J., Fillmore, F. L., Hallett, W. J., Hayward, Jr., B. R., and Jarrett, A. A., *SRE Fuel Element Damage, Final Report, NAA-SR-4488 (suppl.)*, Atomics International, 1961.

wearing protective clothing. In the southwest section of the area, three people (two AI employees and a contractor) were examining material without wearing any protective clothing. One of the health physicists requested that the men leave the area and one of the AI men responded that they were busy. When the men eventually started to leave, the health physicist requested that they remain for a contamination check and the men refused. One of the AI men stated they were late for a meeting and that the health physicist and his supervisor had better not interfere with the operation. As a result of this violation, the AI men and the contractor, subjected themselves to a high radiation field (Incident Report A0351).[1]

- On November 21, 1959, an employee was modifying an SRE core recovery tool when an exit survey found contamination on his nose, upper chest, and undershorts. The undershorts had to be discarded as contaminated waste. Nose swipes indicated contamination up to 3,600 dpm beta-gamma. Smears of the face and upper chest found contamination at 400 and 5,600 dpm beta-gamma, respectively. The employee's dosimeter worn at the time of the incident gave a reading of 50 mR. After a shower and repeated cleaning of the nostrils, no significant contamination was found. A positive urine specimen did come back and the employee was restricted from tagged areas until additional results were received (Incident Report A0390).[2]

- On December 7, 1959, an employee violated standard operating procedures and did not notify the health physics department that he was entering the high bay area of the SRE, a red tagged area. He also failed to wear the proper clothing required for this high radioactive contamination area. The incident report notes the employee was reminded of proper procedure (Incident Report A0548).[3]

- On December 18, 1959, an employee was found working in the SRE Hot Cell Service Area, a red tagged area highly contaminated with beta-gamma activity, without a protective hood. A health physicist verbally informed the employee that he was in violation of his entry permit and he needed to leave the area. The employee stated that no hoods were available and he continued to work. When the employee finally left the area, he did not check himself for radioactive contamination as required by his entry permit. The employee was informed that it was his responsibility to follow the requirements of his work permit (Incident Report A0391).[4]

- On April 11, 1960, an employee's nose became contaminated up to 190 dpm beta-gamma when the viewing glass of the remote cell he was working in started leaking. He was immediately taken out of the area and decontaminated (Incident Report A0510).[5]

[1] Borg, G., Atomics International Internal Letter, re*: Account of Incident on September 10, 1959 at about 10 a.m. in the Radioactive Waste Storage Area West of the SRE as per G. Borg,* September 11, 1959.
[2] Young, C. L., Atomics International Internal Letter, re*: Radiological Safety Incident Report, Sodium Reactor Experiment, 11/21/59,* December 7, 1959.
[3] Bell, C. E., Atomics International Internal Letter, re*: Violation of Health Physics Practices*, December 11, 1959.
[4] Lang, J. C., Atomics International Internal Letter, re*: Notice of Rule Infraction*, December 31, 1959.
[5] Shannon, J. W., Atomics International Internal Letter, re*: Radiological Safety Incident Report, SRE Hi Bay Area, 4/11/60,* April 11, 1960.

- On May 15, 1960, a leak occurred in the tank used for containing sodium removed from the reactor. The sodium ignited upon contact with the atmosphere causing a large volume of smoke. Approximately 200 g of sodium containing fission products was burned. A 30 minute air sample was taken about 10 minutes after the fire occurred. Beta-gamma activity was 1.3 x 10^{-10} µCi/cm^3 on immediate counting. After 1 hour the activity level decreased to 5.0 x 10^{-11} µCi/cm^3 (Incident Report A0394).[1]

- On May 25, 1960, a corescope from the SRE core was being removed and came out of the gas lock because there were no markings to identify the upper limit of the equipment when it is in the gas lock. When the corescope came out, core gas contaminated with mixed fission products escaped for a short period. Two employees received nasal contamination ranging from 47 to 392 dpm beta-gamma. The employees were decontaminated and a recommendation was made to mark all equipment going through a gas lock with an upper limit (Incident Report A0393).[2]

- On June 2, 1960, an employee was slightly injured and contaminated while working on an SRE fuel coffin. The incident report has not been located (A0460).[3]

- On June 9, 1960, a corescope from the SRE reactor core was being removed through a 6-inch gas lock when it was discovered that the valve on the gas lock had not completely closed. Immediate attempts were made to close the valve, but in the brief time it was open gas containing mixed fission products escaped from the SRE reactor core into the high bay. Nasal smears were done and employees were found to be contaminated between 18,000 and 26,000 dpm beta-gamma. At least one employee had hair and facial contamination of 5 mrad/h. The contaminated employees were immediately removed from the high bay area and decontaminated. At least one employee was restricted from further exposure until bioassay results were obtained (Incident Report A005).[4]

- On July 6, 1960, gas contaminated with mixed fission products escaped into the high bay atmosphere. An employee was measuring a moderator can through a window in the gas lock that had a plastic bag covering it and the employee's arm. As the employee removed his arm from the plastic bag, the gas escaped and set off the continuous air monitor. The plastic bag was quickly sealed and the employee was advised to leave the high bay for nasal smears. Fifteen minutes later, the employee had not reported to health physics and claimed his chief operator did not deem it necessary to leave. Eventually three men were given nasal smears as a precaution. Results ranged from 0 to 3,168 dpm beta-gamma. The employee with the highest reading was decontaminated down to 22 dpm beta-gamma for the right nostril and 10 dpm beta-gamma for the left nostril (Incident Report A0442).[5]

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[1] Galperin, A., Atomics International Internal Letter, re*: Radiological Safety Incident Report, SRE High Bay, 5/15/60*, May 26, 1960.
[2] Galperin, A. and Shannon, J. W., Atomics International Internal Letter, re*: Radiological Safety Incident Report, SRE High Bay, 5/25/60*, August 30, 1960.
[3] Boeing Radiation Incident Database, 2010.
[4] Lane, W. D., Atomics International Internal Letter, re*: Radiological Incident Report, SRE High Bay, 6/9/60*, July 20, 1960.
[5] Galperin, A., Atomics International Internal Letter, re*: Radiological Safety Incident Report, SRE High Bay, 7/7/60*, August 31, 1960.

- On December 15, 1960, two employees became contaminated during a sandblasting operation. A sodium pump was being decontaminated by sandblasting in a plastic tent fabricated for this purpose. The pump was contaminated with mixed fission products and a maximum radiation level was measured at approximately 5 rad/h. One employee was working in full protective clothing and face mask inside the tent, while the other employee was operating the sandblasting compressor outside the tent. After approximately 3 minutes, the employee in the tent realized dust was leaking into his face mask. He motioned to have the compressor shut off and stepped out of the tent where he was helped out of his protective gear. Nasal swipes of both men revealed beta-gamma contamination of 75,000 dpm (employee working in tent) and 420 dpm (employee outside tent). A survey meter check found one employee's clothing contaminated up to 0.2 mrad/h. The clothing was disposed and the men were decontaminated (Incident Report A0305).[1, 2]

- On May 17, 1961, an employee working in the SRE high bay discovered contamination on his shoes upon exiting for lunch. Investigation found that the rubber boots he had been wearing as required health and safety dress had developed leaks. After unsuccessful attempts to decontaminate the shoes, they were disposed as radioactive waste (Incident Report A0435).[3]

- On November 4, 1961, an employee working on samples from "hot trap (heater) A" in the SRE high bay became contaminated while grinding a sample container away to expose the sample. The external surface of the sample container was less than 30 dpm beta-gamma, but the sample itself was 3 rad/h. The employee was wearing a hard hat with a face shield for grinding operations and was told that a full respirator would be required when he got close to exposing the sample. The employee stated that he had done this type of work before and had never been contaminated. Upon further observation from a health physicist, the sample had indeed been exposed by grinding operations. A smear survey was taken and indicated high internal contamination. The employee further stated that the air flow through the high bay door was enough to protect him from exposure. The health physicist went to get a face mask for the employee, but none were available. Nasal smears indicated the employee's right nostril was contaminated to 145 dpm beta-gamma and the left nostril was contaminated to 372 dpm beta-gamma. Contamination had also filtered through the employee's cotton gloves and his hands were contaminated to 2 mrad/h. The employee was decontaminated and released (Incident Report A0515).[4, 5]

- On December 23, 1961, an employee entered a red tagged area without a tagged entry permit and manipulated high contaminated core lights without protective gear or without

[1] Klostermann, J. P., Atomics International Internal Letter, re*: Radiological Safety Incident Report, R/A Material Storage Area – SRE, 12/15/60*, December 19, 1960.
[2] Correspondence from Lang, J. C., Atomics International, to Levy, J. V., U.S. Atomic Energy Commission, re*: Preliminary Report – Inhalation Incident at Santa Susana*, January 24, 1961.
[3] DuBois, P. R., Atomics International Internal Letter, re*: Radiological Safety Incident Report, SRE High Bay, May 17, 1961*, May 31, 1961.
[4] Yarrow, A. R., Atomics International Internal Letter, re*: Radiological Safety Incident Report, Bldg. 143 (High Bay), 11/4/61*, November 7, 1961.
[5] Health and Safety Department, Atomics International Internal Letter, re*: Notice of Health and Safety Rule Infraction*, November 8, 1961.

following proper procedure for working with radioactive materials (Incident Report A0472).[1]

- On February 6, 1962, an employee was observed in the Health and Safety Counting Room using counting equipment to measure radioactivity on a smear because he didn't believe the results of a health physicist's survey of the plastic cover on a storage cell. The employee failed to detect the radioactivity (3×10^5 dpm/100 cm^2) observed before and after by health physics analysts. Not only did the employee delay decontamination of the object, but he violated rules by using radiation detection equipment he was not trained to use (Incident Report A0534).[2]

- On April 4, 1962, two sets of air samples for radioactive particulates were taken on the roof of the SRE near the exhaust fans and filters. At least 90 percent of the high bay particulate activity was rubidium-88 (Rb-88). One sample set was taken with the filters bypassed and the other sample set was taken with air exhausted through the filters. The reactor was at 5 MW and only the east fan was on. Air samples from the high bay were taken at the same time as samples on the roof. These results were compared to sample results on March 1, 1962 with the reactor critical. Additionally, a roof sample had been taken on March 3, but it could not be correlated to high bay activity because it was taken in the stack, which only exhausts the hot cell and vent system effluent. Results were as follows:

    - April 4, 1962, 9:30 a.m. filtered exhaust – 5.5×10^{-11} µCi/cm^3 beta-gamma
    - April 4, 1962, 9:30 a.m. high bay activity – 9.4×10^{-9} µCi/cm^3 beta-gamma
    - April 4, 1962, 1:30 p.m. nonfiltered exhaust – 5.9×10^{-9} µCi/cm^3 beta-gamma
    - April 4, 1962, 1:30 p.m. high bay activity – 9.9×10^{-9} µCi/cm^3 beta-gamma
    - March 3, 1962, stack sample – 2.04×10^{-11} µCi/cm^3 beta-gamma
    - March 1, 1962, roof – 1.5×10^{-10} µCi/cm^3 beta-gamma
    - March 1, 1962, high bay – 1.1×10^{-10} µCi/cm^3 beta-gamma (A0015).[3]

- On June 13, 1962, an operator was engulfed in fire during the transfer of core heaters.[4]

- On July 30, 1962, an employee received an exposure exceeding the weekly limit during a source transfer operation. A 200 Ci Sb-124 source was being transferred from one storage cask to another using a bottom loading cask suspended from a crane over the cask containing the source. A cable was then used to pull the source up into the suspended cask. As the source was being drawn up, the suspended cask began to oscillate. The employee approached the cask to steady it so the source could be drawn into it and by so doing exposed himself to the unshielded source. The employee's film badge indicated a dose of 2,150 mrem gamma, but approximately 400 mrem of the film badge exposure

[1] Health and Safety Department, Atomics International Internal Letter, re: *Notice of Health and Safety Rule Infraction*, January 4, 1962.
[2] Health and Safety Department, Atomics International Internal Letter, re: *Notice of Health and Safety Rule Infraction*, February 16, 1962.
[3] Badger, F. H., Atomics International Internal Letter, re: *Air-borne Activity of SRE High Bay*, April 6, 1962.
[4] Boeing Radiological Incident Database, 2010.

was received prior to the incident. The employee was put on restriction to not exceed 100 mrem per week exposure for the remainder of the quarter (Incident Report A0404).[1]

- On October 20, 1962, a three man crew cutting up obsolete core heaters in the northeast corner of the SRE yard became contaminated. The eight heaters were monitored before the operation. All heaters were contaminated less than 150 mrad/h at the surface. The men were dressed in redline coveralls, shoe covers, and gloves for the operation. At lunch time, the men went to the hot change room to change out of their protective gear and contamination was found on their clothing and bodies. Nasal contamination ranged from 70 to 1,200 dpm, hand contamination ranged from 3 to 5 mrad/h, and radiation exposure ranged from 60 to 70 mrad. All men had scattered face and body contamination and two men had contamination on all of their clothes. The men were given continuous showers until contamination levels were brought to background. Further testing was prescribed for internal contamination. The contaminated employees reportedly contaminated most doorknobs in the lower level of the SRE building (up to 300 dpm/100 cm^2) and a large area of the floor (up to 600 dpm/100 cm^2). These areas were decontaminated to 30 dpm/100 cm^2 (Incident Report A0379).[2, 3]

- On March 19, 1964, approximately 3,550 gallons of water were dumped from two new radioactive liquid waste storage tanks located on the north side of the SRE as a part of pre-operation testing for the PEP program. Twenty-four hours later it was discovered that the water was contaminated with an estimated 5.8×10^4 µCi of irradiated corrosion products. A new radioactive liquid waste storage system was installed outside the north end of the SRE building. The system included one used tank (T-1) and two new storage tanks (T-2 and T-3). T-1 was a 150-gallon tank. T-2 was a 350-gallon tank installed alongside T-1 in the sump pit 40 feet below ground level. T-3 was a 3,200-gallon tank installed at ground level. Piping was installed to allow gravity flow of radioactive water to either T-1 or T-2. The waste water was then pumped to ground level where it could be sampled. Activity level permitting, the waste water could then be pumped to T-3 for storage and disposal. T-1 and T-2 were vented to the existing radioactive gas compressor vent system serving the fuel wash cells.

  The old liquid lines to T-1 were closed and T-2 and T-3 were filled with clean water from a nearby fire hydrant to check level indicators and pumps. The next day the water was emptied from the tanks so that the system could go through final checkout. When a health and safety representative came to monitor the circulation lines during final testing, he discovered that two lines from T-2 were radioactive, while the lines to T-1 were at what was characterized at the time as “background.” Apparently, the radioactive gas vent lines had contaminated condensate. A portion of the vent system had been drained of condensate the day before and valved off, but the remainder of the vent line was left open to T-1 and T-2. Condensation accumulated in the open vent line and entered T-2 by gravity flow contaminating the clean hydrant water in the tank. The water was later

[1] Raper, R. R., Atomics International Internal Letter, re*: Radiological Safety Incident Report, SRE West Pad, 7/30/62*, September 6, 1962.
[2] Unknown Author, Atomics International Internal Letter, re*: Incident Report, Contamination of Personnel Working on Disposal of Outworn Core Heaters*, October 20, 1962.
[3] Sapere Consulting, Inc. and The Boeing Company, *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California, Volume 2 – Area IV Site Summaries*, May 2005, p. G-16-17.

analyzed and found to have approximately 18 percent Co-60, 13 percent Co-58, 62 percent Cr-51, and 7 percent Zr-95 – Nb-95.

Once the contamination was discovered the SRE area was secured and a class one emergency was proclaimed. A 150 cubic foot air sample taken in the spill area found airborne activity at 8.3 x 10^{-11} µCi/cm^3 beta-gamma. Survey of personnel in the area found low-level radioactive contamination on shoes only. The maximum contamination on shoes was 2,000 dpm beta-gamma. Vehicles in the area were surveyed and smeared. The maximum contamination detected inside any vehicle was 1,800 dpm/100cm^2 beta-gamma and the maximum contamination outside any vehicle was 4 mrad/h. Contamination was also noted at the north door of the SRE building, where 800 dpm/100cm^2 beta-gamma was detected.

According to the incident report, the major spread of contamination, however, was to the watercourse with low-level contamination spread to no more than 500 feet from the point of dumping on the asphalt. After people and vehicles were decontaminated to less than 30 dpm/100cm^2 beta-gamma they were released from the area. A water sample was taken from the 750,000-gallon SRE retention pond and the drain pump for the pond was secured to prevent release. The pond had not been dumped since the incident. Pond water measured 7.1 x 10^{-6} µCi/cm^3. The asphalt area where the water was first released measured 10 mrad/h with about 3 mrad/h gamma contamination. The SRE ditch measured a maximum 60 mrad/h. The asphalt was hosed down with water and contamination levels dropped to 4 mrad/h, but the maximum contamination in the ditch increased to 80 mrad/h.

Operations decided to abandon efforts to flush the asphalt and brought in a crew to clean out the ditch, and use a floor scrubber and vacuum on the asphalt to decontaminate it. The asphalt was decontaminated to a maximum of 0.7 mrad/h. Four 55-gallon drums of mud and debris from the ditch were removed, which reduced contamination from 80 mrad/h to 15 mrad/h. Further decontamination reduced the ditch contamination to less than 2 mrad/h, except for a small area reading 10 mrad/h that was to be removed later. Any areas indicating up to 2 mrad/h were to be fixed with an additional layer of asphalt.

Rain occurred intermittently for two days during cleanup operations and runoff water filled the SRE pond to within 6 inches of the spillway leading to Brandeis Canyon and Simi Valley on March 23, 1964. The SRE pond was drained to Rocketdyne's Area II ponds to prevent overflow. A sample of the SRE pond when this began indicated 1.8 x 10^{-6} µCi/cm^3. Six hours later a sample indicated 4.1 x 10^{-7} µCi/cm^3. Samples taken at the inlet of the first Area II pond and the midpoint of the second Area II pond 9 hours into the drainage process found 1.4 x 10^{-7} µCi/cm^3 and 6.7 x 10^{-8} µCi/cm^3, respectively. On March 24, 1964, the Area II ponds indicated an average of 6 x 10^{-8} µCi/cm^3. This compares to an average of 6.8 x 10^{-8} µCi/cm3 for a three-month period the previous year. Ultimately, 421,000 gallons of water from the SRE pond was drained to the Area II ponds. It was calculated that the maximum release of contamination from the incident was 5.8 x 10^4 µCi, with 5.2 x 10^3 µCi released in the SRE pond.

According to the incident report, of the major isotopes involved in contamination, the most restrictive maximum permissible concentration at the time for water was 6 x 10^{-5}

μCi/cm^3. With a total release restriction of 1 Ci per year and a release of approximately 3 mCi, it appeared that the standards established by the AEC for liquid disposal were met. The incident report notes that the possibility of significant contamination offsite "appears remote." Failure to detect the release until 24 hours after it happened was attributed to failure of personnel involved to request monitoring of the water, failure of personnel to check out on the hand and foot counter, failure of routine surveys of the building floors to detect increased contamination levels, and lack of frequency in outside surveys (Incident Report A030).[1]

- On June 15, 1964, an employee vacuuming contamination in the fuel handling machine service pit became contaminated. Nose swipes found 90 and 450 dpm beta-gamma in his nostrils and fingers on his right hand were contaminated to 300 dpm beta-gamma. The employee was fully suited and wearing a full face mask while he was working. A few hours later, another employee wearing the same gear exhibited similar results after being in the service pit for 20 minutes. His nostrils were contaminated to 120 and 4,000 dpm beta-gamma. It was determined that the air filter equipment was not rated high enough for the contamination levels in the service pit and supplied air should have been used. The airborne radioactive contamination was mixed fission products from the MK-1 fuel handling machine (Incident Report A0409).[2]

- On June 17, 1964, two employees working in the fuel handling machine service pit were found to be contaminated. One employee was contaminated to a maximum of 0.3 mrad/h on the front of his neck and had a nasal smear of 1,525 dpm beta-gamma. The other employee was contaminated to a maximum of 0.4 mrad/h on the back of his neck and had a nasal smear of 3,675 dpm beta-gamma. Both men were decontaminated, but internal contamination was still present in sputum, spit, and breath. The men were wearing full face masks with supplied air, double coveralls, hoods, two pair of plastic and one pair of canvas shoe covers, and two pair of surgeon's gloves while working. Smears of one of the masks revealed 13,000 dpm beta-gamma inside and 84,000 dpm beta-gamma outside. The incident report notes that there was extremely high surface and airborne contamination beneath the MK-1 fuel handling machine and the incident occurred during removal of Core 1 fuel. No immediate cause was found for the mechanical means of by which the employees inhaled contamination through their protective gear (Incident Report A0493).[3]

- On June 21, 1964, an SRE shift supervisor having been in the MK-1 fuel handling machine service pit was checked out and found to be contaminated. He had been in the pit for inspection prior to component disassembly. A count rate meter indicated approximately 300 cpm on his left forearm and 500 cpm on his shoes. Another employee then exited and was also found to be contaminated to 300 cpm. Nasal smears for the men were 30 and 280 dpm beta-gamma. Apparently, a component from the fuel handling machine had been dropped and caused a cloud of contamination in the tented area. A check of the area indicated 1,000 to 150,000 dpm/100 cm^2 beta-gamma contamination all

[1] Badger, F. H., North American Aviation Internal Letter, re*: SRE R/A Liquid Release*, April 17, 1964.
[2] Bergstrom, W. H., Atomics International Internal Letter, re*: Incident Report, Fuel Handling Machine Service Pit, June 15, 1964*, June 24, 1964.
[3] Unknown Author, Atomics International Internal Letter, re*: Incident Report, FHM Service Pit, 6-17-64*, June 24, 1964.

over the west end of the high bay. An air monitor on the east side of the plastic screen dividing the east and west high bay revealed a 200 cpm increase in airborne contamination. Spots smears of the area revealed less than 30 dpm beta-gamma. Personnel had reportedly taken off the full face mask in a portable change room booth set up adjacent to the service pit during a time when airborne contamination was still significant. Recommendations included providing filtered exhaust to the tented areas of work and use proper donning and doffing of protective gear, including removing face masks after outer garment (Incident Report A0380).[1]

- On September 18, 1964, a crew began work in the SRE high bay to remove Core I fuel, cladding, and debris from the "Poor Man's Hot Cell." Full protective clothing was worn with the exception of full face respirators, as the plan was to set up equipment first and begin operations later in the shift. Grappling tools and a bucket were lowered into the pit. After tedious manipulation with the grappling tool, one 18-inch piece of cladding, possibly containing NaK and up to three fuel slugs, was precariously placed in the bucket. Full face respirators should have been donned at this point, but difficulty was encountered in removing the rod from the bucket and the immediate action of all three personnel was necessary to prevent the rod from falling back into the pit and starting a fire. Upon securing the rod on a ledge, work ceased and all personnel left the area. An immediate contamination survey of two crew members revealed no contamination; however, nose swipes revealed nasal contamination of 1,380 and 9,000 dpm beta-gamma. A third crew member had a nose swipe of 400 dpm beta-gamma after his shower, but the rest of his body was clean. The men were all decontaminated and placed on restriction pending bioassay analysis. The contamination was thought to result from moving the rod to the ledge and creating airborne contamination (Incident Report A0382).[2]

- On December 1, 1964, a probe was wrapped and lowered into a control rod thimble in storage to obtain a radiation measurement. Plastic sheeting was laid on the floor and the employee conducting the survey wore shoe covers and gloves. After getting the measurement, the probe was carefully unwrapped to avoid contamination spread to the probe or the immediate area. A contamination survey of the probe revealed a significant reading on the count rate meter despite precautions. The employee received 0.3 mrad/h contamination on his hands, between 2,000 and 6,000 dpm of contamination over his face, neck, and the front of his clothing, and 1,300 dpm of contamination on a nasal smear. A smear survey of the west high bay area after operation revealed contamination levels from 1,500 to 1,800 dpm /100 cm^2. Decontamination reduced levels to non-detect (Incident Report A0545).[3]

- On December 18, 1964, size reduction of two control rods led to contamination of the surrounding area, equipment, and personnel. A tagged area entry permit was submitted for the transfer, cutting, and canning of control rods in the SRE high bay. Prior to operations, the west high bay floor was covered with plastic and plastic barriers were set

[1] Badger, F. H., Atomics International Internal Letter, re*: Incident Report, SRE High Bay West, June 21, 1964*, July 1, 1964.
[2] Tworek, D. D., Atomics International Internal Letter, re*: Incident Report, "Poor Man's Hot Cell," 9-18-64*, October 6, 1964.
[3] Unknown Author, Atomics International Internal Letter, re*: Incident Report, SRE High Bay, 12-1-64,* December 2, 1964.

up around the storage cells. The work area was roped off and designated a red tagged area. Two control rod lower thimbles were transferred from the canisters in moderator storage cell 2 to the fuel handling machine. They were transferred to two fuel cans, one in storage cell 25 and the other in storage cell 74. The lower 93 inches of each thimble was cut off and remained in the storage cell. The upper 129 inches of each thimble was transferred from the fuel handling machine to the canister in moderator storage cell 2. The radiation levels encountered during the cutting and transfer operations were measured. At 3 feet from the thimble surface, activity was measured at 30 and 36 r/h (units may be incorrectly presented in the source document) for the two thimbles. At the surface of the cutting point, activity was measured at 11.5 and 12 r/h, respectively.

Personnel exposures for three employees at this time were 45, 225, and 240 mr (units may be incorrectly presented in the source document). Follow up smear samples of the area found 3,000 dpm/100 cm^2 beta-gamma on plastic outside the work area, 800 dpm/100 cm^2 beta-gamma on a new full-face mask located south of the storage cells, 300 dpm/100 cm^2 beta-gamma on an uncovered portion of the floor south of the storage cells, and 100 dpm/100 cm^2 on the floor between the hot change room and the door leading to the high bay. One worker had a nasal smear indicating 600 dpm beta-gamma.

A cleanup of the contaminated areas began and another smear survey was conducted. Contamination remained on the hot change room floor (120 dpm/100 cm^2), floor between the hot cell stairs and high bay door (120 dpm/100 cm^2), and high bay floor just inside the hot change room door (180 dpm/100 cm^2). Other surveys found up to 2,400 dpm/100 cm^2 beta-gamma on items in the welder's work area, which prompted immediate roping off of the area and decontamination efforts. It was not clear at the writing of the incident report what caused the contamination of the one employee and the surrounding area. The procedure had followed established guidelines. It was recommended that the open moderator storage cell be covered with a lid or plastic between transfers and that work periodically cease to allow for health and safety monitoring in the future (Incident Report A0371).[1]

- On January 14, 1965, the movement of a temperature probe caused radiation exposure in excess of guidelines for three personnel. Reevaluation of the personnel exposures suggested they were lower than reported because the film badge supplied used a linear formula to calculate exposures instead of a more accurate calibration curve. The corrected exposures showed that the three personnel involved in the incident received lifetime exposures well below the permissible level (Incident Report A0296).[2, 3]

- On February 20, 1965, an SRE core light was removed and replaced with a short plug. Personnel performed the operation manually with 0.5-inch water pressure in the core. The core light was brought up into a bag, which was tied off and cut. An extension of the core channel was removed and the plug was readied for insertion when particles of ignited sodium and contamination were released. The plug was dropped in place almost

[1] Townsend, R. I., Atomics International Internal Letter, re*: Radiological Safety Incident Report, High Bay Area of SRE, Building 143, Santa Susana*, December 18, 1964.
[2] Boeing Incident Database, Reviewed 2011.
[3] Correspondence from Remley, M. E., Atomics International, to Levy, J., U.S. Atomic Energy Commission, re*: Type B Radiation Exposures*, April 2, 1965.

immediately, stopping the release of contamination. The spread of contamination was negligible, but personnel were contaminated. Two workers had contamination on their necks (180 and 300 dpm beta-gamma) and two workers had positive nasal smears (180 and 2,400 dpm). The health physics department was not given advanced notice of the operations and was not aware that the core would be open. Personnel indicated that this activity had been performed in the past without incident. No masks were worn during the operation (Incident Report A0386).[1]

- On February 27, 1965, an employee was contaminated through two pairs of coveralls as he worked to change a door seal inside a moderator cask. The employee was contaminated to about 500 cpm on his neck. Only his head and shoulders were inside the cask and he was wearing a full face mask. The employee was observed the entire time by the health and safety department and no unusual occurrences happened while performing the operation (Incident Report A0416).[2]

- On April 24, 1965, an employee was injured in a non-radiological operation in the SRE high bay. The employee was drilling an electrical circuit box and the drill passed through the tip of this third finger. He was taken to the West Valley Baptist Hospital for treatment and later returned to work. The incident was not radiological in nature, other than it occurred in the SRE high bay (Incident Report A0444).[3]

- On March 22, 1965, an employee cut the tip of his thumb while attempting to adjust the position of a temporary ring in a sodium line prior to welding. A small area of skin on his right wrist was found to be contaminated to 60 dpm beta-gamma. This contamination was easily removed by flushing with water. All other survey results showed background activity (Incident Report A0445).[4]

- On August 19, 1966, an investigation took place to identify the cause of a recent incident at the SRE Tab Exposure Facility (TEF) resulting in exposure of operating personnel to primary sodium. At the time of the incident, personnel had inserted the tabs into the line and were preparing to expose them to primary sodium at nominal operating temperatures when the primary sodium started filling the piping and gas lock used for tab insertion and removal. A freeze stem temperature alarm went off and an operating crew member found drops of sodium on the floor below the gas lock. The TEF inlet and outlet valves were closed and the heaters were turned off so that the TEF was isolated from the primary sodium line. The incident occurred because the temperature alarm on the TEF was out of calibration and alarmed at a higher temperature, preventing cooling operations from being implemented to keep the freeze stem frozen. The occurrence could have been much worse during reactor operations, so standard operating procedures were changed to include adding a lead shield to access ports when the reactor was operating, helium leak testing the TEF prior to melting sodium in the piping and exposure site, and freezing

[1] Bergstrom, W. H., Atomics International Internal Letter, re*: SRE High Bay, 2-20-65*, February 24, 1965.
[2] Owens, D. E., Atomics International Internal Letter, re*: Incident Report, SRE High Bay, 2-27-65,* March 2, 1965.
[3] Moore, J. D., Atomics International Internal Letter, re*: Incident Report, SRE High Bay, 4-24-65,* May 6, 1965.
[4] Moore, J. D., Atomics International Internal Letter, re*: Incident Report, Building 143 Primary Na Pipe Gallery, Mar. 22, 1965,* May 22, 1965.

adjacent piping while sodium was in the exposure site among other changes (Incident Report A0041).[1]

- On December 8, 1967, radioactive water was discovered in two 8-inch pipes that penetrate the floor of the maintenance cell at the SRE. Samples indicated radioactivity of 6×10^{-4} µCi/cm^3, which was principally Cs-137 with small amounts of Sr-90, Y-90, and Co-60. According to the incident report, the radioactivity found in the water samples were comparable to standards for occupational exposure and were no more than a factor of 10 greater than the 1967 standards for exposures in uncontrolled areas, with the exception of Sr-90 in both cases. However, further analysis of the liquid indicated that only about 10 to 15 percent of the total activity in the water was Sr-90. The total activity in the water together with the loose or removable contamination in the pipes was determined to be something less than 0.5 mCi. The incident report states that there is no potential hazard or safety problem associated with the contaminated water, but does note that the accumulation of water is an engineering concern (Incident Report A0321).[2]

- On October 23, 1976, radioactive gas escaped during the removal and replacement of the R-34 instrumentation probe from the core top at the SRE. A health physicist took an air sample 2 inches from inside the plug hole where the probe was located. On his way back to evaluate the sample, he discovered his shoes were contaminated. Results of the air sample were 2.0×10^{-7} µCi/cm^3 for the immediate count and 2.0×10^{-8} µCi/cm^3 for the delayed count. The health physicist reported the suspected contamination around the core and a possible airborne release to the operating personnel. Operating personnel were almost finished reinserting the probe so a 3-minute air sample was taken as the probe was completely replaced. Results of this air sample were 6.3×10^{-9} µCi/cm^3 for the immediate count and 1.7×10^{-11} µCi/cm^3 for the delayed count. The stationary air monitor 5 feet from the core face indicated no increase in radioactivity above background. Four personnel were contaminated between 400 and 500 counts above background. No contamination was found after showering. Nasal smears were below 20 dpm beta for personnel. A smear survey found maximum removable contamination at 10,000 dpm/100 cm^2 beta. Decontamination began to remove the gross contamination as much as possible before the end of the work shift. The SRE high bay was roped off until additional smears and decontamination were completed. The cause of the release was attributed to the core pressure being zero and not negative. Operations involving the removal of plugs from the core were to have verification of negative pressure. Three days later the SRE high bay returned to routine working status (Incident Report A0289).[3]

- On August 1, 1977, the bottom of a cold trap (vapor condenser) at the SRE fell off during movement and contaminated the floor. The cold trap was lifted to a vertical position when the bottom fell off. The top portion of the cold trap was placed in a 55-gallon plastic bag. The bottom portion of the cold trap was hoisted up and placed in a plastic bag inside a 55-gallon drum. Steel baffle plates inside the cold trap had to be pulled

[1] Southward, B. G., Atomics International Internal Letter, re*: Investigation of Incident at SRE Tab Exposure Facility*, August 19, 1966.
[2] Correspondence from Remley, M. E., Atomics International, to Levy, J., U.S. Atomic Energy Commission, re*: Contaminated Water at the SRE*, December 12, 1967.
[3] Radiation and Nuclear Safety, Rockwell International Internal Letter, re*: Incident Report – Radioactive Airborne Release at SRE*, October 28, 1976.

loose and some sodium spilled on to the plastic. Contamination was noted on one of the workers' shoes. Nose smears were taken and ranged from background to 251 cpm. Surveys of personnel clothing revealed contamination ranging from 1,500 cpm to 20,000. Twenty spot smear samples were taken in the high bay area with a maximum count of 50,000 dpm. Additional smears were taken in the health physics office, change room, hallways, shop area, and office area. Two smears came back over 50 dpm and those areas were cleaned (Incident Report A0059).[1]

- On August 10, 1977, a water-filled storage pit used at the SRE for temporary storage of activated material removed from the reactor vessel during decontamination and disposition activities was found to be leaking. The loss of water was detected the day after explosive cutting was done in the reactor vessel near a vault penetration pit that had been welded closed. The thought was that the weld had cracked, allowing water to leak into the reactor cavity. Steps were taken to discontinue work that could aggravate existing cracks; monitor the storage pit water level frequently; and develop plans for locating the leak, storing radioactive components out of the pit, and pumping contaminated water from the pit. The water in the storage pit was contaminated to 7.2 x 10^{-2} µCi/cm^3 gross beta activity with a mixture of Na-22, Co-60, Sr-90, Cs-137, and Pm-147.

  Water samples were collected from existing wells and three additional monitoring wells were drilled. Analysis of the water samples from existing wells indicated that contamination did not spread outside of the immediate site, but could be in the surrounding soil, adjacent vaults, or to the reactor guard vessel annulus. During drilling of one of the new wells outside the east wall of the SRE, soil was found to be contaminated to 1,300 pCi/g. According to Rockwell, normal subsurface soil activity was 10 to 50 pCi/g. The water in the well was much less radioactive than the soil (39 pCi/cm^3). Preliminary water samples taken from nine well sites ranged from 2.1 x 10^{-8} to 4.9 x 10^{-5} µCi/cm^3 where activity was found. The highest contamination was found in the well with the highest soil activity. Thus, the leak appeared to be in the east end of the storage pit. An estimated 2,200 gallons of water was leaked from August 9, 1977 when the pit was filled to August 22, 1977. As a result of the loss of water, radiation levels in working areas at the pit were now 20 to 50 mR/h. In October 1977, water samples were collected again and contamination ranged from 2.7 x 10^{-8} to 9.1 x 10^{-6} µCi/cm^3, with the highest level of contamination at the wash cell valve pit presumably a result of activities that agitated the sediment in the area. Two steel tanks were installed for containment of water in the storage pit and all water in the pit was pumped to these tanks. These tanks also served as the storage location for radioactive components (Incident Report A0414).[2,3]

- On September 23, 1977, a release of airborne radioactivity occurred in the SRE high bay when a sodium passivation vessel was being unloaded by crane. No unusual occurrences

[1] Health and Safety, Rockwell International Internal Letter, re*: Radiation Incident While Moving the Cold Trap into the Alcohol Passivation Tank at SRE*, August 1, 1977.
[2] Correspondence from Tuttle, R. J., Rockwell International, to Jackson, C., Energy Research and Development Administration, re*: Leakage of Radioactively Contaminated Water at SRE*, August 23, 1977.
[3] Correspondence from Tuttle, R. J., Rockwell International, to Jackson, C., Energy Research and Development Administration, re*: Leakage of Radioactively Contaminated Water at SRE,* October 25, 1977.

or visible releases were noted in the operation, but contamination was discovered when a health physicist checked his shoes. One employee had a nasal swipe with 66.5 cpm measured over 10 minutes (Rockwell's nasal background sample showed 20.5 cpm measured over 10 minutes) indicating an airborne release; however, an air sampler 7 feet away did not detect any rise in activity. The contaminated particles were felt by Rockwell to be so large that they fell to the floor in the immediate area and thus were tracked out of the area on shoes (Incident Report A0458 and A0683).[1]

- On June 24, 1978, an employee was carrying a stainless steel tray and tripped over a piece of culvert piping that protruded 4 inches above ground. The worker suffered an injury to his leg and was taken to West Hills Hospital for treatment. The area of the incident was smear surveyed for radioactive contamination. An area of the protruding piping was found to have 50.7 dpm of contamination. No other detectable contamination was found in the area (Incident Report A0578).[2]

Current Use: Building 4143 was demolished in 1999. The extent of the excavation made during building demolition is shown in Figure 2.1.3h.

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

- In early 1967, the AEC approved a plan for the deactivation of the SRE. The implementation of this plan resulted in a "stored-in-place" configuration.[3]

- In 1967 and 1968, Rockwell shut down the primary sodium system and drained the sodium into the primary fill tank, and drained the secondary sodium into drums. The fuel cores were removed to the RMDF. Rockwell flushed and drained the liquid waste system and purged the gaseous waste system. Rockwell decontaminated the sump pit and wash cell pit, and decontaminated the external surfaces of the fuel and moderator handling machines as well as the main and portable hot cells.[1]

- In October 1969, Rockwell pumped groundwater seepage from the SRE wash cell valve pit and spread "Drizite," a commercial drying compound over the pit floor to soak up the remaining moisture to allow for a smear survey of the floor and wall surfaces. Rockwell collected a 500-cm^3 sample of groundwater for radiometric analysis. Results showed a beta concentration of 7.4×10^{-6} $\mu Ci/cm^3$. Groundwater seeped into the pit overnight and a second sample collected the next day indicated a beta concentration of 2.5×10^{-6} $\mu Ci/cm^3$. In November 1969, Rockwell conducted a smear survey and found removable contamination of between 21 and 1,326 dpm/100 cm^2. Rockwell concluded that the soil surrounding the wash cells was contaminated, probably as a result of an explosion that occurred in Wash Cell B in 1959. The wash cell liner was replaced after the explosion, but the outer sleeve was not replaced. This may have ruptured and released fission

[1] Owens, D. E., Rockwell International Internal Letter, re*: Incident Report, SRE – September 23, 1977*, Undated.
[2] Owen, R. K., Rockwell International Internal Letter, re*: Personal Injury Incident of June 24, 1978 at SRE*, July 7, 1978.
[3] Ureda, B. and Heine, W., *Facilities Dismantling Plan for SRE*, Atomics International Report No. FDP-704-990-003, June 24, 1975, pp. 9, 13, 17-18.

products into the surrounding soil.[1] The wash cells were located in the northwest corner of Building 4143.

- In October 1972, Rockwell reported that several areas of the SRE, accessible to personnel, had radiation levels in excess of 100 milliroentgens per hour (mR/h). These areas constituted "high radiation areas" and were required to be equipped with alarms that would be automatically actuated in the event of personnel entry, or were required to be locked with positive control on entry. Rockwell reported that extensive internal contamination was present in the fuel handling machines and moderator handling machines. Also, there was a "significant" amount of combustible material in wooden and cardboard boxes, which posed a fire hazard.[2]

- In July 1973, Rockwell prepared an environmental assessment for the decommissioning of the SRE. Specific items of work included the removal and disposal of primary sodium, sodium piping and tanks; the removal of the remaining secondary sodium system piping, pumps, tanks and components; the removal of systems for the cover gas, heaters, and instrumentation; the removal of the core components; the dissection and disposal of the reactor vessel, liner, and the activated concrete encasing the liner; the cleaning of piping galleries and floor trenches; the decontamination and reinstallation of shield plugs and cover plates; the removal of the fuel element wash cells and below-grade earth as required to eliminate contamination; and the backfilling, compacting, and patching of the floor with concrete to match the existing floor.[3]

- In December 1974, Rockwell made plans to ship SRE fuel to Savannah River.[4]

- In 1975, Rockwell further dismantled and decontaminated the partially dismantled SRE. Rockwell removed reactor vessels and sodium systems, chemically passivated residual sodium, stored bulk primary sodium, and scrapped or buried components. The remaining facilities were decontaminated. [5, 6]

- In December 1976, Rockwell discussed its plan to excavate and repair the high bay. Rockwell's plan called for the excavation of all concrete surrounding the reactor vessel, excavation of all concrete structures enclosing the fuel storage cells, excavation of the wash cells structure including the valve pit, and excavation of the hot cell structure. Rockwell would backfill the excavations with clean concrete rubble and sand and would then pour a new high bay floor.[7]

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[1] North American Rockwell Corporation Internal Letter from R. K. Owen to W. F. Heine, re: *Water Seepage Hole in the SRE Wash Cell Valve Pit*, January 15, 1970.

[2] North American Rockwell Internal Letter from W. F.eine to R. W. Hartzler, re: *Use of SRE Facility for Storage*, October 30, 1972.

[3] North American Rockwell Corporation, Environmental Assessment, *Decommissioning of the SRE*, July 27, 1973.

[4] Rockwell International, Telephone Conversation Record from W. F. Heine to B. Chandler, re: *Shipment of SRE Fuel to Savannah River*, December 11, 1974.

[5] Ureda, B. and Heine, W., *Facilities Dismantling Plan for SRE,* Atomics International Report No. FDP-704-990-003, June 24, 1975, pp. 9, 13, 17-18.

[6] Sontag, S., *Passivation of Remaining Sodium in SRE Core Vessel, Bldg. 143, Detailed Working Procedure,* North American Rockwell Report No. N704-DWP-990-009, October 10, 1975.

[7] Rockwell International Internal Letter from B. F. Ureda to W. F. Heine, re: *SRE Hot Cells D & D,* December 1, 1976.

- In June 1977, Rockwell informed the Energy Research and Development Administration (ERDA) that the plutonium content in 55,000 pounds of SRE primary sodium (in 158 drums) that it planned to ship to Hanford for storage, was below the detection limit of 2 x 10^{-7} µCi/g.[1]

- In February 1979, Rockwell excavated, removed, and shipped to Beatty, Nevada, for disposal, the SRE's 4-foot-thick concrete biological shield. Figure 2.1.3i shows the excavation of reactor shielding, Figure 2.1.3j shows the excavation of concrete surrounding the fuel storage cells, and Figure 2.1.3k shows below-ground excavation. According to Rockwell, tritium (H-3) produced in the reactor would have diffused into the concrete and the soil with which the concrete was in contact. The tritium would also have diffused into groundwater in the region of the SRE. Rockwell considered the releases to be below regulatory limits in effect at the time.[2]

- Between November 1979 and September 1982, ANL conducted a series of radiological measurements and analyses at the SRE. Activities included conducting instrument and smear surveys for radioactive contamination and collecting and analyzing material samples. During the survey in the summer of 1982, 46 locations with elevated radioactivity were detected. Of these areas, 27 indicated contamination in excess of ANL's acceptable limits. However, all the areas were subsequently cleaned to below detectable limits before the survey was completed. ANL collected sludge samples from five access points in the sanitary sewer and storm sewer systems. Elevated concentrations of Cs-137 were detected in three samples from the storm sewer, and Sr-90, Cs-137, and U were detected in the samples from the sanitary sewer as it exited Building 4143. ANL concluded that the effluent from the outfall of the storm and sanitary sewer lines was potentially contaminated.[3]
- In 1983, Rockwell conducted a final release survey of Building 143 that included the below-grade hot cell, the high bay, the overhead bridge cranes, the radioactive exhaust systems, the mezzanine offices, main floor offices, and main floor support areas. Rockwell found all below-grade surface radiation readings to be less than 0.1 mrad/h. All below-grade soil samples registered less than 100 pCi/g. Rockwell's average background reading in the high bay was 0.04 mrad/h. Smear survey results from the high bay were less than 10 dpm/100 cm^2 alpha activity, and less than 70 dpm/100 cm^2 beta-gamma activity. All results were below Rockwell's applicable limits for release for unrestricted use.[4]

- In 1983, Rockwell surveyed Region IX of the SRE facility. This area comprised the paved area surrounding the northern portion of Building 4143 including the drainage channel along the north side of the fence. Rockwell found all surface radiation readings

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[1] Rockwell International Letter from W. D. Kittinger to C. D. Jackson, ERDA, re: *Shipment of SRE Sodium to Hanford*, June 7, 1977.
[2] Tuttle, R. J., *Tritium Production and Release to Groundwater at SSFL*, Rockwell International Report No. N001SRR140120, December 6, 1991, pp. 9-17, 46-48, 54.
[3] Argonne National Laboratory, *Post Remedial Action Survey Report for the Sodium Reactor Experiment (SRE) Facility, Santa Susana Field Laboratories, Rockwell International, Ventura County, California*, DOE-EV-0005-46, ANL-OHS/HP-84-101, February 1984, pp. iii-iv, 15.
[4] Wallace, J. H., *Radiological Survey Results – Release to Unrestricted Use, SRE Building 143*, Rockwell International Report No. N704TI990038, May 31, 1983, pp. 3, 8-9.

to be less than 0.1 mrad/h. All soil samples registered less than 100 pCi/g. All results were below Rockwell's applicable limits for release for unrestricted use.[1]

- In 1983, Rockwell surveyed Region VIII of the SRE facility. This area comprised the paving to the south and west of Building 4143 to approximately the enclosure for the standing tanks T1, T2 and T3, including the drainage channel along the southwest to south edge of the paved area. Rockwell found all surface radiation readings to be less than 0.1 mrad/h. All results were below Rockwell's applicable limits for release for unrestricted use.[2]

- In 1983, Rockwell surveyed Region III of the SRE facility. This area adjoined Building 4163, the Component Equipment Repair Facility (CERF), and comprised the entrance approach to the SRE complex. Rockwell found all surface radiation readings to be less than 0.1 mrad/h. All results were below Rockwell's applicable limits for release for unrestricted use.[3]

- On July 23, 1985, the DOE released the SRE complex for unrestricted use and removed it from the DOE's radiologically contaminated Surplus Facilities Program.[4]

- In July 2000, Boeing excavated, removed, and surveyed for radiological contamination the drainage lines, septic tank and leach field that served Buildings 4003, 4143, and 4163. Instrument measurements and wipe samples were collected from the septic tank and associated piping. Boeing found no man-made gamma emitting radionuclides from gamma spectroscopy of concrete debris from the septic tank. The septic tank was full of a mixture of debris and soil. Boeing collected seven soil/gravel samples from the debris within the septic tank, its inlet pipes, and its outlet pipes. Using gamma spectroscopy, Boeing detected Cs-137 in the inlet pipes and inlet chamber in concentrations up to 2.5 pCi/g. These materials were packaged as radioactive waste per Boeing's policy. Boeing also collected four soil samples from beneath the septic tank, but no man-made radionuclides were identified in these samples. Boeing collected seven soil/gravel samples along the length of the leach field lines. The highest concentration detected was Cs-137 at 0.65 pCi/g, which Boeing considered to be consistent with its local background level in 2001.[5]

- In October, November, and December 2000, Pacific Materials Laboratory, Inc. provided compaction tests during the structural backfill of two 20-foot deep excavations that remained at the conclusion of the demolition and removal of Buildings 4003 and 4143. Rough grading activities were conducted by engineering contractors Standard Industries of Ventura. Prior to fill placement using heavy grading equipment, minor isolated

[1] Wallace, J. H., *Radiological Survey Results – Release to Unrestricted Use, SRE Region IX*, Rockwell International Report No. N704TI990035, May 31, 1983, pp. 3, 7-8.
[2] Wallace, J. H., *Radiological Survey Results – Release to Unrestricted Use, SRE Region VIII*, Rockwell International Report No. N704TI990034, May 13, 1983, pp. 3, 7-8.
[3] Wallace, J. H., *Radiological Survey results – Release to Unrestricted Use, SRE Region III*, Rockwell International Report No. N704TI990029, May 13, 1983, pp. 3, 7-8.
[4] Voigt, W. R., Jr., *Certification for Unrestricted Use of the Sodium Reactor Experiment (SRE) Complex and the Hot Cave Facility (Building 003)*, U.S. Department of Energy, July 23, 1985.
[5] Letter from B. D. Sujata, The Boeing Company, to J. Evans, County of Ventura, re: *Information Regarding Permit – Septic Tank and Leach Field*, October 23, 2001.

depressions and irregularities within the bedrock surface were backfilled with ¾-inch gravel to less than 1 foot in thickness to create a nearly flat surface in the bottom of each excavation. Fill soils placed in the excavation consisted of imported soils exported from an off-site borrow site as well as on-site native soils local to the building sites. The limits of the excavation for Building 4003 are shown in Figure 2.1.3h.[1]

- In 2001, Boeing conducted soil sampling at the former SRE site in areas planned for excavation due to high mercury levels. Boeing found no elevated radiation levels in these areas, but found elevated radiation levels in two locations in a drainage ditch northeast of the former Building 4143 site. Following excavation, confirmation sampling determined that Cs-137 levels were below Boeing's cleanup level of 9.2 pCi/g.[2]

- In 2001, the California Department of Health Services (DHS) conducted soil sampling at the location of elevated soil mercury concentrations, east of the former location of the SRE. The agency found gamma spectral results and isotopic analysis for uranium and thorium to be consistent with DHS background levels.[3]

Radiological Use Authorizations: The following radiological use authorizations were assigned to Building 4143.

- Use Authorization No. 94, issued July 8, 1975, to expire on July 8, 1976, for the decontamination and disposition of the facilities program for the SRE. Authorized materials were unknown quantities of uranium, thorium, and "minor' amounts of transuranic elements, activation products, and mixed fission products.[4]
- Use Authorization No. 94A, issued July 8, 1976, to expire July 8, 1977, for the decontamination and disposition of the facilities program for the SRE. Authorized materials were unknown quantities of uranium, thorium, and "minor' amounts of transuranic elements, activation products, and mixed fission products.[5]

- Use Authorization No. 94C, issued July 8, 1978, to expire July 8, 1979, for the decontamination and disposition of the facilities program for the SRE. Authorized materials were unknown quantities of uranium, thorium, and "minor' amounts of transuranic elements, activation products, and mixed fission products.[6]

Former Radiological Burial or Disposal Locations: A sanitary septic tank was installed for Buildings 4003, 4143, and 4163 as part of the original construction in 1956-57. The system, tank, and leach field were abandoned in 1964 when the complex was connected to the site-wide

[1] Pacific Materials Laboratory, Inc., *Final Compaction Test Report – Structural Backfill of Former Buildings 4143 and 4003 Test Cells, Area IV Rocketdyne, Santa Susana Field Laboratory, Ventura County, CA*, January 2, 2001.
[2] Letter from P. Rutherford, The Boeing Company, to S. Hsu, Department of Health Services, re: *Request for Approval to Ship Soil from SRE to a Landfill*, September 25, 2001.
[3] California, Department of Health Services, Radiologic Health Branch, *Preliminary Radiological Survey of Mercury Contaminated Soils East of the Former SRE Building – Survey Date: July 26, 2001*, November 19, 2002.
[4] Use Authorization No. 94 for the Decontamination and Disposition of the Facilities Program for the SRE, issued July 8, 1975.
[5] Use Authorization No. 94A for the Decontamination and Disposition of the Facilities Program for the SRE, issued July 8, 1976.
[6] Use Authorization No. 94C for the Decontamination and Disposition of the Facilities Program for the SRE, issued July 8, 1978.

sewage treatment plant. In 2000, the septic tank, leach field, and associated piping were excavated and removed.[1]

Aerial Photographs: Aerial photographs show undeveloped land until a 1957 photograph when an irregularly shaped building is identified as Building 4143. A possible crane and overhead piping are identified in the 1957 photograph. In the 1959, approximately 1960, 1965, 1967, 1972, and 1978, photographs, storage tanks, overhead piping, an open storage area, possible debris, and a stain are identified. Surface water flow from the north and south sides of the building are shown to flow to a small pond located northeast of Building 4143. In the 1980 photograph, excavation around the northeast corner of Building 4143 is observed. In the 1983 photograph, open storage is observed at the northeast corner of Building 4143. Building 4143 is present in the 1988 and 1995 photographs, but a vegetated area is seen in place of Building 4143 in the 2005 and 2009 photographs.[2]

Radionuclides of Concern: Building 4143 housed the SRE reactor that initially included a slightly enriched uranium reactor core and later included a uranium-thorium metal alloy core. Possible radionuclides include U-238, U-234, U-235, U-236, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, neptunium-237 (Np-237), Th-232, H-3, Na-22, Na-24, Cr-51, Mn-54, Fe-59, Co-60, Kr-85, Sr-89, Sr-90, Sb-125, I-129, I-131, Cs-134, Cs-137, Ce-141, Ba (La)-140, technetium-99 (Tc-99), Nb-95, Ru-103, Ru-106, Xn-133, Xe-135, Pm-147, Sm-151).[3, 4, 5] All radionuclides of concern listed with the exception of Na-24, Cr-51, Mn-54, Fe-59, Kr-85, Sr-89, I-131, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xe-133, Xe-135, Pm-147 and Sm-151 are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives except for Sm-151 for which no analytical method is available. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Building 4143 was located south of a drainage divide. Based on general site topography, surface water flows into the storm drain system located south of the site and into the drainage channel located north of the site, which both connect to the SRE retention pond located northeast of the site. Outflow from the retention pond was initially onto the NBZ and Brandeis-Bardin Institute land. In 1959, a 6-foot diameter overflow pipe and a pumped sump were installed at the confluence of the two main drainage channels upstream of the pond. Water was then pumped through a 4-inch diameter overland pipe to a channel connecting to the Area II ponds. The overflow from these ponds is into Bell Canyon and thence to the Los Angeles River.[6]

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[1] Letter from B. D. Sujata, The Boeing Company, to J. Evans, County of Ventura, re; *Information Regarding Permit – Septic Tank and Leach Field*, October 23, 2001.
[2] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[3] Hart, R. S., *Distribution of Fission Product Contamination in the SRE*, Atomics International Report No. NAA-SR-6890, March 1, 1962, pp. 8-27.
[4] Kinzer, J. and Crawford, A. C., *SRE First Core Fuel*, Atomics International Technical Data Record No. 5301, May 16, 1960, pp. 1-7.
[5] Letter from Heine, W. F., Atomics International, to Proctor, J. F., E. I. du Pont de Nemours & Company, re: *Fission Product and Fissile Content of SRE Fuel*, July 2, 1975.
[6] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.

Radiological Contamination Potential: The preliminary MARSSIM classification for the Building 4143 area is Class 1 due to its documented releases and its former use as the SRE reactor building.

Recommended Locations for Soil/Sediment Sampling:

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

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

- The flat and low-lying areas surrounding Building 4143. Radionuclides originating from Building 4143 may have migrated to these areas via surface water flow or airborne releases.

- The northeast corner of Building 4143 where open storage was identified in aerial photographs and where spills occurred from sumps and underground vaults.

- The north side of Building 4143 where approximately 3,550 gallons of water were dumped from two radioactive liquid waste storage tanks in 1964, and another spill occurred in 1977.

- The area of the fuel cleaning cells (also known as wash cells) where an explosion caused damage to system components in June 1959.

- The north and east sides of Building 4143 where possible debris and stains were identified in aerial photographs.

- The former septic tank and leach field area that also serviced Buildings 4003 and 4163. Boeing excavated, removed, and survey these items in 2000, but it is not clear that this area was thoroughly investigated and decontaminated.

- The storm drain system located south of the site that connected to the SRE retention pond. The pond initially drained to the NBZ and Brandeis-Bardin Institute land, but was later connected through an overland pipe to a channel/ditch connecting to the Area II ponds.

- The drainage channel/ditch located north of the site that connected to the SRE retention pond. Accidental spills of contaminated water drained into this channel.

- The sanitary sewer line located east of the site. If radionuclides were released into the sanitary sewer system, residual contamination may exist in the materials surrounding the sewer lines.

2.1.4 Building 4153 Area

Site Description: The Building 4153 area comprises Building 4153, and the land surrounding this building located in the SRE complex at the northeast corner of Building 4143 at the end of E Street. Building 4153 was constructed in approximately 1957, as a service building for the SRE.[1, 2] Figure 2.1.4a provides a current photograph. Figure 2.1.4b provides a site layout, and Figures 2.1.4c, 2.1.4d, and 2.1.4e show Building 4153 undergoing demolition. The location of Building 4153 in the SRE complex is presented in Figures 2.1.1f and 2.1.1g.

Building Features: Building 4153 was a small sheet-metal building located at the northeast corner of Building 4143. This is shown on the Building 4143 Floor Plan presented in Figure 2.1.3b. The site layout is presented in Figure 2.1.4b. Building 4153 contained an underground vault, a 2,620-gallon secondary fill tank, a diffusion cold trap (vapor condenser) attached to the bottom of the secondary fill tank, an 80-gallon transfer tank, a sodium melt station, piping, valves, a freeze trap, a vapor trap, electrical controls, and switch gear.[1]

Former Use(s): Building 4153 was the SRE sodium service building.[2]

Information from Interviewees: In 2010, a number of former workers were interviewed about their experiences at the SSFL. One had knowledge of Building 4153. Excerpts from his comments are presented below.

- "Building 4153, the Sodium Service Building, contained the secondary sodium storage tank and the sodium melt station."[3] This interviewee worked at the SSFL between 1958 and 1968.

Radiological Incident Reports: There have been several incidents associated with Building 4153 that could have resulted in a release to the environment. The following table provides information presented in an incidents database provided by Boeing. Summaries of the incident reports are provided following the table, when available.

Building 4153 Incident Report Summary

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A0340	3/12/1960	NA SERVICE VAULT		SODIUM SERVICE VAULT SPILL CLEAN-UP RESULTED IN FIRE IN SODIUM CONTAINER.
A0426	4/4/1960	NA SERVICE VAULT	ACP	SRE SODIUM SERVICE VAULT MODIFICATION IGNITED TETRALIN DURING WELDING.
A0010	4/10/1961	NA SERVICE VAULT	MFP	SODIUM FIRE IN SODIUM SERVICE VAULT.

[1] Ureda, B. and Heine, W, *Facilities Dismantling Plan for SRE*, Atomics International Report No. FDP-704-990-003, June 26, 1975, pp. 76-77.
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[3] Interview No. 300 of former worker conducted by the DOE and EPA on July 16, 2010, p. 2.

Building 4153 Incident Report Summary (continued)

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A0532	1/29/1962	SRE NA VAULT		EMPLOYEE REPORTED INJURED AND CONTAMINATED LEG ON THE NEXT DAY.
A0013	1/30/1962	SRE NA VAULT	MFP	EMPLOYEE MOVED CONTAMINATED ITEM INTO CLEAN AREA WITH OUT HP APPROVAL.
A0533	3/6/1962	NA SERVICE VAULT	MFP	WORKER IN SODIUM SERVICE VAULT W/O REQUIRED PERMIT OR CONTROLS.

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

- On March 12, 1960, a crew of men was going to work on a filter and cold trap (vapor condenser) in the Sodium Service Vault when one of the men noticed sodium leaking from a valve. The sodium had leaked over some of the piping and onto the floor of the vault. The fire department was notified and the sodium was removed from the vault by putting it in a 55-gallon drum filled with calcium carbonate. The sodium was measured at 1,300 dpm/g and the radiation field the men were working in was 400 mrad/h. At approximately 10:45 a.m., a fire started in one of the 55-gallon drums, but it was quickly put out with an argon purge. A few minutes later, a fire was noticed in the sodium service vault. The vault workers donned contained breathing apparatus and some assisted the firemen in trying to put out the fire. Eventually, the vault had to be sealed and purged with argon to put the fire out. During the fire, a high volume air sample was taken and measured 1.64×10^{-10} $\mu Ci/cm^3$. All personnel and equipment in the immediate area were smeared and found free of contamination (Incident Report A0340).[1]

- On April 4, 1960, a fire started in the Sodium Service Vault when welding sparks ignited tetralin on the floor of the vault. Approximately 2 quarts of residual tetralin was on the floor when tetralin lines had been removed for modification. The area and personnel involved were monitored and no contamination was found. A high volume air sample was also taken and revealed no radioactive airborne contamination (Incident Report A0426).[2]

- On April 10, 1961, a contaminated sodium fire erupted in the Sodium Service Vault area. Sodium that had leaked onto the floor of the vault was being removed by being placed in 35-gallon drums with calcium carbonate. Once all the sodium from the floor was drummed, sodium-covered insulation from the cold trap flange was placed in the drum. An explosion occurred and an employee nearby started pouring calcium carbonate on the contents of the drum. Another explosion occurred, accompanied by flames, and the drum was capped with a lid. At this time, an employee in full face mask carried the drum out

[1] Hetzler, D.K., Atomics International Internal Letter, re*: Radiological Safety Incident Report, SRE Sodium Service Vault, 3/12/60,* March 30, 1960.
[2] Marcotte, E.J., Atomics International Internal Letter, re*: Radiological Safety Incident Report, Sodium Service Vault SRE, 4/4/60,* April 19, 1960.

of the area so fire fighting could be effectively employed. After the smoking drum was removed another bag of calcium carbonate was emptied into the drum and an argon purge was started under the lid of the drum. Calcium carbonate was banked along the bottom of the drum to prevent any sodium from leaking out. The drum started to cool off and it was placed in a 55-gallon drum as secondary containment with additional calcium carbonate. Personnel involved received nose smears, but all were negative. A high volume air sample taken in the Sodium Service Vault showed airborne activity at 6.3×10^{-10} µCi/cm^3. Smears taken in the surrounding area were all less than 30 dpm. The cause of the fire appeared to be use of damp calcium carbonate (Incident Report A0010).[1]

- On January 29, 1962, an employee scratched his leg while working in the Sodium Service Vault. He did not report the injury or have it checked out at the time. The following day he became contaminated again. The front portion of the employee's leg was contaminated to 1.3 mrad/h. The wound itself was free from detectable contamination. The Sodium Service Vault was noted as a red tagged area. The employee had been handling waste from this area with a radiation field of 250 mrad/h before the contamination was detected (Incident Report A0532).[2]

- On January 30, 1962, a tagged area entry permit for work in the Sodium Service Vault was approved for the first shift of workers. The permit was specified to expire at 4:00 p.m. A tour of the SRE facility at 6:30 p.m. revealed that four men were working in the area. Two men were in the vault welding the hot trap (heater) and two men were packaging waste. All four men had initialed the entry permit after it expired. One of the employees requested the health physicist to monitor some radioactive waste. The waste was found to be 230 mrad/h, an abnormally high reading for waste from the Sodium Service Vault. A check of personnel was immediately conducted. One employee was found to have contamination on his hands (1.2 mrad/h), leg (1.3 mrad/h), shoe (1.2 mrad/h), socks (0.7 mrad/h), and nose (nasal smear 374 dpm). Another employee had 0.5 mrad/h contamination on his hand because he did not have rubber gloves on under his canvas work gloves. Both men were successfully decontaminated. In an effort to pinpoint the cause of the contamination, an employee brought a flashlight into the Health and Safety Office, an untagged area, for a smear survey. The flashlight was found to be contaminated to 120 dpm beta-gamma. Eventually, a new tagged area entry permit was requested to complete the work in the Sodium Service Vault. Numerous radiological safety rules and practices were violated in this incident and rule infraction notices were issued (Incident Report A0013).[3, 4]

- On March 6, 1962, an employee removed tape over a weld in the SETF high bay and NaK ran out onto his hand and leg. He "flipped" the NaK off his hands, but his coveralls started to burn. He took the coveralls off and headed for the shower. The Fire

[1] Lane, W.D., Atomics International Internal Letter, re*: Radiological Safety Incident Report, SRE Sodium Service Vault, 4/10/61*, April 28, 1961.
[2] Health and Safety Department, Atomics International Letter, re*: Notice of Health and Safety Rule Infraction*, February 7, 1962.
[3] Denham, R.S., Atomics International Internal Letter, re*: Unusual Incident – SRE – January 30, 1962*, February 5, 1962.
[4] Health and Safety Department, Atomics International Internal Letter, re*: Notice of Health and Safety Rule Infraction*, February 7, 1962.

Department cleaned up the NaK. Health and Safety monitored the area and found no detectable beta-gamma contamination. The employee was found free of contamination. He did not realize there was NaK in the system and was not dressed in proper protective gear (Incident Report A0533).[1]

Current Use: Building 4153 was demolished in 1978. Figures 2.1.4c through 2.1.4e show stages in the demolition process.

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

- By 1975, Rockwell had drained the secondary fill tank. At this time, Rockwell found that the diffusion cold trap, welded to the underside of the secondary fill tank, contained between 5 and 15 cubic feet of solid sodium. Rockwell planned to passivate the sodium in Building 4163 and cut the cold trap loose. After removing the sodium systems and deactivating the electrical and gas services, Rockwell planned to have Building 4153 razed by a salvage contractor.[1]

- In May 1977, Rockwell requested that Building 4153 be "razed" by a demolition contractor who would accept the resulting salvage materials in exchange for the labor required. This demolition contractor was also required to remove the water tank support structure, the vent system blower support structure, both located above the inert gas system on the north SRE wall, and the shed-like structure located between the SRE and vault.[2]

- In 1978, Rockwell undertook the demolition of Building 4153, part of which was underground. The concrete surfaces of the sodium service vault had become contaminated during reactor operations. Rockwell excavated an access ramp at the northeast corner of Building 4143 and found radiological contamination as high as 13,000 pCi/g in the soil and in cracks in the bedrock surrounding the footing of Building 4143. Rockwell packaged contaminated rubble, soil, and bedrock in tri-wall cardboard containers of 2000-pound capacity, mounted on plywood skids. Rockwell shipped this contaminated waste to two unnamed burial sites. Uncontaminated concrete was used as backfill material. The area was backfilled to provide machine access for further decontamination activity within the high bay of Building 4143.[3] Figures 2.1.4c through 2.1.4e show stages in the demolition process.

- In September 1982, ANL conducted an independent verification survey in the region of former Building 4153. This included instrument and smear surveys and analysis of

[1] Sessions, S.D., Atomics International Internal Letter, re*: Radiological Safety Incident Report, SETF High Bay, Bldg 24, 3/6/62*, March 21, 1962.
[2] Rockwell International Internal Letter from B. F. Ureda to S. Cunha, re: *Disposition of Building 153 – Sodium Service Building*, May 25, 1977.
[3] Rockwell International, *Sodium Reactor Experiment Decommissioning Final Report*, ESG-DOE-13403, August 15, 1983, pp. 115-120, 166-171.

material samples. ANL found that radiological contamination was below the limits specified in the Draft ANSI standard No. N13.2 and the 1982 NRC guidelines.[1]

- In 1983, Rockwell conducted a radiological survey of the paved area surrounding the northern portion of Building 4143 including the drainage path along the north side of the fence. Survey results indicated an average reading of 0.04 mrad/h for surface gamma radiation, and 108 soil samples were found to have an average of 33 pCi/g of gross detectable beta activity, with a maximum of 98 pCi/g. Rockwell's acceptable limit for soil was 100 pCi/g of gross detectable beta activity. All survey results were below Rockwell's applicable limits for release for unrestricted use.[2]

Radiological Use Authorizations: The DOE released the area for unrestricted use as part of the SRE release dated July 23, 1985.[3]

Former Radiological Burial or Disposal Locations: Building 4143, adjacent to Building 4153, had a sanitary septic tank installed as part of the original construction for Buildings 4003, 4143, and 4163 in 1956-57. The system, tank, and leach field were abandoned in 1964 when the complex was connected to the site-wide sewage treatment plant. In 2000, the septic tank, leach field, and associated piping were excavated and removed.[4]

Aerial Photographs: Aerial photographs show undeveloped land until the 1957 aerial photograph when a small rectangular building is identified as Building 4153. Building 4153 is seen in the 1959, approximately 1960, 1965, 1967, and 1972 photographs. In the 1978 photograph, Building 4153 appears to have been demolished. In the 1980 photograph, an excavation is observed in the location of Building 4153. In the 1983 photograph, open storage is observed in the location of former Building 4153. Bare ground is observed in the 1988 and 1995 photographs, and a vegetated area is seen in the 2005 and 2009 photographs.[5]

Radionuclides of Concern: Building 4153 was part of the SRE reactor complex and was located on the north side of Building 4143. Possible radionuclides include U-238, U-234, U-235, U-236, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Th-232, H-3, Na-22, Na-24, Cr-51, Mn-54, Fe-59, Co-60, Kr-85, Sr-89, Sr-90, Sb-125, I-129, I-131, Cs-134, Cs-137, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xn-133, Xe-135, Pm-147, Sm-151.[6, 7, 8] All radionuclides of concern listed with the exception of Na-24, Cr-51, Mn-54, Fe-59, Kr-85, Sr-89, I-131, Ce-141, Ba (La)-

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1 Argonne National Laboratory, *Post Remedial Action Survey Report for the Sodium Reactor Experiment (SRE) Facility, Santa Susana Field Laboratories, Rockwell International, Ventura County, California*, DOE-EV-0005-46, ANL-OHS/HP-84-101, February 1984, pp. 1-3, 15.
2 Wallace, J. H., *Radiological Survey Results – Release to Unrestricted Use, SRE Region IX*, Rockwell International Report No. N704TI990035, May 31, 1983, pp. 3-8.
3 U.S. Department of Energy, *Certification for Unrestricted Use of the Sodium Reactor Experiment (SRE) Complex and the Hot Cave Facility (Bldg. 003)*, July 23, 1985.
4 Letter from B. D. Sujata, The Boeing Company, to J. Evans, County of Ventura, r: *Information Regarding Permit – Septic Tank and Leach Field*, October 23, 2001.
5 U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
6 Hart, R. S., *Distribution of Fission Product Contamination in the SRE*, Atomics International Report No. NAA-SR-6890, March 1, 1962, pp. 8-27.
7 Kinzer, J. and Crawford, A. C., *SRE First Core Fuel*, Atomics International Technical Data Record No. 5301, May 16, 1960, pp. 1-7.
8 Letter from Heine, W. F., Atomics International, to Proctor, J. F., E. I. du Pont de Nemours & Company, re: *Fission Product and Fissile Content of SRE Fuel*, July 2, 1975.

140, Nb-95, Ru-103, Ru-106, Xe-133, Xe-135, Pm-147 and Sm-151 are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives except for Sm-151 for which no analytical method is available. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Building 4153 was located south of a drainage divide. Based on general site topography, surface water flows into the drainage channel located north of the site, which connects to the SRE retention pond located northeast of the site. Outflow from the retention pond was initially onto the NBZ and Brandeis-Bardin Institute land. In 1959, a 6-foot diameter overflow pipe and a pumped sump were installed at the confluence of the two main drainage channels upstream of the pond. Water was then pumped through a 4-inch diameter overland pipe to a channel connecting to the Area II ponds. The overflow from these ponds is into Bell Canyon and thence to the Los Angeles River.[1]

Radiological Contamination Potential: The preliminary MARSSIM classification for the Building 4153 area is Class 1 due to its former use as a service building for the SRE reactor.

Recommended Locations for Soil/Sediment Sampling:

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

Previous characterization studies for the Building 4153 area were focused on delineating the extent of contamination to standards that were applicable at the time. Characterization was not conducted to delineate the extent of contamination consistent with the DTSC/DOE December 2010 AOC. Therefore, additional characterization is recommended for the Building 4153 area. This includes the following Building 4153 areas and appurtenances:

- The flat and low-lying areas surrounding and in the location of Building 4153 where open storage was identified from aerial photographs. Radionuclides originating from Buildings 4143 and/or 4153 may have migrated to these areas via surface water flow or airborne releases.

- The drainage channel located north of the site that connects to the SRE retention pond. Spills occurred in Building 4153 that contained an underground vault, a 2,620-gallon secondary fill tank, a diffusion cold trap attached to the bottom of the secondary fill tank, an 80-gallon transfer tank, a sodium melt station, piping, valves, a freeze trap, and a vapor trap.

2.1.5 Building 4163 Area

Site Description: The Building 4163 area comprised Building 4163 and the land surrounding it, located in the SRE complex approximately 50 feet east of Building 4143, at the end of E Street. Building 4163 was constructed in 1958 as a site service building.[2, 1] Figures 2.1.5a through

[1] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.
[2] Wallace, J. H., *Radiological Survey Results – Release to Unrestricted Use, SRE Building 163*, Rockwell International Report No. N704TI990039, April 8, 1982, pp. 3-7.

2.1.5c provide a current photograph, a floor plan, and a 1977 aerial photograph. The location of Building 4163 in the SRE complex is presented in Figures 2.1.1f and 2.1.1g.

Building Features: Building 4163 was a rectangular building located about 50-feet east of Building 4143. Building 4163 was built in two sections; the west side comprised a steel prefabricated Butler building structure approximately 40 feet by 40 feet, separated from the east side by a floor-to-ceiling sheetrock wall. The west side contained a change room, a 1-ton crane, sprinklers, and an exhaust system.[2, 3] The east side was a 3,200 square feet box shop, which contained a 5.5-foot deep SRE operations mockup pit with concrete walls and a soil bottom.[1] Figure 2.1.5b presents a floor plan. The location of the mockup pit on the floor plan is unclear. Figure 2.1.5c provides an aerial view of Building 4163 taken in July 1977.

Former Use(s): Building 4163 was the Component Equipment Repair Facility (CERF) and Box Shop. The west side was used for the repair of radiologically contaminated equipment, such as primary sodium pumps and valves, while the east side, containing a pipe shop and machine shop, was used for the construction of wooden shipping containers and for non-nuclear support work.[4,5]

Information from Interviewees: In 2010, a number of former workers were interviewed about their experiences at the SSFL. One had knowledge of Building 163. Excerpts from his comments are presented below.

- "One end of Building 4163 was used for the disassembly and maintenance of radioactive and non-radioactive SRE components and equipment. The remainder of the building was a machine shop. . . Sodium pumps, valves, and intermediate heat exchangers were examined and repaired as necessary in Building 4163. The work there involved components from both radioactive and non-radioactive systems. The building was decontaminated as necessary so that personnel access was generally unrestricted."[6] This former employee worked at the SSFL between 1958 and 1968.

Radiological Incident Reports: There have been several incidents associated with Building 4163 that could have resulted in a release to the environment. The following table provides information presented in an incidents database provided by Boeing. Summaries of the incident reports are provided following the table, when available.

[1] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[2] Rockwell International letter from C. C. Comnners to L. Lanni, DOE, re: *Building 003 and Building 163 Ownership*, March 25, 1982.
[3] Ureda, B. F., *SRE Activity Requirement 24, Decontamination of Building 163 (CERF)*, Rockwell International Report No. N704ACR990020, February 15, 1977, p. 2.
[4] Owens, D. E., *Radiological Survey Results – Release to Unrestricted Use, SRE Region II (Building 163, Box Shop)*, Rockwell International Report No. N704TI990028, May 4, 1978, pp. 3, 5-7.
[5] Owen, R. K., *Radiological Survey Plan, Support of D & D Program Operations at T-143 (SRE)*, Rockwell International Report No. N704TP990008, September 15, 1981, p. 2.
[6] Interview No. 300 of former worker conducted by the DOE and EPA on July 16, 2010, p. 2.

Building 4163 Incident Report Summary

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A0424	2/13/1960	SRE PIPE SHOP	ACP	EMPLOYEES UNWRAPPED CONTAMINATED PUMP FOR REPAIR IN CLEAN PIPE SHOP.
A0381	8/5/1964	SRE AREA		IMPROPER HANDLING OF SODIUM COMPONENTS CONTAMINATED PERSONNEL AND AREA.
A0542	9/15/1964	SRE BLDG 163	MFP	DRUM CONTAINING PRIMARY PIPING FROM SRE WAS FOUND SMOKING IN CERF BLDG.
A0461	12/7/1964	SRE CERF	ACP	ARC CUTTING PLUGGED FILTERS CAUSING HIGH AIRBORNE ACTIVITY.
A0385	12/21/1964	T163 CERF		WORK IN THE CONTAMINATED EQUIPMENT REPAIR FACILITY CONTAMINATED 3 EMPLOYEES.
A0600	11/1/1966	CERF T163 BLDG	MFP	PRIMARY SODIUM VALVE CLEANING RESULTED IN EXPLOSION & CONTAMINATION SPREAD.

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

- On February 13, 1960, an employee removed a contaminated pump impeller (126 dpm/100 cm^2 beta-gamma) from its protective wrapping in a clean area of the SRE Pipe Shop. A health physicist questioned why this was done and the employee noted there was no other area available to perform the repair operation on the part. The health physicist noted that if the health physics department had been notified arrangements would have been made for a controlled work area. The impeller was rewrapped until it could be decontaminated. The incident report notes that the supervisor involved showed poor management and the employee has constantly shown a lack of respect for established radiological safety practices (Incident Report A0424).[1]

- On August 5, 1964, personnel and equipment were contaminated in the Sodium Component Cleaning Area. An employee discovered his hands and feet were contaminated on a routine checkout survey. Smears of the forklift he had been driving showed 200 to 300 dpm/100 cm^2 beta-gamma. Two bags of radioactive waste on the forklift were 700 dpm/100 cm^2 beta-gamma on the outside surface. Other members of the crew were alerted to the contamination and brought in for monitoring. Contamination of the four men involved ranged from 7 to 18 mrad/h on the shoes, 2 to 6 mrad/h on the hands, and nasal smears ranging from 30 to 2,100 dpm beta-gamma. The rest of their bodies showed nothing above background levels. The men were decontaminated and

[1] Health Physics Department, Atomics International Internal Letter, re*: Health Physics Notice of Rule Infraction*, February 13, 1960.

released, although two men were placed on restriction until bioassay results were received.

An extensive smear survey was then conducted in all areas and building where the men had been working as well as all equipment that had been used by the men. Areas found to have contamination levels exceeding "permissible limits" included: door handles between the SRE lobby and hallway (370 dpm beta-gamma), door handles in the CERF room (1,200 dpm beta-gamma), the ground in front of the CERF door (120 dpm beta-gamma), and the cherry picker seat/steering wheel (300 dpm beta-gamma), and running board (110 dpm beta-gamma). Additional smear surveys found maximum levels of contamination as follows: crane hook on steam pad (3.4×10^4 dpm beta-gamma), Dowanol tank on the steam pad (2.7×10^4 dpm beta-gamma), concrete steam-cleaning pad (1.8×10^3 dpm beta-gamma), concrete oil-bath pad (1.3×10^4 dpm beta-gamma), and floor of building containing oil-bath tank (3.6×10^3 dpm beta-gamma). Both concrete pads and most of the items on the pads were contamination to some level, but none to the levels described above. Smears of the asphalt between the two pads were below 30 dpm beta-gamma.

The incident appears to have resulted from handling of a contaminated pipe during various stages of the component cleaning operation. Nasal contamination may have resulted from the initial unwrapping of the pipe where airborne release may have occurred, or from personnel touching their nose with contaminated hands. The incident report suggests temporarily suspending operations until the exact cause of contamination is found and corrective measures can be implemented (Incident Report A0381).[1]

- On September 15, 1964, an employee noticed smoke coming from under the lid of a 55-gallon waste disposal drum at the CERF. The drum was approximately half full of pipes containing sodium contaminated with fission products. The fire department was called and they arrived in full protective gear. They opened the drum and poured a bag of calcium carbonate in to cover all of the sodium. The drum was closed. No contamination to personnel or equipment resulted from the incident (A0542).[2]

- On December 7, 1964, an arc welder cutting through a contaminated steel and sodium component had to stop because the smoke inside the glove box he was working in obscured his vision. Smoke then started coming out of various openings in the glove box so the operation was shut down and personnel were requested to leave the area. A high volume air sampler that was started at the beginning of the cutting operation was shut off after a 10-minute period and indicated activity of 1.76×10^{-8} $\mu Ci/cm^3$. Two employees had nasal smears that revealed contamination of 72 and 150 dpm and a fireman responding to the incident had a nasal smear of 18 dpm. The men were restricted from radioactive areas until bioassay results were reviewed. The incident report notes that the health physics department should be given a copy of any written procedure for work

[1] Townsend, R. E., and C. L. Young, Atomics International Internal Letter, re*: Radiological Safety Incident Report*, August 23, 1964.
[2] Young, C. L., Atomics International Internal Letter, re*: Incident Report, Building 163 (CERF), 9-15-64*, September 17, 1964.

involving radioactive material with sufficient time prior to the start of the job to fully evaluate hazards involved (Incident Reports A0461).[1]

- On December 21, 1964, a tagged area entry permit was approved for cleanup of the CERF Building 163. The area had been used for the disposition of the SRE main intermediate heat exchanger (MIHE). When a health physicist entered the work area to provide assistance, he noticed that an operation was being performed that was not approved in the permit. An employee was using a skill saw to cut wood used as cribbing for the SRE MIHE. The wood cribbing was saturated with cutting oil and material from within the heat exchanger. The air in the CERF was filled with sawdust and no one was wearing respirators. The employee was told to stop sawing, but he stated he was almost finished and that the health physicist could swipe his nose if he wanted. A nasal smear indicated background activity, but it was suspected the employee blew his nose prior to the swipe. A 10-minute air sample indicated airborne activity at 1.83×10^{-9} µCi/cm^3. Later, the whole work crew was surveyed for contamination and results were negative on all, but three people. Nasal smears ranged from 120 dpm to 300 dpm beta-gamma. No clothing or skin contamination was detected as proper protective clothing was worn. A second 10-minute air sample taken after the dust settled showed a reduction in activity to 7.1×10^{-11} µCi/cm^3. The incident occurred due to haste and lack of foresight in the cutting operation (Incident Report A0385).[2]

- On November 1, 1966, a sodium explosion occurred in the CERF (Building 4163). The incident occurred during cleaning of a valve used in the SRE primary sodium service system. Although the valve had been soaking in Dowanol solvent for approximately 6 weeks prior to the cleaning operation, some unreacted sodium remained in the valve and reacted violently with the cleaning agent. Smear surveys of the area following the explosion indicated contamination levels from 726 to 57,762 dpm/100 cm^2 beta-gamma. A high volume air sample obtained in the CERF change room indicated airborne concentrations of 2×10^{-9} µCi/cm^3. A recount of the air sample 24 hours later indicated a concentration of 1.2×10^{-9} µCi/cm^3. Filter paper from the air sample was analyzed for isotope identification. Results showed the presence of Cs-137, Na-22, Sr-90, and Y-90. The CERF room was decontaminated and SRE employees were reminded of the hazards involved in using solvents to react sodium (Incident Report A0600).[3]

Current Use: Building 4163 was demolished in 1999. Based on available information, the dimensions of the excavation made during building demolition are unknown.

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

- In 1978, Rockwell conducted a radiological survey at the east end of Building 4163 and on asphalt-covered outside areas, to see whether contamination had migrated from the west end of the building. Rockwell did this in preparation for removing the wall between the two parts of Building 4163. Survey results for the east end of Building 4163 indicated

[1] Galperin, A., Atomics International Internal Letter, re*: Incident Report, CERF, 12-7-64*, January 7, 1965.
[2] Tworek, D.D., Atomics International Internal Letter, re*: Incident Report, Contaminated Equipment Repair Facility (CERF) Building 163, 12-21-64*, January 8, 1965.
[3] Unknown Author, Atomics International, re*: Radiation Safety Progress for November 1966,* December 9, 1966.

less than 30 dpm/100 cm^2 for removable contamination, below 0.1 mrad/h for surface gamma radiation, and below 100 dpm/100 cm^2 for beta-gamma emitters. All survey results indicated that the east end of Building 4163 was below Rockwell's applicable limits for release for unrestricted use.[3]

- In October 1981, Rockwell commenced decontamination and removal activities in the contaminated west end of Building 4163. Rockwell removed a 5-ton overhead bridge crane together with the radioactive exhaust system and all aluminum wainscot interior walls. Rockwell scabbled the floor area and packaged all radioactively contaminated equipment for shipment to an unnamed offsite land burial location.[1]

- In early 1982, Rockwell conducted a radiological survey of Building 4163 following the completion of decontamination activities. Survey results for the west end of Building 4163 indicated, for removable contamination, less than 20 dpm/100 cm^2 for alpha emitters, and less than 75 dpm/100 cm^2 for beta-gamma emitters. For surface radiation, all readings were below 0.1 mrad/h. Concrete wall and core samples from the 5.5-foot deep box shop mockup pit were found to be below 25 pCi/g of gross detectable beta activity. Soil samples collected from the bottom of the pit were found to be below 30 pCi/g. All survey results for the west end of Building 4163 were below Rockwell's applicable limits for release for unrestricted use.[1, 2]

- In September 1982, ANL completed a verification survey of the SRE complex. This included instrument and smear surveys and analysis of material samples. ANL found that Building 4163 and its surrounding area had been decontaminated to below limits specified in the Draft ANSI Standard No. N13.12 and NRC 1982 guidelines.[3]

Radiological Use Authorizations: The DOE released the area for unrestricted use on July 23, 1985.[4]

Former Radiological Burial or Disposal Locations: Building 4163 was initially connected to the Buildings 4003, 4143, and 4163 leach field system until it was closed and abandoned in 1964 when the complex was connected to the site-wide sewage treatment plant. In 2000, the septic tank, leach field, and associated piping were excavated and removed.[5]

Aerial Photographs: Aerial photographs show undeveloped land until the 1957 photograph when a rectangular-shaped building is identified as Building 4163. Building 4163 appears to have increased in area by about 50 percent in the 1959 photograph. Building 4163 is seen in the approximately 1960, 1965, 1967, 1972, 1978, 1980, 1983, 1988, and 1995 photographs. A

[1] Wallace, J. H., *Radiological Survey Results – Release to Unrestricted Use, SRE Building 163,* Rockwell International Report No. N704TI990039, April 8, 1982, pp. 3-7.
[2] Wallace, J. H., *Radiological Survey Results – Release to Unrestricted Use, SRE Region III*, Rockwell International Report No. N704TI990029, May 13, 1983, pp. 3-7.
[3] Argonne National Laboratory, *Post Remedial Action Survey Report for the Sodium Reactor Experiment (SRE) Facility, Santa Susana Field Laboratories, Rockwell International, Ventura County, California*, DOE-EV-0005-46, ANL-OHS/HP-84-101, February 1984, pp. 1-3, 15.
[4] U.S. Department of Energy, *Certification for Unrestricted Use of the Sodium Reactor Experiment (SRE) Complex and the Hot Cave Facility (Bldg. 003)*, July 23, 1985.
[5] Letter from B. D. Sujata, The Boeing Company, to J. Evans, County of Ventura, re: *Information Regarding Permit – Septic Tank and Leach Field*, October 23, 2001.

vegetated area is seen in the location of Building 4163 in the 2005 photograph. Dark colored sheeting appears to cover the site in the 2009 photograph.[1]

Radionuclides of Concern: Building 4163 was part of the SRE reactor complex and was located northeast of Building 4143. Possible radionuclides include U-238, U-234, U-235, U-236, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Th-232, H-3, Na-22, Na-24, Cr-51, Mn-54, Fe-59, Co-60, Kr-85, Sr-89, Sr-90, Sb-125, I-129, I-131, Cs-134, Cs-137, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xn-133, Xe-135, Pm-147, Sm-151.[2, 3, 4] All radionuclides of concern listed with the exception of Na-24, Cr-51, Mn-54, Fe-59, Kr-85, Sr-89, I-131, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xe-133, Xe-135, Pm-147 and Sm-151 are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives except for Sm-151 for which no analytical method is available. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Based on general site topography, surface water flows into the storm drain system located south and east of the site, which connects to the SRE retention pond located northeast of the site. Outflow from the retention pond was initially onto the NBZ and Brandeis-Bardin Institute land. In 1959, a 6-foot diameter overflow pipe and a pumped sump were installed at the confluence of the two main drainage channels upstream of the pond. Water was then pumped through a 4-inch diameter overland pipe to a channel connecting to the Area II ponds. The overflow from these ponds is into Bell Canyon and thence to the Los Angeles River.[5]

Radiological Contamination Potential: The preliminary MARSSIM classification for the Building 4163 area is Class 1 due to its documented releases and its former use as an SRE support building.

Recommended Locations for Soil/Sediment Sampling:

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

Previous characterization studies for the Building 4163 area were focused on delineating the extent of contamination to standards that were applicable at the time. Characterization was not conducted to delineate the extent of contamination consistent with the DTSC/DOE December 2010 AOC. Therefore, additional characterization is recommended for the Building 4163 area. This includes the following Building 4163 areas and appurtenances:

- The flat and low-lying areas surrounding Building 4163. Radionuclides originating from Buildings 4163 and/or 4143 may have migrated to these areas via surface water flow or airborne releases.

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[1] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[2] Hart, R. S., *Distribution of Fission Product Contamination in the SRE*, Atomics International Report No. NAA-SR-6890, March 1, 1962, pp. 8-27.
[3] Kinzer, J. and Crawford, A. C., *SRE First Core Fuel*, Atomics International Technical Data Record No. 5301, May 16, 1960, pp. 1-7.
[4] Letter from Heine, W. F., Atomics International, to Proctor, J. F., E. I. du Pont de Nemours & Company, re: *Fission Product and Fissile Content of SRE Fuel*, July 2, 1975.
[5] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.

- The storm drain system located south of the site that connects to the SRE retention pond.

- The sanitary sewer line for Buildings 4003, 4143, and 4163 located south of the site. If radionuclides were released into the sanitary sewer system, residual contamination may exist in the materials surrounding the sewer lines.

2.1.6 Building 4183 Area

Site Description: The Building 4183 area comprised Building 4183 and the land surrounding it located in the SRE complex at the end of E Street. Building 4183 was constructed in approximately 1957 as a fire pump building.[1, 2] Figures 2.1.6a and 2.1.6b provide current and historic photographs. The location of Building 4183 in the SRE complex is presented in Figure 2.1.1g.

Building Features: Building 4183, located northeast of Building 4143, was less than 1,000 square feet in area and was constructed with a steel frame, siding and roof. It contained an emergency generator, which was connected to a 1,500-gallon gasoline fuel underground tank, UT-71. This tank was excavated and removed in 1998 without monitoring for radioactivity.[1, 3] A historical site photograph taken on February 12, 1975, is presented in Figure 2.1.6b. It shows a large diameter pipe, which was connected to the water tower. It also shows bags of material located on the south side of Building 4183, which appear to be related to decontamination and demolition activities.

Former Use(s): Building 4183 was the fire pump building for the SRE complex.[2] This building is assumed to have housed pumps to pump water from the water tower to the SRE complex in the event of a fire.

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: Building 4183 was demolished in 1999. Based on available information, the dimensions of the excavation made during building demolition are unknown.

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

- In September 1982, ANL completed a verification survey of the SRE complex. This included instrument and smear surveys and analysis of material samples. ANL found that Building 4183 and its surrounding area had been decontaminated to below limits specified in the Draft ANSI Standard No. N13.12 and NRC 1982 guidelines.[4]

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[1] Historical Site Photograph from Boeing Database, February 12, 1975.
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[3] Sierra Geoscience, Inc., *Report on UST Closure, Tank #UT-71 Building 4183, Santa Susana Field Laboratory, Ventura County, California*, January 11, 1999, p. 2.
[4] Argonne National Laboratory, *Post Remedial Action Survey Report for the Sodium Reactor Experiment (SRE) Facility, Santa Susana Field Laboratories, Rockwell International, Ventura County, California,* DOE-EV-0005-46, ANL-OHS/HP-84-101, February 1984, pp. 1-3, 15.

- In 1983, Rockwell conducted a radiological survey as part of the SRE survey. Survey results indicated, for surface radiation, an average reading of 10 μR/h. Soil samples collected from this area were found to contain less than 30 pCi/g of gross detectable beta activity. All survey results were below Rockwell's applicable limits for release for unrestricted use.[1]

Radiological Use Authorizations: The DOE released the area for unrestricted use on July 23, 1985.[2]

Former Radiological Burial or Disposal Locations: Building 4183 had a 1,500-gallon underground gasoline fuel tank that was removed in December 1998.[3]

Aerial Photographs: Aerial photographs show undeveloped land until the 1957 photograph when a square-shaped building is identified as Building 4183. Building 4183 is seen in 1959, with a pipe connecting it to the water tower Site 4703. This is also seen in the approximately 1960, 1965, and 1967 photographs. In the 1972, 1978, 1980, 1983, 1988 and 1985 photographs, the pipe extends half-way up the hillside; it does not reach the water tower. A vegetated area is seen in the location of Building 4183 in the 2005 photograph. The 2009 photograph shows dark-colored sheeting covering the location of former Building 4183.[4]

Radionuclides of Concern: Building 4183 was part of the SRE reactor complex and was located northeast of Building 4143. Possible radionuclides include U-238, U-234, U-235, U-236, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Th-232, H-3, Na-22, Na-24, Cr-51, Mn-54, Fe-59, Co-60, Kr-85, Sr-89, Sr-90, Sb-125, I-129, I-131, Cs-134, Cs-137, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xn-133, Xe-135, Pm-147, Sm-151.[5, 6, 7] All radionuclides of concern listed with the exception of Na-24, Cr-51, Mn-54, Fe-59, Kr-85, Sr-89, I-131, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xe-133, Xe-135, Pm-147 and Sm-151 are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives except for Sm-151 for which no analytical method is available. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Building 4183 was located south of a drainage divide. Based on general site topography, surface water flows into the drainage channel located north of the site, which connects to the SRE retention pond located northeast of the site. Outflow from the retention pond was initially onto the NBZ and Brandeis-Bardin Institute land. In 1959, a 6-foot diameter overflow pipe and a pumped sump were installed at the confluence of the two main drainage

[1] Wallace, J. H., *Radiological Survey Results – Release to Unrestricted Use, SRE Region X*, Rockwell International Report No. N704TI990036, May 31, 1983, pp. 7-8.
[2] U.S. Department of Energy, *Certification for Unrestricted Use of the Sodium Reactor Experiment (SRE) Complex and the Hot Cave Facility (Bldg. 003)*, July 23, 1985.
[3] Sierra Geoscience, Inc., *Report on UST Closure, Tank #UT-71 Building 4183, Santa Susana Field Laboratory, Ventura County, California*, January 11, 1999, pp. 1-2.
[4] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[5] Hart, R. S., *Distribution of Fission Product Contamination in the SRE*, Atomics International Report No. NAA-SR-6890, March 1, 1962, pp. 8-27.
[6] Kinzer, J. and Crawford, A. C., *SRE First Core Fuel*, Atomics International Technical Data Record No. 5301, May 16, 1960, pp. 1-7.
[7] Letter from Heine, W. F., Atomics International, to Proctor, J. F., E. I. du Pont de Nemours & Company, re: *Fission Product and Fissile Content of SRE Fuel*, July 2, 1975.

channels upstream of the pond. Water was then pumped through a 4-inch diameter overland pipe to a channel connecting to the Area II ponds. The overflow from these ponds is into Bell Canyon and thence to the Los Angeles River.[1] Radioactive materials do not appear to have been handled in Building 4183, but the site could have become contaminated by surface water and airborne releases from other buildings within the SRE complex.

Radiological Contamination Potential: The preliminary MARSSIM classification for the Building 4183 area is Class 1 due to its former use as an SRE support building.

Recommended Locations for Soil/Sediment Sampling:

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

Previous characterization studies for the Building 4183 area were focused on delineating the extent of contamination to standards that were applicable at the time. Characterization was not conducted to delineate the extent of contamination consistent with the DTSC/DOE December 2010 AOC. Therefore, additional characterization is recommended for the Building 4183 area. This includes the following Building 4183 areas and appurtenances:

- The flat and low-lying areas surrounding Building 4183. Radionuclides originating from Building 4143 may have migrated to these areas via surface water flow or airborne releases.

- The area south of Building 4183 where bags of material can be seen in the 1975 historical photograph. It is unclear whether radioactive material was stored in the bags.

- The drainage channel located north of the site that connects to the SRE retention pond.

2.1.7 Building 4184 Area

Site Description: The Building 4184 area comprises Building 4184, and the land surrounding it located in the SRE complex at the end of E Street. Building 4184 was constructed in approximately 1957 as a battery room and diesel generator canopy.[2] Figure 2.1.7a provides a current photograph. Building 4184 was located between Buildings 4183 and 4185, as shown in Figure 1.3.

Building Features: Building 4184 was a single story building of less than 1,000 square feet in area.

Former Use(s): Building 4184 was the SRE battery room and diesel generator canopy.[1]

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

[1] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.

Current Use: Building 4184 was demolished prior to 1978. Based on available information, the dimensions of the excavation made during building demolition are unknown.

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

- In September 1982, ANL completed a verification survey of the SRE complex. This included instrument and smear surveys and analysis of material samples. ANL found that Building 4184 and its surrounding area had been decontaminated to below limits specified in the Draft ANSI Standard No. N13.12 and NRC 1982 guidelines.[1]

- In 1983, Rockwell conducted a radiological survey as part of the SRE survey. Survey results indicated, for surface radiation, an average reading of 10 μR/h. Soil samples collected from this area were found to contain less than 30 pCi/g of gross detectable beta activity. All survey results were below Rockwell's applicable limits for release for unrestricted use.[2]

Radiological Use Authorizations: The DOE released the area for unrestricted use on July 23, 1985.[3]

Former Radiological Burial or Disposal Locations: Adjacent Building 4183 had a 1,500-gallon underground gasoline fuel tank that was removed in December 1998.[4]

Aerial Photographs: Aerial photographs show undeveloped land until the 1957 photograph when a rectangular-shaped building is identified as Building 4184. (The HSA team believes that Building 4184 is indistinguishable from Building 4185 in the aerial photographs.) Building 4184 is seen in the 1959, approximately 1960, 1965, 1967, and 1972 photographs. A building slab is observed in the 1978, 1980, and 1983 photographs. Bare ground is seen in the 1988 and 1995 photographs. A vegetated area is seen in the location of Building 4184 in the 2005 photograph. Dark colored sheeting covers the site in the 2009 photograph.[5]

Radionuclides of Concern: Building 4184 was part of the SRE reactor complex and was located northeast of Building 4143. Possible radionuclides include U-238, U-234, U-235, U-236, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Th-232, H-3, Na-22, Na-24, Cr-51, Mn-54, Fe-59, Co-60, Kr-85, Sr-89, Sr-90, Sb-125, I-129, I-131, Cs-134, Cs-137, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xn-133, Xe-135, Pm-147, Sm-151.[6, 7, 1] All radionuclides of concern listed

[1] Argonne National Laboratory, *Post Remedial Action Survey Report for the Sodium Reactor Experiment (SRE) Facility, Santa Susana Field Laboratories, Rockwell International, Ventura County, California*, DOE-EV-0005-46, ANL-OHS/HP-84-101, February 1984, pp. 1-3, 15.
[2] Wallace, J. H., *Radiological Survey Results – Release to Unrestricted Use, SRE Region X,* Rockwell International Report No. N704TI990036, May 31, 1983, pp. 7-8.
[3] U.S. Department of Energy, *Certification for Unrestricted Use of the Sodium Reactor Experiment (SRE) Complex and the Hot Cave Facility (Bldg. 003),* July 23, 1985.
[4] Sierra Geoscience, Inc., *Report on UST Closure, Tank #UT-71 Building 4183, Santa Susana Field Laboratory, Ventura County, California*, January 11, 1999, pp. 1-2.
[5] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[6] Hart, R. S., *Distribution of Fission Product Contamination in the SRE*, Atomics International Report No. NAA-SR-6890, March 1, 1962, pp. 8-27.
[7] Kinzer, J. and Crawford, A. C., *SRE First Core Fuel*, Atomics International Technical Data Record No. 5301, May 16, 1960, pp. 1-7.

with the exception of Na-24, Cr-51, Mn-54, Fe-59, Kr-85, Sr-89, I-131, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xe-133, Xe-135, Pm-147 and Sm-151 are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives except for Sm-151 for which no analytical method is available. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Building 4184 was located south of a drainage divide. Based on general site topography, surface water flows into the drainage channel located north of the site, which connects to the SRE retention pond located northeast of the site. Outflow from the retention pond was initially onto the NBZ and Brandeis-Bardin Institute land. In 1959, a 6-foot diameter overflow pipe and a pumped sump were installed at the confluence of the two main drainage channels upstream of the pond. Water was then pumped through a 4-inch diameter overland pipe to a channel connecting to the Area II ponds. The overflow from these ponds is into Bell Canyon and thence to the Los Angeles River.[2] Radioactive materials do not appear to have been handled in Building 4184, but the site could have become contaminated by surface water and airborne releases from other buildings within the SRE complex.

Radiological Contamination Potential: The preliminary MARSSIM classification for the Building 4184 area is Class 1 due to its former use as an SRE support building.

Recommended Locations for Soil/Sediment Sampling:

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

Previous characterization studies for the Building 4184 area were focused on delineating the extent of contamination to standards that were applicable at the time. Characterization was not conducted to delineate the extent of contamination consistent with the DTSC/DOE December 2010 AOC. Therefore, additional characterization is recommended for the Building 4184 area. This includes the following Building 4184 areas and appurtenances:

- The flat and low-lying areas surrounding Building 4184. Radionuclides originating from Building 4143 may have migrated to these areas via surface water flow or airborne releases.

- The drainage channel located north of the site that connects to the SRE retention pond.

2.1.8 Building 4185 Area

Site Description: The Building 4185 area comprises Building 4185, and the land surrounding it located in the SRE complex at the end of E Street. Building 4185 was constructed in approximately 1957 as a steam generator control building.[3] Figures 2.1.8a and 2.1.8b provide a

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[1] Letter from Heine, W. F., Atomics International, to Proctor, J. F., E. I. du Pont de Nemours & Company, re: *Fission Product and Fissile Content of SRE Fuel*, July 2, 1975.
[2] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.
[3] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.

current photograph and floor plan. The location of Building 4185, west of Building 4184, is shown in Figure 1.3.

Building Features: Building 4185 was of less than 1,000 square feet in area. A floor plan for Building 4185 is presented in Figure 2.1.8b.

Former Use(s): Building 4185 was the steam generator control building.[1]

Information from Interviewees: None to date

Radiological Incident Reports: None found.

Current Use: Building 4185 was demolished prior to 1978. Based on available information, the dimensions of the excavation made during building demolition are unknown.

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

- In September 1982, ANL completed a verification survey of the SRE complex. This included instrument and smear surveys and analysis of material samples. ANL found that Building 4185 and its surrounding area had been decontaminated to below limits specified in the Draft ANSI Standard No. N13.12 and NRC 1982 guidelines.[1]

- In 1983, Rockwell conducted a radiological survey on Region IX as part of the SRE survey. The western half of Building 4185 was in Region IX. Survey results indicated, for surface radiation, an average reading of 0.04 mrad/h. Soil samples collected from this area were found to contain less than 98 pCi/g of gross detectable beta activity. All survey results were below Rockwell's applicable limits for release for unrestricted use.[2]

- In 1983, Rockwell conducted a radiological survey on Region X as part of the SRE survey. The eastern half of Building 4185 was in Region X. Survey results indicated, for surface radiation, an average reading of 10 μR/h. Soil samples collected from this region were found to contain less than 30 pCi/g of gross detectable beta activity. All survey results were below Rockwell's applicable limits for release for unrestricted use.[3]

Radiological Use Authorizations: The DOE released the area for unrestricted use on July 23, 1985.[4]

Former Radiological Burial or Disposal Locations: Building 4143, located a few feet southwest of Building 4185, had a sanitary septic tank installed as part of the original

[1] Argonne National Laboratory, *Post Remedial Action Survey Report for the Sodium Reactor Experiment (SRE) Facility, Santa Susana Field Laboratories, Rockwell International, Ventura County, California*, DOE-EV-0005-46, ANL-OHS/HP-84-101, February 1984, pp. 1-3, 15.
[2] Wallace, J. H., *Radiological Survey Results – Release to Unrestricted Use, SRE Region IX*, Rockwell International Report No. N704TI990035, May 31, 1983, pp. 7-8.
[3] Wallace, J. H., *Radiological Survey Results – Release to Unrestricted Use, SRE Region X*, Rockwell International Report No. N704TI990036, May 31, 1983, pp. 7-8.
[4] U.S. Department of Energy, *Certification for Unrestricted Use of the Sodium Reactor Experiment (SRE) Complex and the Hot Cave Facility (Bldg. 003)*, July 23, 1985.

construction in 1956-57. The system, tank, and leach field were abandoned in 1964 when the complex was connected to the site-wide sewage treatment plant. In 2000, the septic tank, leach field, and associated piping were excavated and removed.[1]

Aerial Photographs: Aerial photographs show undeveloped land until the 1957 photograph when a rectangular-shaped building is identified as Building 4185. (The HSA team believes that Building 4185 is indistinguishable from Building 4184 in the aerial photographs.) Building 4185 is seen in the 1959, approximately 1960, 1965, 1967, and 1972 photographs. A building slab is seen in the 1978, 1980, and 1983 photographs. Bare ground is seen in the 1988 and 1995 photographs. A vegetated area is seen in the location of Building 4185 in the 2005 photograph. Dark colored sheeting is observed in the location of Building 4185 in the 2009 aerial photograph.[2]

Radionuclides of Concern: Building 4185 was part of the SRE reactor complex and was located northeast of Building 4143. Possible radionuclides include U-238, U-234, U-235, U-236, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Th-232, H-3, Na-22, Na-24, Cr-51, Mn-54, Fe-59, Co-60, Kr-85, Sr-89, Sr-90, Sb-125, I-129, I-131, Cs-134, Cs-137, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xn-133, Xe-135, Pm-147, Sm-151.[3, 4, 5] All radionuclides of concern listed with the exception of Na-24, Cr-51, Mn-54, Fe-59, Kr-85, Sr-89, I-131, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xe-133, Xe-135, Pm-147 and Sm-151 are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives except for Sm-151 for which no analytical method is available. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Building 4185 was located south of a drainage divide. Based on general site topography, surface water flows into the drainage channel located north of the site, which connects to the SRE retention pond located northeast of the site. Outflow from the retention pond was initially onto the NBZ and Brandeis-Bardin Institute land. In 1959, a 6-foot diameter overflow pipe and a pumped sump were installed at the confluence of the two main drainage channels upstream of the pond. Water was then pumped through a 4-inch diameter overland pipe to a channel connecting to the Area II ponds. The overflow from these ponds is into Bell Canyon and thence to the Los Angeles River.[6] Radioactive materials do not appear to have been handled in Building 4185, but the site could have become contaminated by surface water and airborne releases from other buildings within the SRE complex.

Radiological Contamination Potential: The preliminary MARSSIM classification for the Building 4185 area is Class 1 due to its former use as an SRE support building.

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[1] Letter from B. D. Sujata, The Boeing Company, to J. Evans, County of Ventura, r: *Information Regarding Permit – Septic Tank and Leach Field*, October 23, 2001.
[2] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[3] Hart, R. S., *Distribution of Fission Product Contamination in the SRE*, Atomics International Report No. NAA-SR-6890, March 1, 1962, pp. 8-27.
[4] Kinzer, J. and Crawford, A. C., *SRE First Core Fuel*, Atomics International Technical Data Record No. 5301, May 16, 1960, pp. 1-7.
[5] Letter from Heine, W. F., Atomics International, to Proctor, J. F., E. I. du Pont de Nemours & Company, re: *Fission Product and Fissile Content of SRE Fuel*, July 2, 1975.
[6] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.

Recommended Locations for Soil/Sediment Sampling:

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

Previous characterization studies for the Building 4185 area were focused on delineating the extent of contamination to standards that were applicable at the time. Characterization was not conducted to delineate the extent of contamination consistent with the DTSC/DOE December 2010 AOC. Therefore, additional characterization is recommended for the Building 4185 area. This includes the following Building 4185 areas and appurtenances:

- The flat and low-lying areas surrounding Building 4185. Radionuclides originating from Building 4143 may have migrated to these areas via surface water flow or airborne releases.

- The drainage channel located north of the site that connects to the SRE retention pond.

2.1.9 Building 4505 Area

Site Description: The Building 4505 area comprised Building 4505 and the land surrounding it located in the SRE complex at the end of E Street. Building 4505 was constructed prior to 1959 as a storage shed.[1] Figure 2.1.9a provides a current photograph. The location of Building 4505, northeast of Building 4163, is shown in Figure 1.3.

Building Features: Building 4505 was an approximately 600 to 800 square-foot storage shed located northeast of the east end of Building 4163 in the SRE complex.[1]

Former Use(s): Building 4505 was a storage shed. No information has been found concerning the materials stored in the shed, but the shed was in the SRE complex so may have contained radioactive materials.

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: Building 4505 was demolished prior to 1980. The concrete pad of Building 4505 was demolished prior to 1995.

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

- In 1978, Rockwell conducted a radiological survey at the east end of Building 4163 and on asphalt-covered outside areas extending to Building 4505, to see whether contamination had migrated from the west end of the building. Survey results indicated less than 30 dpm/ 100 cm^2 for removable contamination, below 0.1 mrad/h for surface

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

gamma radiation, and below 100 dpm/100 cm^2 for beta-gamma emitters. All survey results were below Rockwell's applicable limits for release for unrestricted use.[1]

- In September 1982, ANL completed a verification survey of the SRE complex. This included instrument and smear surveys and analysis of material samples. ANL found that the concrete pad remaining from Building 4505 had been decontaminated to below limits specified in the Draft ANSI Standard No. N13.12 and NRC 1982 guidelines.[2]

Radiological Use Authorizations: The DOE released the area for unrestricted use on July 23, 1985.[3]

Former Radiological Burial or Disposal Locations: None found.

Aerial Photographs: Aerial photographs show undeveloped land until the 1959 photograph when a square-shaped building is identified as Building 4505. This can also be seen in the approximately 1960, 1965, 1967, 1972, and 1978 photographs. A concrete pad is observed in the 1980, 1983, and 1988 photographs. Bare ground is seen in the 1995 photograph, while a vegetated area is seen in the location of Building 4505 in the 2005 photograph. Dark colored sheeting is observed in the location of Building 4505 in the 2009 aerial photograph.[4]

Radionuclides of Concern: Building 4505 was part of the SRE reactor complex and was located northeast of Building 4143. Possible radionuclides include U-238, U-234, U-235, U-236, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Th-232, H-3, Na-22, Na-24, Cr-51, Mn-54, Fe-59, Co-60, Kr-85, Sr-89, Sr-90, Sb-125, I-129, I-131, Cs-134, Cs-137, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xn-133, Xe-135, Pm-147, Sm-151.[5, 6, 7] All radionuclides of concern listed with the exception of Na-24, Cr-51, Mn-54, Fe-59, Kr-85, Sr-89, I-131, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xe-133, Xe-135, Pm-147 and Sm-151 are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives except for Sm-151 for which no analytical method is available. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Based on general site topography, surface water flows into the storm drain system located south and east of the site, which connects to the SRE retention pond located northeast of the site. Outflow from the retention pond was initially onto the NBZ and Brandeis-Bardin Institute land. In 1959, a 6-foot diameter overflow pipe and a pumped sump were

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1 Owens, D. E., *Radiological Survey Results – Release to Unrestricted Use, SRE Region II (Building 163, Box Shop)*, Rockwell International Report No. N704TI990028, May 4, 1978, pp. 5-7.
2 Argonne National Laboratory, *Post Remedial Action Survey Report for the Sodium Reactor Experiment (SRE) Facility, Santa Susana Field Laboratories, Rockwell International, Ventura County, California*, DOE-EV-0005-46, ANL-OHS/HP-84-101, February 1984, pp. 1-3, 15.
3 U.S. Department of Energy, *Certification for Unrestricted Use of the Sodium Reactor Experiment (SRE) Complex and the Hot Cave Facility (Bldg. 003)*, July 23, 1985.
4 U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
5 Hart, R. S., *Distribution of Fission Product Contamination in the SRE*, Atomics International Report No. NAA-SR-6890, March 1, 1962, pp. 8-27.
6 Kinzer, J. and Crawford, A. C., *SRE First Core Fuel*, Atomics International Technical Data Record No. 5301, May 16, 1960, pp. 1-7.
7 Letter from Heine, W. F., Atomics International, to Proctor, J. F., E. I. du Pont de Nemours & Company, re: *Fission Product and Fissile Content of SRE Fuel*, July 2, 1975.

installed at the confluence of the two main drainage channels upstream of the pond. Water was then pumped through a 4-inch diameter overland pipe to a channel connecting to the Area II ponds. The overflow from these ponds is into Bell Canyon and thence to the Los Angeles River.[1] It is unknown whether radioactive materials were handled in Building 4505, but the site could have become contaminated by surface water and airborne releases from other buildings within the SRE complex.

Radiological Contamination Potential: The preliminary MARSSIM classification for the Building 4505 area is Class 1 due to its former use as an SRE support building.

Recommended Locations for Soil/Sediment Sampling:

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

Previous characterization studies for the Building 4505 area were focused on delineating the extent of contamination to standards that were applicable at the time. Characterization was not conducted to delineate the extent of contamination consistent with the DTSC/DOE December 2010 AOC. Therefore, additional characterization is recommended for the Building 4505 area. This includes the following Building 4505 areas and appurtenances:

- The flat and low-lying areas surrounding and beneath Building 4505. Radionuclides originating from Buildings 4163 and/or 4143 may have migrated to these areas via surface water flow or airborne releases.

- The former leach field area for Buildings 4003, 4143, and 4163, located east of Building 4505. It is not clear that this area was thoroughly investigated and decontaminated.

- The storm drain system located south of the site that connects to the SRE retention pond.

- The sanitary sewer line located south of the site. If radionuclides were released into the sanitary sewer system, residual contamination may exist in the materials surrounding the sewer lines.

2.1.10 Building 4653 Area

Site Description: The Building 4653 area comprises Building 4653 and the land surrounding it on the hillside north of the SRE on the east side of 11th Street. Building 4653 was constructed in about 1957 as an Interim Radioactive Waste Vault.[2] Figure 2.1.10a provides a current photograph. Figure 2.1.10b provides a plot plan showing Building 4653 located north of the SRE complex. Figure 2.1.10c shows waste holdup tanks in 1977.

Building Features: Building 4653, located on the hillside above Building 4143, consisted of several vaults one of which contained 10 50-gallon tanks and interconnected piping. A compressor vault contained compressors, controls and piping. A suction tank was buried behind

[1] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.

and above Building 4653. Six decay tanks, four for gas and two for liquid, were buried in front of and below Building 4653. Building 4653 was connected to the SRE by piping.[1, 2]

Former Use(s): Building 4653 was an interim radioactive waste vault. Liquid wastes generated in the SRE were directed to one of the two 5,000-gallon liquid holdup tanks before disposal. Liquids were pumped from floor drains in the hot cell area, hot sinks in the controlled areas, and the fuel element wash station located in the high bay area of the reactor room. Most of the radioactivity was from mixed fission products. There were two gas storage systems: a low volume system for the core cover gas, and a larger volume system for all other areas of the SRE. Gas was pumped to one of four gas holdup tanks where short-lived radioactivity decayed. Activation products were the primary isotopes detected in the gas holdup system.[3]

Information from Interviewees: In 2010, a number of former workers were interviewed about their experiences at the SSFL. One had knowledge of Building 4653. An exerpt from his comments is presented below.

- "The reactor gas was stored in four tanks behind the SRE. It was kept in those tanks until the radiation degraded enough for it to be safely released to the environment, which took approximately two weeks. One of my assignments was to check the wind direction and weather conditions. If the wind was directed towards the ocean, or over the San Fernando Valley and Los Angeles, then the gases would be released from the appropriate tank. This occurred at night, to minimize the possibility of exposure to SSFL workers."[3] This interviewee worked at the SSFL between 1959 and 1960.

Radiological Incident Reports: There has been one incident associated with Building 4653 that could have resulted in a release to the environment. The following table provides information presented in an incidents database provided by Boeing. A summary of the incident report is provided following the table.

Building 4653 Incident Report Summary

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A0062	11/14/1977	NORTH OF HIGH BAY	MFP	OVERFILLED LIQUID TRANSFER TANK SPILLED R/A LIQUID OUTSIDE.

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

- On November 14, 1977, the 500-gallon radioactive liquid transfer tank, one of two on the hillside, was overfilled while performing a backflush of the SRE Culligan filter. An estimated 25 gallons of water overflowed around the tank and to the surrounding asphalt. Activity was estimated at 0.12 µCi/cm^3, for a total of 11 mCi. Principal isotopes were Cs-137, Sr-90, and Co-60. Absorbent material was placed on the spill and efforts were

[1] Gallegos, A. N., *Disposal of Radioactive Waste Systems at Bldg 653 and Bldg 143*, Rockwell International Report No. N704-DWP-990-054, April 7, 1977, pp. 3, 9-10.
[2] Owens, D. E., *Radiological Survey Results – Release to Unrestricted Use, SRE Region V (Gas Storage Vault)*, Rockwell International Report No. N704TI990031, November 2, 1978, pp. 3-9.
[3] Interview No. 207 of former worker conducted by the EPA, only, September 2010.

made to cover the areas with plastic and plywood to prevent further spreading of contamination in the high wind conditions at the time. The incident occurred because the operator was not continuously watching the tank sight gage and the backflush operations proved difficult (Incident Report A0062).[1] Contaminated soil does not appear to have been removed.

Current Use: Building 4653 was demolished in 1977. Figure 2.1.10c shows some of the waste holdup tanks undergoing removal in 1977. Based on available information, the dimensions of the excavation made during building demolition are unknown.

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

- In 1977, Rockwell removed, using a back hoe, all buried tanks and associated piping. Contaminated soil was detected between the liquid holdup tanks and near one of the concrete vaults. This soil was excavated and stored in 39-cubic-foot waste containers before being shipped off-site as radioactive waste together with the pipes, valves, and tanks from the building. After the systems had been removed, additional contamination was detected in the concrete walls and floor of one vault. Several inches of concrete were chipped off the vault, packaged, and shipped off-site. It was reported that uncontaminated concrete was left in place to stabilize the hillside before backfilling.[3]

- Following demolition, Rockwell conducted a radiological survey of the site of Building 4653 as part of an SRE survey. Survey results indicated a maximum reading of 0.08 ± 0.05 mrad/h along the south side of the area. Concrete samples were collected during demolition and all concrete with activity above 100 pCi/g was removed. Soil samples were collected throughout the area. The maximum beta activity detected in soil was 49.3 pCi/g. All survey results were below Rockwell's acceptable limits for release to unrestricted use.[2]

- Between November 1979 and September 1982, ANL conducted a series of verification surveys of the SRE complex. This included instrument and smear surveys and analysis of material samples. ANL found that the Building 4653 area was decontaminated below the limits specified in the draft ANSI Standard N13.12 and NRC Guidelines dated 1982.[3]

Radiological Use Authorizations: The DOE released the area for unrestricted use on July 23, 1985.[4]

Former Radiological Burial or Disposal Locations: Building 4653 was a disposal location.

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[1] Brengle, R.G., Rockwell International Internal Letter, re*: Spill of Radioactively Contaminated Water During SRE Backflush Operations*, November 15, 1977.
[2] Owens, D. E., *Radiological Survey Results – Release to Unrestricted Use, SRE Region V (Gas Storage Vault)*, Rockwell International Report No. N704TI990031, November 2, 1978, pp. 3-9.
[3] Argonne National Laboratory, *Post Remedial Action Survey Report for the Sodium Reactor Experiment (SRE) Facility, Santa Susana Field Laboratories, Rockwell International, Ventura County, California*, Report No. DOE-EV-0005/46, ANL-OHS/HP-84-101, February 1984, pp. iii, 15.
[4] U.S. Department of Energy, *Certification for Unrestricted Use of the Sodium Reactor Experiment (SRE) Complex and the Hot Cave Facility (Bldg. 003)*, July 23, 1985.

Aerial Photographs: Aerial photographs show undeveloped land until the 1957 photograph when disturbed ground is seen in the location of Building 4653. Building 4653 can be seen in the 1959, approximately 1960, 1965, 1967, and 1972 photographs. Disturbed ground is seen in the 1978 photograph. The site is vegetated in the 1980, 1983, 1988, 1995, 2005, and 2009 photographs.[1]

Radionuclides of Concern: Building 4653 was part of the SRE reactor complex and was located northwest of Building 4143. Possible radionuclides include U-238, U-234, U-235, U-236, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Th-232, H-3, Na-22, Na-24, Cr-51, Mn-54, Fe-59, Co-60, Kr-85, Sr-89, Sr-90, Sb-125, I-129, I-131, Cs-134, Cs-137, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xn-133, Xe-135, Pm-147, Sm-151.[2, 3, 4] All radionuclides of concern listed with the exception of Na-24, Cr-51, Mn-54, Fe-59, Kr-85, Sr-89, I-131, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xe-133, Xe-135, Pm-147 and Sm-151 are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives except for Sm-151 for which no analytical method is available. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Building 4653 is located on high ground south of a drainage divide and north of SRE Building 4143. Based on general site topography, surface water flows south to a drainage channel located north of Building 4143. This channel carries surface water to the SRE retention pond located northeast of the site. Outflow from the retention pond was initially onto the NBZ and Brandeis-Bardin Institute land. In 1959, a 6-foot diameter overflow pipe and a pumped sump were installed at the confluence of the two main drainage channels upstream of the pond. Water was then pumped through a 4-inch diameter overland pipe to a channel connecting to the Area II ponds. The overflow from these ponds is into Bell Canyon and thence to the Los Angeles River.[5]

Radiological Contamination Potential: The preliminary MARSSIM classification for the Building 4653 area is Class 1 due to its former use as an SRE support building.

Recommended Locations for Soil/Sediment Sampling:

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

Information is lacking regarding the excavation activities at Building 4653. In addition, previous characterization studies for the Building 4653 area were focused on delineating the extent of contamination to standards that were applicable at the time. Characterization was not conducted to delineate the extent of contamination consistent with the DTSC/DOE December 2010 AOC. Therefore, additional characterization is recommended for the Building 4653 area. This includes the following Building 4653 areas and appurtenances:

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[1] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[2] Hart, R. S., *Distribution of Fission Product Contamination in the SRE*, Atomics International Report No. NAA-SR-6890, March 1, 1962, pp. 8-27.
[3] Kinzer, J. and Crawford, A. C., *SRE First Core Fuel*, Atomics International Technical Data Record No. 5301, May 16, 1960, pp. 1-7.
[4] Letter from Heine, W. F., Atomics International, to Proctor, J. F., E. I. du Pont de Nemours & Company, re: *Fission Product and Fissile Content of SRE Fuel*, July 2, 1975.
[5] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.

- The flat and low-lying areas surrounding Building 4653. Radionuclides originating from Building 4653 may have migrated to these areas via surface water flow or airborne releases.

- The hillside downgradient of Building 4653 where one of the two liquid waste tanks overflowed, as a result of overfilling, contaminating soil in the run-off area in 1977.

- The storm drain system located south of the site that connects to the SRE retention pond.

2.1.11 Pad 4684 Area

Site Description: The Pad 4684 area comprised Pad 4684 and the land surrounding it located in the SRE complex at the end of E Street. Pad 4684 was constructed in about 1957 as a steam generator pad.[1] Figure 2.1.11a provides a current photograph. The location of Pad 4684 is shown in Figure 1.3.

Building Features: Pad 4684 was less than 2,000 square feet in area located northeast of the east end of Building 4143 in the SRE complex.[1]

Former Use(s): Pad 4684 was a concrete pad for the steam generator.

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: Pad 4684 was demolished prior to 1980.

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

- In September 1982, ANL completed a verification survey of the SRE complex. This included instrument and smear surveys and analysis of material samples. ANL found that Pad 4684 and its surrounding area had been decontaminated to below limits specified in the Draft ANSI Standard No. N13.12 and NRC 1982 guidelines.[2]

- In 1983, Rockwell conducted a radiological survey in the area of Pad 4684. The survey area was designated as SRE Region X. Survey results indicated an average reading of 10 μR/h for surface gamma radiation, and 25 soil samples were found to have less than 30 pCi/g of gross detectable beta activity. All survey results were below Rockwell's applicable limits for release for unrestricted use.[3]

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

[2] Argonne National Laboratory, *Post Remedial Action Survey Report for the Sodium Reactor Experiment (SRE) Facility, Santa Susana Field Laboratories, Rockwell International, Ventura County, California*, DOE-EV-0005-46, ANL-OHS/HP-84-101, February 1984, pp. 1-3, 15.

[3] Wallace, J. H., *Radiological Survey Results – Release to Unrestricted Use, SRE Region X*, Rockwell International Report No. N704TI990036, May 31, 1983, pp. 5-8.

Radiological Use Authorizations: The DOE released the area for unrestricted use on July 23, 1985.[1]

Former Radiological Burial or Disposal Locations: None found.

Aerial Photographs: Aerial photographs show undeveloped land until the 1957 photograph when a rectangular pad is identified as Pad 4684. This can also be seen in the 1959, approximately 1960, 1965, 1967, 1972, and 1978 photographs. Cleared ground is observed in the 1980 photograph. Open storage is seen in the 1983, 1988, and 1995 photographs. A vegetated area is seen in the 2005 photograph. Dark colored fabric covers the area in the 2009 photograph.[2]

Radionuclides of Concern: Pad 4684 was part of the SRE reactor complex and was located northeast of Building 4143. Possible radionuclides include U-238, U-234, U-235, U-236, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Th-232, H-3, Na-22, Na-24, Cr-51, Mn-54, Fe-59, Co-60, Kr-85, Sr-89, Sr-90, Sb-125, I-129, I-131, Cs-134, Cs-137, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xn-133, Xe-135, Pm-147, Sm-151.[3, 4, 5] All radionuclides of concern listed with the exception of Na-24, Cr-51, Mn-54, Fe-59, Kr-85, Sr-89, I-131, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xe-133, Xe-135, Pm-147 and Sm-151 are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives except for Sm-151 for which no analytical method is available. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Pad 4684 was located northeast of SRE Building 4143. Based on general site topography, surface water flows north to a drainage channel located north of Building 4143. This channel carries surface water to the SRE retention pond located northeast of the site. Outflow from the retention pond was initially onto the NBZ and Brandeis-Bardin Institute land. In 1959, a 6-foot diameter overflow pipe and a pumped sump were installed at the confluence of the two main drainage channels upstream of the pond. Water was then pumped through a 4-inch diameter overland pipe to a channel connecting to the Area II ponds. The overflow from these ponds is into Bell Canyon and thence to the Los Angeles River.[6] Radioactive materials do not appear to have been handled in Pad 4684, but the site could have become contaminated by surface water and airborne releases from other buildings within the SRE complex.

Radiological Contamination Potential: The preliminary MARSSIM classification for the Pad 4684 area is Class 1 due to its former use as an SRE support building.

Recommended Locations for Soil/Sediment Sampling:

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[1] U.S. Department of Energy, *Certification for Unrestricted Use of the Sodium Reactor Experiment (SRE) Complex and the Hot Cave Facility (Bldg. 003)*, July 23, 1985.
[2] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[3] Hart, R. S., *Distribution of Fission Product Contamination in the SRE*, Atomics International Report No. NAA-SR-6890, March 1, 1962, pp. 8-27.
[4] Kinzer, J. and Crawford, A. C., *SRE First Core Fuel*, Atomics International Technical Data Record No. 5301, May 16, 1960, pp. 1-7.
[5] Letter from Heine, W. F., Atomics International, to Proctor, J. F., E. I. du Pont de Nemours & Company, re: *Fission Product and Fissile Content of SRE Fuel*, July 2, 1975.
[6] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.

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

Previous characterization studies for the Pad 4684 area were focused on delineating the extent of contamination to standards that were applicable at the time. Characterization was not conducted to delineate the extent of contamination consistent with the DTSC/DOE December 2010 AOC. Therefore, additional characterization is recommended for the Pad 4684 area. This includes the following Pad 4684 areas and appurtenances:

- The flat and low-lying areas surrounding Pad 4684. Radionuclides originating from Building 4143 may have migrated to these areas via surface water flow or airborne releases.

- The storm drain system located north of the site that connects to the SRE retention pond.

2.1.12 Site 4686 Area

Site Description: The Site 4686 area comprised Site 4686 and the land surrounding it located at the top of the hill above the SRE complex at the end of E Street. Site 4686 was constructed in about 1957 as a temporary hot radioactive waste storage facility.[1] Figure 2.1.12a provides a current photograph. The location of Site 4686 is shown in Figure 1.3 and in plot plan Figure 2.1.10b.

Building Features: Site 4686 was a fenced-in asphalt-topped storage area containing plastic-wrapped radioactive items in wooden boxes.[2]

Former Use(s): Site 4686 was a temporary "hot" radioactive waste storage facility where solid radioactive waste, such as irradiated core components, moderator cans, and fuel elements were stored temporarily. The principal radioactive material stored in this area was plastic wrapped failed fuel elements containing induced radioactivity and mixed fission products. Aerial photographs indicate that this facility was used for storage until at least 1972.

Information from Interviewees: None to date.

Radiological Incident Reports: There has been one incident associated with Building 4686 that could have resulted in a release to the environment. The following table provides information presented in an incidents database provided by Boeing. A summary of the incident report is provided following the table.

[1] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[2] Owens, D. E., *Radiological Survey Results – Release to Unrestricted Use, SRE Region V*, Rockwell International Report No. N704TI990031, May 26, 1978, pp. 3-9.

Building 4686 Incident Report Summary

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A0396	6/17/1960	SRE WASTE AREA	MFP	R/A STORAGE AREA WAS ENTERED WITH OUT APPROVAL OR PROTECTIVE CLOTHING.

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

- On June 17, 1960, three employees entered the SRE Temporary Waste Storage Area without contacting the health physics department, despite a sign on the entrance gate requesting this action. The employees were not wearing any protective clothing. They removed a highly contaminated grapple (a type of bucket) from the area and left it unattended. One of the employees later requested a survey of his clothing and found a spot of contamination on his pants. The other employees were checked, but no contamination was found. Investigation found that the SRE Temporary Waste Storage Area gate was usually unlocked and that personnel freely moved in and out of the area without contacting the health physics department. There was also no specific information on whether a tagged area entry permit or protective clothing was required (Incident Report A0396).[1]

Current Use: Site 4686 was demolished prior to 1978. All asphalt has been removed from the site.

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

- In 1978, Rockwell hired an outside contractor to remove the asphalt-covered fenced area. An unknown amount of contaminated material was packaged and shipped to an unnamed site as radioactive waste. Rockwell then conducted a radiological survey in the area of Site 4686. The survey area was designated as SRE Region V. Survey results indicated a maximum reading of 0.08 mrad/h for surface gamma radiation, and soil samples were found to have less than 50 pCi/g of gross detectable beta activity. All survey results were below Rockwell's applicable limits for release for unrestricted use.[2]

- In September 1982, ANL completed a verification survey of the SRE complex. This included instrument and smear surveys and analysis of material samples. ANL found that Site 4686 and its surrounding area had been decontaminated to below limits specified in the Draft ANSI Standard No. N13.12 and NRC 1982 guidelines.[2]

[1] Health Physics, Atomics International Internal Letter, re*: Notice of Radiological or Industrial Safety Rule Infraction*, August 12, 1960.
[2] Argonne National Laboratory, *Post Remedial Action Survey Report for the Sodium Reactor Experiment (SRE) Facility, Santa Susana Field Laboratories, Rockwell International, Ventura County, California,* DOE-EV-0005-46, ANL-OHS/HP-84-101, February 1984, pp. 1-3, 15.

Radiological Use Authorizations: The DOE released the area for unrestricted use on July 23, 1985.[1]

Former Radiological Burial or Disposal Locations: None found.

Aerial Photographs: Aerial photographs show undeveloped land until the 1957 photograph when disturbed ground is seen in the location of Site 4686. In the 1959 photograph, objects are seen on a rectangular pad that is identified as Site 4686. Objects are also seen in the approximately 1960, 1965, 1967, and 1972 photographs. A rectangular-shaped cleared area is observed in the 1978 photograph. The area is vegetated in the 1980, 1983, 1988, 1995, 2005 and 2009 photographs.[2]

Radionuclides of Concern: Site 4686 was part of the SRE reactor complex and was located on the hill above the SRE complex. Possible radionuclides include U-238, U-234, U-235, U-236, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Th-232, H-3, Na-22, Na-24, Cr-51, Mn-54, Fe-59, Co-60, Kr-85, Sr-89, Sr-90, Sb-125, I-129, I-131, Cs-134, Cs-137, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xn-133, Xe-135, Pm-147, Sm-151.[3, 4, 5] All radionuclides of concern listed with the exception of Na-24, Cr-51, Mn-54, Fe-59, Kr-85, Sr-89, I-131, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xe-133, Xe-135, Pm-147 and Sm-151 are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives except for Sm-151 for which no analytical method is available. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: A drainage divide is located south of the site. Based on general site topography, surface water flows north through the NBZ onto Brandeis-Bardin Institute land through Meier Canyon and into Arroyo Simi in Simi Valley.

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Site 4686 area is Class 1 because of the former use in the SRE complex.

Recommended Locations for Soil/Sediment Sampling:

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

Previous characterization studies for the Site 4686 area were focused on delineating the extent of contamination to standards that were applicable at the time. Characterization was not conducted to delineate the extent of contamination consistent with the DTSC/DOE December 2010 AOC. Therefore, additional characterization is recommended for the Site 4686 area. This includes the following Site 4686 areas and appurtenances:

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[1] U.S. Department of Energy, *Certification for Unrestricted Use of the Sodium Reactor Experiment (SRE) Complex and the Hot Cave Facility (Bldg. 003)*, July 23, 1985.
[2] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[3] Hart, R. S., *Distribution of Fission Product Contamination in the SRE*, Atomics International Report No. NAA-SR-6890, March 1, 1962, pp. 8-27.
[4] Kinzer, J. and Crawford, A. C., *SRE First Core Fuel*, Atomics International Technical Data Record No. 5301, May 16, 1960, pp. 1-7.
[5] Letter from Heine, W. F., Atomics International, to Proctor, J. F., E. I. du Pont de Nemours & Company, re: *Fission Product and Fissile Content of SRE Fuel*, July 2, 1975.

- The flat and low-lying areas on and surrounding Site 4686. Radionuclides originating from Site 4686 may have migrated to these areas via surface water flow or airborne releases.

- The hillside downgradient of Site 4686 (run-off areas) where solid waste may have been transported during heavy rain or wind events.

2.1.13 Site 4689 Area

Site Description: The Site 4689 area comprised Site 4689 and the land surrounding it located in the northwest corner of the SRE complex at the end of E Street. Site 4689 was constructed in about 1959 as an intermediate storage area for contaminated items from the SRE.[1] Figure 2.1.13a provides a current photograph. The location of Site 4689 is shown in Figure 1.3.

Building Features: Site 4689 was a fenced-in asphalt-topped storage area.[2]

Former Use(s): Site 4689 was the intermediate (sometimes referred to as interim) storage area for contaminated items from the SRE. This is assumed to the an area where intermediate-level radioactive waste was stored.. Aerial photographs indicate that this facility was used for storage until at least 1965.

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: Site 4689 was removed prior to 1967.

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

- AI removed Site 4689 prior to the decommissioning of the SRE. The contaminated asphalt in the area was removed and the area was repaved.[2] The area appears to have become contaminated from the radioactive waste stored there.

- In 1978, Rockwell conducted a radiological survey in the area of Site 4689. The survey area was designated as SRE Region V. Survey results indicated a maximum reading of 0.08 ± 0.05 mrad/h for surface gamma radiation, and soil samples were found to have less than 50 pCi/g of gross detectable beta activity. All survey results were below Rockwell's applicable limits for release for unrestricted use.[3]

- In September 1982, ANL completed a verification survey of the SRE complex. This included instrument and smear surveys and analysis of material samples. ANL found that

[1] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[2] Rockwell International, *Sodium Reactor Experiment Decommissioning Final Report*, Report No. ESG-DOE-13403, August 15, 1983, p. 196.
[3] Owens, D. E., *Radiological Survey Results – Release to Unrestricted Use, SRE Region V*, Rockwell International Report No. N704TI990031, May 26, 1978, pp. 3-9.

Site 4689 and its surrounding area had been decontaminated to below limits specified in the Draft ANSI Standard No. N13.12 and NRC 1982 guidelines.[1]

Radiological Use Authorizations: The DOE released the area for unrestricted use on July 23, 1985.[2]

Former Radiological Burial or Disposal Locations: None found.

Aerial Photographs: Aerial photographs show undeveloped land until the 1959 photograph when open storage of items is observed that is identified as Site 4689. Different items are seen in the approximately 1960 and 1965 photographs. The items appear to have been removed in the 1967, 1972, 1978, and 1980 photographs. A probable tank pad is identified in the 1983 photograph, which is not visible in the 1988 and 1995 photographs. Vegetation is seen in the location of Site 4689 in the 2005 and 2009 photographs.[3]

Radionuclides of Concern: Site 4689 was part of the SRE reactor complex and was located northwest of Building 4143. Possible radionuclides include U-238, U-234, U-235, U-236, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Th-232, H-3, Na-22, Na-24, Cr-51, Mn-54, Fe-59, Co-60, Kr-85, Sr-89, Sr-90, Sb-125, I-129, I-131, Cs-134, Cs-137, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xn-133, Xe-135, Pm-147, Sm-151.[4, 5, 6] All radionuclides of concern listed with the exception of Na-24, Cr-51, Mn-54, Fe-59, Kr-85, Sr-89, I-131, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xe-133, Xe-135, Pm-147 and Sm-151 are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives except for Sm-151 for which no analytical method is available. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Site 4689 was located northwest of SRE Building 4143. Based on general site topography, surface water on Site 4689 flows into a drainage channel located southeast of the site. This channel carries surface water to the SRE retention pond located northeast of the site. Outflow from the retention pond was initially onto the NBZ and Brandeis-Bardin Institute land. In 1959, a 6-foot diameter overflow pipe and a pumped sump were installed at the confluence of the two main drainage channels upstream of the pond. Water was then pumped through a 4-inch diameter overland pipe to a channel connecting to the Area II ponds. The overflow from these ponds is into Bell Canyon and thence to the Los Angeles River.[7]

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[1] Argonne National Laboratory, *Post Remedial Action Survey Report for the Sodium Reactor Experiment (SRE) Facility, Santa Susana Field Laboratories, Rockwell International, Ventura County, California*, DOE-EV-0005-46, ANL-OHS/HP-84-101, February 1984, pp. 1-3, 15.

[2] U.S. Department of Energy, *Certification for Unrestricted Use of the Sodium Reactor Experiment (SRE) Complex and the Hot Cave Facility (Bldg. 003)*, July 23, 1985.

[3] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.

[4] Hart, R. S., *Distribution of Fission Product Contamination in the SRE*, Atomics International Report No. NAA-SR-6890, March 1, 1962, pp. 8-27.

[5] Kinzer, J. and Crawford, A. C., *SRE First Core Fuel*, Atomics International Technical Data Record No. 5301, May 16, 1960, pp. 1-7.

[6] Letter from Heine, W. F., Atomics International, to Proctor, J. F., E. I. du Pont de Nemours & Company, re: *Fission Product and Fissile Content of SRE Fuel*, July 2, 1975.

[7] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.

Radiological Contamination Potential: The preliminary MARSSIM classification for the Site 4689 area is Class 1 due to its former use as an SRE support building.

Recommended Locations for Soil/Sediment Sampling:

Plate 1 and Figure 2.1 provide a convenient reference for the following recommendations. Information is lacking regarding the excavation activities at Site 4689. In addition, previous characterization studies for the Site 4689 area were focused on delineating the extent of contamination to standards that were applicable at the time. Characterization was not conducted to delineate the extent of contamination consistent with the DTSC/DOE December 2010 AOC. Therefore, additional characterization is recommended for the Site 4689 area. This includes the following Site 4689 areas and appurtenances:

- The flat and low-lying areas on and surrounding Site 4689. Radionuclides originating from Site 4689 may have migrated to these areas via surface water flow or airborne releases.

- The hillside downgradient of Site 4689 (run-off areas) where solid waste may have been transported during heavy rain or wind events.

- The storm drain system located southeast of the site that connects to the SRE retention pond.

2.1.14 Building 4695 Area

Site Description: The Building 4695 area comprised Building 4695 and the land surrounding it located on the north side of the SRE between Building 4753, the primary fill/drain tank vault, and Building 4153, the sodium service building at the end of E Street. Building 4695 was constructed in about 1957 as the cold trap (vapor condenser) vault.[1] Figures 2.1.14a and 2.1.14b provide a current photograph and elevation views of the below-ground vault. Figure 2.1.14c provides a view of the site after below-ground demolition.

Building Features: Building 4695 was a below-ground vault for the SRE that contained a cold trap (vapor condenser) and two hot traps (heaters).[2] Elevation views of the sodium service vault are presented in Figure 2.1.14b.[3]

Former Use(s): Building 4695 was the cold trap vault for the SRE.

Information from Interviewees: None to date.

[1] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[2] Owen, R. K., *Radiological Survey Plan, Support of D & D Program Operations at T-143 (SRE)*, Rockwell International Report No. N704TP990008, September 15, 1981, p. 3.
[3] Ureda, B. and Heine, W., *Facilities Dismantling Plan for SRE*, Atomics International Report No. FDP-704-990-003, June 26, 1975, p. 26.

Radiological Incident Reports: During the course of reactor operations, several primary sodium leaks and fires occurred within the vault.[1] No additional information has been found about these incidents.

Current Use: Building 4695 was demolished in 1978. All of the below-grade structures were removed and the area was backfilled and paved. Concrete rubble reported to be "clean" was included in the backfill.[2] Figure 2.1.14c shows the site after demolition.

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

- In September 1982, ANL completed a verification survey of the SRE complex. This included instrument and smear surveys and analysis of material samples. ANL found that the Building 4695 site and its surrounding area had been decontaminated to below limits specified in the Draft ANSI Standard No. N13.12 and NRC 1982 guidelines.[3]

- In 1983, Rockwell conducted a radiological survey in the area of Building 4695. The survey area was designated as SRE Building 143. Survey results indicated a maximum below-grade reading of less than 0.1 mrad/h for surface gamma radiation, and below-grade soil samples were found to have less than 100 pCi/g of gross detectable beta activity, with an average of 51 pCi/g. All survey results were below Rockwell's applicable limits for release for unrestricted use.[4]

Radiological Use Authorizations: None. However, the DOE released the area for unrestricted use on July 23, 1985.[5]

Former Radiological Burial or Disposal Locations: None found.

Aerial Photographs: Aerial photographs show undeveloped land until the 1957 photograph when a rectangular pad adjacent to the north side of Building 4143 is seen and is identified as Building 4695. Because of the small size of Building 4695 and because it is adjacent to Building 4143 and is an underground vault, it is very difficult to see on every aerial photograph. It can be seen on the 1959 photograph, but cannot be see on photographs from the 1960s and 1970s. In the 1980 photograph, an excavation is seen in the location of Building 4695. Open storage is identified in the 1983 photograph. The area appears clear of objects in the 1988 and 1995 photographs. Vegetation is seen in the location of Building 4695 in the 2005 and 2009 photographs.[6]

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[1] Owen, R. K., *Radiological Survey Plan, Support of D & D Program Operations at T-143 (SRE)*, Rockwell International Report No. N704TP990008, September 15, 1981, p. 3.
[2] Rockwell International, *Sodium Reactor Experiment Decommissioning Final Report*, Report No. ESG-DOE-13403, August 15, 1983, pp. 156-157, 196.
[3] Argonne National Laboratory, *Post Remedial Action Survey Report for the Sodium Reactor Experiment (SRE) Facility, Santa Susana Field Laboratories, Rockwell International, Ventura County, California*, DOE-EV-0005-46, ANL-OHS/HP-84-101, February 1984, pp. 1-3, 15.
[4] Wallace, J. H., *Radiological Survey Results – Release to Unrestricted Use, SRE Building 143*, Rockwell International Report No. N704TI990038, May 31, 1983, pp. 3-10.
[5] U.S. Department of Energy, *Certification for Unrestricted Use of the Sodium Reactor Experiment (SRE) Complex and the Hot Cave Facility (Bldg. 003)*, July 23, 1985.
[6] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.

Radionuclides of Concern: Building 4695 was part of the SRE reactor complex and was adjacent to the north side of Building 4143. Possible radionuclides include U-238, U-234, U-235, U-236, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Th-232, H-3, Na-22, Na-24, Cr-51, Mn-54, Fe-59, Co-60, Kr-85, Sr-89, Sr-90, Sb-125, I-129, I-131, Cs-134, Cs-137, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xn-133, Xe-135, Pm-147, Sm-151.[1, 2, 3] All radionuclides of concern listed with the exception of Na-24, Cr-51, Mn-54, Fe-59, Kr-85, Sr-89, I-131, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xe-133, Xe-135, Pm-147 and Sm-151 are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives except for Sm-151 for which no analytical method is available. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Based on general site topography, surface water flows into the drainage channel located north of the site, which connects to the SRE retention pond located northeast of the site. Outflow from the retention pond was initially onto the NBZ and Brandeis-Bardin Institute land. In 1959, a 6-foot diameter overflow pipe and a pumped sump were installed at the confluence of the two main drainage channels upstream of the pond. Water was then pumped through a 4-inch diameter overland pipe to a channel connecting to the Area II ponds. The overflow from these ponds is into Bell Canyon and thence to the Los Angeles River.[4]

Radiological Contamination Potential: The preliminary MARSSIM classification for the Building 4695 area is Class 1 due to its former use as a service building for the SRE reactor.

Recommended Locations for Soil/Sediment Sampling:

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

Previous characterization studies for the Building 4695 area were focused on delineating the extent of contamination to standards that were applicable at the time. Characterization was not conducted to delineate the extent of contamination consistent with the DTSC/DOE December 2010 AOC. Therefore, additional characterization is recommended for the Building 4695 area. This includes the following Building 4695 areas and appurtenances:

- The flat and low-lying areas surrounding Building 4695. Radionuclides originating from Buildings 4143 and/or 4695 may have migrated to these areas via surface water flow or airborne releases.

- The location of open storage on the site as seen in aerial photographs.

- The drainage channel located north of the site that connects to the SRE retention pond.

[1] Hart, R. S., *Distribution of Fission Product Contamination in the SRE*, Atomics International Report No. NAA-SR-6890, March 1, 1962, pp. 8-27.
[2] Kinzer, J. and Crawford, A. C., *SRE First Core Fuel*, Atomics International Technical Data Record No. 5301, May 16, 1960, pp. 1-7.
[3] Letter from Heine, W. F., Atomics International, to Proctor, J. F., E. I. du Pont de Nemours & Company, re: *Fission Product and Fissile Content of SRE Fuel*, July 2, 1975.
[4] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.

2.1.15 Site 4703 Area

Site Description: The Site 4703 area comprised Site 4703 and the land surrounding it located at the top of the hill above the SRE complex at the end of E Street. Site 4703 was constructed in about 1957 as a wooden water tower.[1] Figure 2.1.15a provides a current photograph. The location of Site 4703 is shown in plot plan Figure 2.1.10b.

Building Features: Site 4703 was a tower topped by a large wooden water tank with an access stairway and piping.[2]

Former Use(s): Site 4703 stored emergency cooling water for the Edison Company steam generator portion of the SRE. According to Rockwell, because of its inaccessibility, no other use was made of this site.[2]

Information from Interviewees: In 2010, a number of former workers were interviewed about their experiences at the SSFL. One had knowledge of Site 4703. Excerpts from his comments are presented below.

- **"**SCE owned the redwood cooling tower which was necessary for operation of their turbine generator and hence was essential for distribution to SCE's grid of the power produced by SRE. Although we believe that the automatic sprinklers designed to maintain the moisture content of the redwood functioned sometime in the preceding 24 hours, the cooling tower burned and was totally destroyed." This individual worked at the SSFL between 1958 and 1968.[3]

Radiological Incident Reports: None found.

Current Use: Site 4703 was destroyed by a brush fire prior to 1978, according to an interviewee.

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

- In 1978, Rockwell conducted a radiological survey in the area of Site 4703. The survey area was designated as SRE Region VI. Survey results indicated a maximum reading of 0.05 mrad/h for surface gamma radiation, and 18 soil samples were found to have less than 32 pCi/g of gross detectable beta contamination, with an average of 22 pCi/g. All survey results were below Rockwell's applicable limits for release for unrestricted use.[2]

- In September 1982, ANL completed a verification survey of the SRE complex. This included instrument and smear surveys and analysis of material samples. ANL found that

[1] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[2] Owens, D. E., *Radiological Survey Results – Release to Unrestricted Use, SRE Region VI Water Tank Area*, Rockwell International Report No. N704TI990032, November 10, 1978, pp. 3-8.
[3] Interview No. 300 of former worker conducted by the DOE and EPA on July 16, 2010, p. 7.

Site 4703 and its surrounding area had been decontaminated to below limits specified in the Draft ANSI Standard No. N13.12 and NRC 1982 guidelines.[1]

Radiological Use Authorizations: The DOE released the area for unrestricted use on July 23, 1985.[2]

Former Radiological Burial or Disposal Locations: None found.

Aerial Photographs: Aerial photographs show undeveloped land until the 1957 photograph when a vertical tank is seen that is identified as Site 4703. This is also seen in the 1959, approximately 1960, 1965, 1967, and 1972 photographs. The tank is absent from the 1978 photograph, but a tank pad is identified in the 1978, 1980, 1983, 1988, 1995, 2005, and 2009 photographs.[3]

Radionuclides of Concern: Site 4703 was located north of the SRE reactor complex. Radionuclides originating from Building 4143 may have migrated to this area via airborne releases. Possible radionuclides include U-238, U-234, U-235, U-236, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Th-232, H-3, Na-22, Na-24, Cr-51, Mn-54, Fe-59, Co-60, Kr-85, Sr-89, Sr-90, Sb-125, I-129, I-131, Cs-134, Cs-137, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xn-133, Xe-135, Pm-147, Sm-151.[4, 5, 6] All radionuclides of concern listed with the exception of Na-24, Cr-51, Mn-54, Fe-59, Kr-85, Sr-89, I-131, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xe-133, Xe-135, Pm-147 and Sm-151 are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives except for Sm-151 for which no analytical method is available. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Site 4703 was located on a drainage divide. Based on general site topography, surface water from Site 4703 flows north and south on each side of a drainage divide. The portion that flows north passes through the NBZ and the Brandeis-Bardin Institute property through Meier Canyon and into Arroyo Simi in Simi Valley. The portion that flows south reaches the drainage channel north of Building 4143 and is carried to the SRE retention pond, then to ponds in Areas II and III, and finally to Bell Canyon and the Los Angeles River.[7]

Radiological Contamination Potential: The preliminary MARSSIM classification for the Site 4703 area is Class 2 due to its location near the SRE complex.
Recommended Locations for Soil/Sediment Sampling:

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[1] Argonne National Laboratory, *Post Remedial Action Survey Report for the Sodium Reactor Experiment (SRE) Facility, Santa Susana Field Laboratories, Rockwell International, Ventura County, California*, DOE-EV-0005-46, ANL-OHS/HP-84-101, February 1984, pp. 1-3, 15.
[2] U.S. Department of Energy, *Certification for Unrestricted Use of the Sodium Reactor Experiment (SRE) Complex and the Hot Cave Facility (Bldg. 003)*, July 23, 1985.
[3] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[4] Hart, R. S., *Distribution of Fission Product Contamination in the SRE*, Atomics International Report No. NAA-SR-6890, March 1, 1962, pp. 8-27.
[5] Kinzer, J. and Crawford, A. C., *SRE First Core Fuel*, Atomics International Technical Data Record No. 5301, May 16, 1960, pp. 1-7.
[6] Letter from Heine, W. F., Atomics International, to Proctor, J. F., E. I. du Pont de Nemours & Company, re: *Fission Product and Fissile Content of SRE Fuel*, July 2, 1975.
[7] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.

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

Previous characterization studies for the Site 4703 area were focused on delineating the extent of contamination to standards that were applicable at the time. Characterization was not conducted to delineate the extent of contamination consistent with the DTSC/DOE December 2010 AOC. Therefore, additional characterization is recommended for the Site 4703 area. This includes the following Site 4703 areas:

- The flat and low-lying areas surrounding Site 4703. Radionuclides originating from Buildings 4143 may have migrated to this area via airborne releases.

2.1.16 Site 4714 Area

Site Description: The Site 4714 area comprised Site 4714 and the land surrounding it located north of Building 4163 in the SRE complex at the end of E Street. Site 4714 was constructed prior to 1959 as an outdoor work area for Building 4163.[1] Figure 2.1.16a provides a current photograph. The location of Site 4714 is shown on Figure 1.3.

Building Features: Site 4714 was a square-shaped pad that served as an outdoor work area.[1]

Former Use(s): Site 4714 was used for research and development in the SRE.

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: Site 4714 was demolished prior to 1983.

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

- In 1978, Rockwell conducted a radiological survey in the area of Site 4714. The survey area was designated as SRE Region II. Survey results indicated an average reading of 0.06 ± 0.05 mrad/h for surface gamma radiation recorded outside Building 4163. No soil samples were collected because the area was covered with asphalt paving. All survey results were below Rockwell's applicable limits for release for unrestricted use.[2]
- In September 1982, ANL completed a verification survey of the SRE complex. This included instrument and smear surveys and analysis of material samples. ANL found that Site 4714 and its surrounding area had been decontaminated to below limits specified in the Draft ANSI Standard No. N13.12 and NRC 1982 guidelines.[3]

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[1] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[2] Owens, D. E., *Radiological Survey Results – Release to Unrestricted Use, SRE Region II (Building 163, Box Shop)*, Rockwell International Report No. N704TI990028, May 4, 1978, pp. 3-7.
[3] Argonne National Laboratory, *Post Remedial Action Survey Report for the Sodium Reactor Experiment (SRE) Facility, Santa Susana Field Laboratories, Rockwell International, Ventura County, California*, DOE-EV-0005-46, ANL-OHS/HP-84-101, February 1984, pp. 1-3, 15.

Radiological Use Authorizations: The DOE released the area for unrestricted use on July 23, 1985.[1]

Former Radiological Burial or Disposal Locations: None found.

Aerial Photographs: Aerial photographs show undeveloped land until the 1959 photograph when a square-shaped pad is seen that is identified as Site 4714. This is also seen in the approximately 1960, 1965, 1967, 1972, 1978, and 1980 photographs. Site 4714 cannot be seen in the 1983, 1988, and 1995 photographs. A vegetated area is seen in the location of Site 4714 in the 2005 photograph, and dark colored sheeting is seen in the 2009 photographs.[2]

Radionuclides of Concern: Building 4714 was associated with SRE Building 4163. Possible radionuclides include U-238, U-234, U-235, U-236, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Th-232, H-3, Na-22, Na-24, Cr-51, Mn-54, Fe-59, Co-60, Kr-85, Sr-89, Sr-90, Sb-125, I-129, I-131, Cs-134, Cs-137, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xn-133, Xe-135, Pm-147, Sm-151.[3, 4, 5] All radionuclides of concern listed with the exception of Na-24, Cr-51, Mn-54, Fe-59, Kr-85, Sr-89, I-131, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xe-133, Xe-135, Pm-147 and Sm-151 are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives except for Sm-151 for which no analytical method is available. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Based on general site topography, surface water flows into the storm drain system located south and east of the site, which connects to the SRE retention pond located northeast of the site. Outflow from the retention pond was initially onto the NBZ and Brandeis-Bardin Institute land. In 1959, a 6-foot diameter overflow pipe and a pumped sump were installed at the confluence of the two main drainage channels upstream of the pond. Water was then pumped through a 4-inch diameter overland pipe to a channel connecting to the Area II ponds. The overflow from these ponds is into Bell Canyon and thence to the Los Angeles River.[6]

Radiological Contamination Potential: The preliminary MARSSIM classification for the Site 4714 area is Class 1 due to its former use as an SRE support building.

Recommended Locations for Soil/Sediment Sampling:

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

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[1] U.S. Department of Energy, *Certification for Unrestricted Use of the Sodium Reactor Experiment (SRE) Complex and the Hot Cave Facility (Bldg. 003)*, July 23, 1985.
[2] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[3] Hart, R. S., *Distribution of Fission Product Contamination in the SRE*, Atomics International Report No. NAA-SR-6890, March 1, 1962, pp. 8-27.
[4] Kinzer, J. and Crawford, A. C., *SRE First Core Fuel*, Atomics International Technical Data Record No. 5301, May 16, 1960, pp. 1-7.
[5] Letter from Heine, W. F., Atomics International, to Proctor, J. F., E. I. du Pont de Nemours & Company, re: *Fission Product and Fissile Content of SRE Fuel*, July 2, 1975.
[6] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.

Previous characterization studies for the Site 4714 area were focused on delineating the extent of contamination to standards that were applicable at the time. Characterization was not conducted to delineate the extent of contamination consistent with the DTSC/DOE December 2010 AOC. Therefore, additional characterization is recommended for the Site 4714 area. This includes the following Site 4714 areas:

- The flat and low-lying areas surrounding Building 4714. Radionuclides originating from Buildings 4163 and/or 4143 may have migrated to these areas via surface water flow or airborne releases. In 1978, asphalt paving reportedly prevented Rockwell from collecting soil samples at the time of demolition. Therefore, site characterization is incomplete.

2.1.17 Site 4723 Area

Site Description: The Site 4723 area comprised Site 4723 and the land surrounding it located at the extreme east end of the SRE complex at the end of E Street, about 250 feet northeast of Building 4003. Site 4723 was constructed in about 1957 as a sodium cleaning pad.[1] Figure 2.1.17a provides a current photograph. The location of Site 4723 is shown in Figure 1.3.

Building Features: Site 4723 was a 20- by 20-foot concrete pad according to one source and a 25- by 28-foot concrete pad according to a second source.[2, 3]

Former Use(s): Site 4723 was used as a steam cleaning pad for equipment and materials in the SRE. Prior to an incident in March 1960, the pad was used to clean low-level radioactivity from items of equipment. After the incident, AI decided not to use the pad for radioactive decontamination.[4] The pad was then used for sand blasting items and equipment that were believed to be free of radioactivity.[2]

Information from Interviewees: None to date.

Radiological Incident Reports: There has been one incident associated with Building 4723 that could have resulted in a release to the environment. The following table provides information presented in an incidents database provided by Boeing. A summary of the incident report is provided following the table, when available.

Building 4723 Incident Report Summary

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A0004	3/19/1960	SRE STEAM PAD	MFP	STEAM CLEANED R/A SODIUM PIPE AT CLEAN PAD CONTAMINATING AREA.

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

[1] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[2] Owens, D. E., *Radiological Survey Results – Release to Unrestricted Use, SRE Region I (Building 724 Area)*, Rockwell International Report No. N704TI990027, May 4, 1978, pp. 3-11.
[3] Ureda, B. F., *SRE Activity Requirement No. 25, Decontamination and Dismantling of Building 724 and Pad 723*, Rockwell International Report No. N704ACR990021, p. 2.
[4] Inter-office letter from J. Borg and E. J. Marcotte to W. L. Fisher, re: *Steam Clean Pad Incident*, June 2, 1960.

- On March 19, 1960, employees were decontaminating a 2-inch valve containing radioactively contaminated sodium at the SRE steam cleaning pad. The valve was placed in an oil bath and then removed for steam cleaning. The residual sodium was blasted from the valve and spread over the greater portion of the concrete pad. The employees were not wearing protective clothing and their shoes were contaminated as a result. The pad was hosed down, washing contaminated sodium and water onto the soil.

  Two of the men had contamination on their shoes that ranged from 1.5 to 3.0 mrad/h beta-gamma activity. Surveys from the south, east, and west edges of the pad to the center ranged from 0.5 to 30 mrad/h; however, the north edge of the pad to the center ranged from 30 to 100 mrad/h. Ten representative soil samples were collected from the north edge of the pad down the hillside to the retention pond. Beta-gamma activity in soil ranged from 2.7×10^{-7} to 1.5×10^{-2} µCi/g. According to Rockwell, water samples from the retention pond revealed nothing in excess of normal ground water activity.

  Decontamination efforts included chipping the pad surface and removing soil on the hillside. Sixteen barrels of concrete and 46 barrels of contaminated soil were collected for disposal. Follow-up soil samples found beta-gamma contamination ranging from 5.3 $\times 10^{-6}$ to 4.8×10^{-5} µCi/g showing decontamination was successful as the average soil activity for the area was 10^{-5} µCi/g. Smears taken of the concrete pad showed beta-gamma activity ranging from 4 to 20 dpm/100 cm^2, with the exception of one sample that was 40 dpm/100 cm^2. A survey of the pad found readings between 0.08 and 0.15 mrad/h, which were deemed by Rockwell as low enough to resurface the pad (Incident Report A004).[1]

Current Use: Site 4723 was demolished in 1998.

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

- In 1978, Rockwell conducted a radiological survey in the area of Site 4723. The survey area was designated as SRE Region I. Survey results indicated a maximum reading of 0.04 ± 0.05 mrad/h for surface gamma radiation, and 27 soil samples were found to have less than 46 pCi/g of gross detectable beta contamination. All survey results were below Rockwell's applicable limits for release for unrestricted use.[2]

- In September 1982, ANL completed a verification survey of the SRE complex. This included instrument and smear surveys and analysis of material samples. ANL found that Site 4686 and its surrounding area had been decontaminated to below limits specified in the Draft ANSI Standard No. N13.12 and NRC 1982 guidelines.[2]

[1] Borg, J. and E.J. Marcotte, Atomics International Internal Letter, re*: Steam Clean Pad Incident*, June 2, 1960.
[2] Argonne National Laboratory, *Post Remedial Action Survey Report for the Sodium Reactor Experiment (SRE) Facility, Santa Susana Field Laboratories, Rockwell International, Ventura County, California*, DOE-EV-0005-46, ANL-OHS/HP-84-101, February 1984, pp. 1-3, 15.

Radiological Use Authorizations: The DOE released the area for unrestricted use on July 23, 1985.[1]

Former Radiological Burial or Disposal Locations: None found.

Aerial Photographs: Aerial photographs show undeveloped land until the 1957 photograph when disturbed ground is seen in the location of Site 4723. In the 1959 photograph, a square-shaped pad is identified as Site 4723. This is also seen in the approximately 1960, 1965, 1967, 1972, 1978, 1980, 1983, 1988, and 1995 photographs. A vegetated area is seen in the location of Site 4723 in the 2005 and 2009 photographs.[2]

Radionuclides of Concern: Site 4723 was initially used for cleaning low-level radioactivity from items of equipment. Possible radionuclides include U-238, U-234, U-235, U-236, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Th-232, H-3, Na-22, Na-24, Cr-51, Mn-54, Fe-59, Co-6, Kr-85, Sr-89, Sr-90, Sb-125, I-129, I-131, Cs-134, Cs-137, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xn-133, Xe-135, Pm-147, Sm-151.[3, 4, 5] All radionuclides of concern listed with the exception of Na-24, Cr-51, Mn-54, Fe-59, Kr-85, Sr-89, I-131, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xe-133, Xe-135, Pm-147 and Sm-151 are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives except for Sm-151 for which no analytical method is available. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Based on general site topography, surface water flows northwest into the SRE retention pond located northwest of the site. Outflow from the retention pond was initially onto the NBZ and Brandeis-Bardin Institute land. In 1959, a 6-foot diameter overflow pipe and a pumped sump were installed at the confluence of the two main drainage channels upstream of the pond. Water was then pumped through a 4-inch diameter overland pipe to a channel connecting to the Area II ponds. The overflow from these ponds is into Bell Canyon and thence to the Los Angeles River.[6]

Radiological Contamination Potential: The preliminary MARSSIM classification for the Site 4723 area is Class 1 because of its former use within the SRE complex.

Recommended Locations for Soil/Sediment Sampling:

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

[1] U.S. Department of Energy, *Certification for Unrestricted Use of the Sodium Reactor Experiment (SRE) Complex and the Hot Cave Facility (Bldg. 003)*, July 23, 1985.
[2] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[3] Hart, R. S., *Distribution of Fission Product Contamination in the SRE*, Atomics International Report No. NAA-SR-6890, March 1, 1962, pp. 8-27.
[4] Kinzer, J. and Crawford, A. C., *SRE First Core Fuel*, Atomics International Technical Data Record No. 5301, May 16, 1960, pp. 1-7.
[5] Letter from Heine, W. F., Atomics International, to Proctor, J. F., E. I. du Pont de Nemours & Company, re: *Fission Product and Fissile Content of SRE Fuel*,July 2, 1975.
[6] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.

Previous characterization studies for the Site 4723 area were focused on delineating the extent of contamination to standards that were applicable at the time. Characterization was not conducted to delineate the extent of contamination consistent with the DTSC/DOE December 2010 AOC. Therefore, additional characterization is recommended for the Site 4723 area. This includes the following Site 4723 areas:

- The flat and low-lying areas on and surrounding Site 4723. Radionuclides originating from Site 4723 may have migrated to these areas via surface water flow or airborne releases. The steam cleaning incident in 1960 spread radioactive contamination in the area.

2.1.18 Building 4724 Area

Site Description: The Building 4724 area comprised Building 4724, and auxiliary skid Building 4688, and the land surrounding these buildings located at the extreme east end of the SRE complex at the end of E Street, about 250 feet northeast of Building 4003. Building 4724 was constructed in about 1966 as a contaminated sodium cleaning building.[1] Figure 2.1.18a provides a current photograph. The location of Building 4724 is shown in Figure 1.3.

Building Features: Building 4724 was a 10- by 22- by 12-foot high steel enclosure containing a monorail crane that extended 222 feet beyond the enclosure entrance. The enclosure was vented through duct work, an air filter, blowers, and an exhaust stack. The interior of the facility was posted as a radiation area. A concrete pit, containing an oil heater and oil supply tank, was located south of the steel enclosure. A concrete sump was located west of the enclosure.[2]

Former Use(s): Building 4724 was a hot oil sodium cleaning facility that was designed for cleaning sodium, in a hot oil bath, from large pipes and assemblies from the secondary loop of the SRE.[3] No further details about the cleaning method have been found.

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: In 1978, the Building 4724 steel enclosure was decontaminated, dismantled and relocated to become Building 4133.[3, 4] Building 4133 is discussed in the TM for HSA-7.

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

- In 1977, Rockwell found that Building 4724 had a buildup of contamination from mixed fission products. Most of the activity was located inside a small trench dug along the

[1] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[2] Ureda, B. F., *SRE Activity Requirement No. 25, Decontamination & Dismantling of Building 724 and Pad 723*, Rockwell International Report No. N704ACR990021, March 28, 1977, pp. 2-5.
[3] Owens, D. E., *Radiological Survey Results – Release to Unrestricted Use, SRE Region I (Building 724 Area)*, Rockwell International Report No. N704TI990027, May 4, 1978, pp. 3-11.
[4] Boeing letter from B. Sujata to S. Baxter, California Environmental Protection Agency, re: *Radiological Release of Former Building 724*, November 14, 2005.

west wall of Building 4724. The metal diamond-plate floor was cut free in an attempt to remove the contamination, which was also detected in the underlying concrete. Rockwell decontaminated the walls and ceiling of Building 4724 to bring them under the limits of 20 dpm/100 cm^2 removable alpha activity, 100 dpm/100 cm^2 removable beta activity, 100 dpm/100 cm^2 total alpha activity and 0.1 mrad/h total beta-gamma activity. When certified clean, Rockwell cut the walls free from the metal floor and relocated the walls and roof to become Building 4133.[1] All that remained at the site was some contaminated metal flooring and concrete. Rockwell used a jack hammer to break the metal and remove the concrete in large sections. After the operation began, a network of rebar prevented use of this method for removing the concrete. Contaminated concrete was then broken free, placed in 34-cubic-foot waste containers, and shipped to an unnamed burial site. Each location that had been contaminated was tested for residual activity by collecting loose powder and dust from the concrete.[2]

- In 1978, Rockwell conducted a radiological survey in the area of Building 4724. The survey area was designated as SRE Region I. After all the contaminated concrete had been removed, 45 smear swipes of concrete were collected and the highest recorded level was 48 dpm/100 cm^2. Rockwell's applicable limit for removable contamination was 100 dpm/100 cm^2 for beta-gamma emitters. For surface radiation, survey results indicated a maximum reading of 0.04 mrad/h, and 27 soil samples were found to have less than 46 pCi/g of gross detectable beta activity. Five concrete samples were collected from the Building 4724 pad. Four of five samples were found to contain less than 100 pCi/g. A layer of concrete was removed from the west trench where the fifth sample had been collected. No source of activity was then detected in the trench. Two water samples were collected from the 3-foot-deep concrete pit located outside of Building 4724. Activity was measured at 2.3×10^{-8} $\mu Ci/cm^3$ for Sr-90. All survey results were below Rockwell's applicable limits for release for unrestricted use.[1]

- In September 1982, ANL completed a verification survey of the SRE complex. This included instrument and smear surveys and analysis of material samples. ANL found that Building 4724 and its surrounding area had been decontaminated to below limits specified in the Draft ANSI Standard No. N13.12 and NRC 1982 guidelines.[3]

Radiological Use Authorizations: The DOE released the area for unrestricted use on July 23, 1985.[4]

Former Radiological Burial or Disposal Locations: None found.

Aerial Photographs: Aerial photographs show undeveloped land until the 1967 photograph when a rectangular building is identified as Building 4724. This is also seen in the 1972

[1] Rockwell International internal letter from F. E. Begley to R. J. Tuttle, re: *Unconditional Release of Building T724 – for Unrestricted Use*, January 18, 1976.
[2] Owens, D. E., *Radiological Survey Results – Release to Unrestricted Use, SRE Region I (Building 724 Area)*, Rockwell International Report No. N704TI990027, May 4, 1978, pp. 3-11.
[3] Argonne National Laboratory, *Post Remedial Action Survey Report for the Sodium Reactor Experiment (SRE) Facility, Santa Susana Field Laboratories, Rockwell International, Ventura County, California*, DOE-EV-0005-46, ANL-OHS/HP-84-101, February 1984, pp. 1-3, 15.
[4] U.S. Department of Energy, *Certification for Unrestricted Use of the Sodium Reactor Experiment (SRE) Complex and the Hot Cave Facility (Bldg. 003)*, July 23, 1985.

photograph. A building pad is seen in the 1978, 1980, 1983, 1988, and 1995 photographs. A vegetated area is seen in the location of Building 4724 in the 2005 and 2009 photographs.[1]

Radionuclides of Concern: Building 4724 was used for cleaning items of equipment from the secondary loop of the SRE. Possible radionuclides include U-238, U-234, U-235, U-236, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Th-232, H-3, Na-22, Na-24, Cr-51, Mn-54, Fe-59, Co-60, Kr-85, Sr-89, Sr-90, Sb-125, I-129, I-131, Cs-134, Cs-137, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xn-133, Xe-135, Pm-147, Sm-151.[2, 3, 4] All radionuclides of concern listed with the exception of Na-24, Cr-51, Mn-54, Fe-59, Kr-85, Sr-89, I-131, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xe-133, Xe-135, Pm-147 and Sm-151 are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives except for Sm-151 for which no analytical method is available. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Based on general site topography, surface water flows northwest into the SRE retention pond located northwest of the site. Outflow from the retention pond was initially onto the NBZ and Brandeis-Bardin Institute land. In 1959, a 6-foot diameter overflow pipe and a pumped sump were installed at the confluence of the two main drainage channels upstream of the pond. Water was then pumped through a 4-inch diameter overland pipe to a channel connecting to the Area II ponds. The overflow from these ponds is into Bell Canyon and thence to the Los Angeles River.[5]

Radiological Contamination Potential: The preliminary MARSSIM classification for the Building 4724 area is Class 1 because of its former use within the SRE complex.

Recommended Locations for Soil/Sediment Sampling:

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

Previous characterization studies for the Building 4724 area were focused on delineating the extent of contamination to standards that were applicable at the time. Characterization was not conducted to delineate the extent of contamination consistent with the DTSC/DOE December 2010 AOC. Therefore, additional characterization is recommended for the Building 4724 area. This includes the following Building 4724 areas:

- The flat and low-lying areas on and surrounding Building 4724. Radionuclides originating from Building 4724 may have migrated to these areas via surface water flow or airborne releases. It is unclear whether soil in the region of the Building 4724 concrete pad was sampled. In 1977, Building 4724 was found to have a buildup of contamination from mixed fission products.

[1] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[2] Hart, R. S., *Distribution of Fission Product Contamination in the SRE*, Atomics International Report No. NAA-SR-6890, March 1, 1962, pp. 8-27.
[3] Kinzer, J. and Crawford, A. C., *SRE First Core Fuel*, Atomics International Technical Data Record No. 5301, May 16, 1960, pp. 1-7.
[4] Letter from Heine, W. F., Atomics International, to Proctor, J. F., E. I. du Pont de Nemours & Company, re: *Fission Product and Fissile Content of SRE Fuel*, July 2, 1975.
[5] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.

- The concrete pit and sump located west of the building enclosure.

2.1.19 Site 4733 Area

Site Description: The Site 4733 area comprised Site 4733 and the land surrounding it located north of Building 4143 in the SRE complex at the end of E Street. Site 4733 was constructed in about 1957 as a sodium cleaning pad.[1] Figure 2.1.19a provides a current photograph. The location of Site 4733 is shown in Figure 1.3.

Building Features: Site 4733 was a small rectangular concrete pad.

Former Use(s): Site 4733 was used to clean sodium from items from the SRE.

Information from Interviewees: None to date.

Radiological Incident Reports: There has been one incident associated with Building 4733 that could have resulted in a release to the environment. The following table provides information presented in an incidents database provided by Boeing. A summary of the incident report is provided following the table.

Building 4733 Incident Report Summary

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A0282	5/12/1961	SRE NORTH PAD	MFP	STEAM CLEANING OPERATION CONTAMINATED A CONCRETE PAD, EQUIPMENT AND & SHOES.

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

- On May 12, 1961, parts were being steam cleaned near an open SRE high bay door. A smear survey of the area outside the open door indicated contamination levels as high as 1,200 dpm beta-gamma. The area was roped off and a meter survey of personnel was made. Contamination was found on the bottom of two employees' shoes and the shoes had to be discarded. Additionally, 60 packages that were wrapped for storage outside the high bay doors were contaminated. A smear survey of the control room floor indicated 50 dpm beta-gamma. The control room and areas outside the high bay door were decontaminated (Incident Report A0282).[2]

Current Use: Site 4733 was demolished in the 1970s.

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

[1] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[2] Galperin, A. Atomics International Internal Letter, re*: Radiological Safety Incident Report, SRE, 5-12-1961*, May 19, 1961.

- In September 1982, ANL completed a verification survey of the SRE complex. This included instrument and smear surveys and analysis of material samples. ANL found that Site 4733 and its surrounding area had been decontaminated to below limits specified in the Draft ANSI Standard No. N13.12 and NRC 1982 guidelines.[1]

- In 1983, Rockwell conducted a radiological survey in the area of Site 4733. The survey area was designated as SRE Region IX. Survey results indicated an average reading of 0.04 mrad/h for surface radiation, and 108 soil samples were found to have less than 100 pCi/g of gross detectable beta contamination, with an average of 33 pCi/g. All survey results were below Rockwell's applicable limits for release for unrestricted use.[2]

Radiological Use Authorizations: The DOE released the area for unrestricted use on July 23, 1985.[3]

Former Radiological Burial or Disposal Locations: None found.

Aerial Photographs: Aerial photographs show undeveloped land until the 1957 photograph when a rectangular pad is seen in the location of Site 4733. This is also seen in the 1959, approximately 1960, 1965, 1967, 1972 photographs. Open storage is seen in the 1978, 1980, 1983, 1988, and 1995 photographs. These may have been items awaiting cleaning. A vegetated area is seen in the location of Site 4733 in the 2005 and 2009 photographs.[4]

Radionuclides of Concern: Site 4733 was used for cleaning sodium from items from the SRE. Possible radionuclides include U-238, U-234, U-235, U-236, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Th-232, H-3, Na-22, Na-24, Cr-51, Mn-54, Fe-59, Co-60, Kr-85, Sr-89, Sr-90, Sb-125, I-129, I-131, Cs-134, Cs-137, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xn-133, Xe-135, Pm-147, Sm-151.[5, 6, 7] All radionuclides of concern listed with the exception of Na-24, Cr-51, Mn-54, Fe-59, Kr-85, Sr-89, I-131, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xe-133, Xe-135, Pm-147 and Sm-151 are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives except for Sm-151 for which no analytical method is available. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Based on general site topography, surface water flows into the drainage channel located in the region of the site, which connects to the SRE retention pond located

[1] Argonne National Laboratory, *Post Remedial Action Survey Report for the Sodium Reactor Experiment (SRE) Facility, Santa Susana Field Laboratories, Rockwell International, Ventura County, California*, DOE-EV-0005-46, ANL-OHS/HP-84-101, February 1984, pp. 1-3, 15.
[2] Wallace, J. H., *Radiological Survey Results – Release to Unrestricted Use, SRE Region IX*, Rockwell International Report No. N704TI990035, May 31, 1983, pp. 3-8.
[3] U.S. Department of Energy, *Certification for Unrestricted Use of the Sodium Reactor Experiment (SRE) Complex and the Hot Cave Facility (Bldg. 003)*, July 23, 1985.
[4] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[5] Hart, R. S., *Distribution of Fission Product Contamination in the SRE*, Atomics International Report No. NAA-SR-6890, March 1, 1962, pp. 8-27.
[6] Kinzer, J. and Crawford, A. C., *SRE First Core Fuel*, Atomics International Technical Data Record No. 5301, May 16, 1960, pp. 1-7.
[7] Letter from Heine, W. F., Atomics International, to Proctor, J. F., E. I. du Pont de Nemours & Company, r: *Fission Product and Fissile Content of SRE Fuel*, July 2, 1975.

northeast of the site. Outflow from the retention pond was initially onto the NBZ and Brandeis-Bardin Institute land. In 1959, a 6-foot diameter overflow pipe and a pumped sump were installed at the confluence of the two main drainage channels upstream of the pond. Water was then pumped through a 4-inch diameter overland pipe to a channel connecting to the Area II ponds. The overflow from these ponds is into Bell Canyon and thence to the Los Angeles River.[1]

Radiological Contamination Potential: The preliminary MARSSIM classification for the Site 4733 area is Class 1 due to its former use as a cleaning pad for the SRE reactor.

Recommended Locations for Soil/Sediment Sampling:

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

Previous characterization studies for the Site 4733 area were focused on delineating the extent of contamination to standards that were applicable at the time. Characterization was not conducted to delineate the extent of contamination consistent with the DTSC/DOE December 2010 AOC. Therefore, additional characterization is recommended for the Site 4733 area. This includes the following Site 4733 areas and appurtenances:

- The flat and low-lying areas on and surrounding Site 4733. Radionuclides originating from Buildings 4143 and/or Site 4733 may have migrated to these areas via surface water flow or airborne releases.

- The drainage channel located in the region of the site that connects to the SRE retention pond. It is unknown whether contaminated water from steam cleaning operations was collected in the area.

2.1.20 Site 4743 Area

Site Description: The Site 4743 area comprised Site 4743 and the land surrounding it located north of Building 4143 in the SRE complex at the end of E Street. Site 4743 was constructed in about 1957 to house a tetralin heat exchanger.[2] Figure 2.1.20a, provides a current photograph. The location of Site 4743 is shown in Figure 1.3.

Building Features: Site 4743 was a small rectangular area.

Former Use(s): Site 4743 was used to house a heat exchanger for the hydrocarbon coolant and lubricant tetralin. The decomposition of tetralin in the SRE in 1959 caused multiple fuel element failures. Tetralin was not used in the SRE after this event, but the description "Tetralin Heat Exchanger" remained on site layout maps until at least 1971.

Information from Interviewees: None to date.

[1] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.

Radiological Incident Reports: None found.

Current Use: Site 4743 was demolished in the 1970s.

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

- In September 1982, ANL completed a verification survey of the SRE complex. This included instrument and smear surveys and analysis of material samples. ANL found that Site 4743 and its surrounding area had been decontaminated to below limits specified in the Draft ANSI Standard No. N13.12 and NRC 1982 guidelines.[1]

- In 1983, Rockwell conducted a radiological survey in the area of Site 4743. The survey area was designated as SRE Region IX. Survey results indicated an average reading of 0.04 mrad/h for surface radiation, and 108 soil samples were found to have less than 100 pCi/g of gross detectable beta contamination, with an average of 33 pCi/g. All survey results were below Rockwell's applicable limits for release for unrestricted use.[2]

Radiological Use Authorizations: The DOE released the area for unrestricted use on July 23, 1985.[3]

Former Radiological Burial or Disposal Locations: None found.

Aerial Photographs: Aerial photographs show undeveloped land until the 1957 photograph when a rectangular area is seen in the location of Site 4743. This is also seen in the 1959, approximately 1960, 1965, 1967, and 1972 photographs. Open storage is seen in the 1978, 1980, 1983, 1988, and 1995 photographs. A vegetated area is seen in the location of Site 4743 in the 2005 and 2009 photographs.[4]

Radionuclides of Concern: Site 4743 was used to house a tetralin heat exchanger for the SRE. Possible radionuclides include U-238, U-234, U-235, U-236, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Th-232, H-3, Na-22, Na-24, Cr-51, Mn-54, Fe-59, Co-60, Kr-85, Sr-89, Sr-90, Sb-125, I-129, I-131, Cs-134, Cs-137, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xn-133, Xe-135, Pm-147, Sm-151.[5, 6, 7] All radionuclides of concern listed with the exception of Na-24, Cr-51, Mn-54, Fe-59, Kr-85, Sr-89, I-131, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xe-133, Xe-

[1] Argonne National Laboratory, *Post Remedial Action Survey Report for the Sodium Reactor Experiment (SRE) Facility, Santa Susana Field Laboratories, Rockwell International, Ventura County, California*, DOE-EV-0005-46, ANL-OHS/HP-84-101, February 1984, pp. 1-3, 15.
[2] Wallace, J. H., *Radiological Survey Results – Release to Unrestricted Use, SRE Region IX*, Rockwell International Report No. N704TI990035, May 31, 1983, pp. 3-8.
[3] U.S. Department of Energy, *Certification for Unrestricted Use of the Sodium Reactor Experiment (SRE) Complex and the Hot Cave Facility (Bldg. 003)*, July 23, 1985.
[4] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[5] Hart, R. S., *Distribution of Fission Product Contamination in the SRE*, Atomics International Report No. NAA-SR-6890, March 1, 1962, pp. 8-27.
[6] Kinzer, J. and Crawford, A. C., *SRE First Core Fuel*, Atomics International Technical Data Record No. 5301, May 16, 1960, pp. 1-7.
[7] Letter from Heine, W. F., Atomics International, to Proctor, J. F., E. I. du Pont de Nemours & Company, re: *Fission Product and Fissile Content of SRE Fuel*, July 2, 1975.

135, Pm-147 and Sm-151 are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives except for Sm-151 for which no analytical method is available. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Based on general site topography, surface water flows into the drainage channel located in the region of the site, which connects to the SRE retention pond located northeast of the site. Outflow from the retention pond was initially onto the NBZ and Brandeis-Bardin Institute land. In 1959, a 6-foot diameter overflow pipe and a pumped sump were installed at the confluence of the two main drainage channels upstream of the pond. Water was then pumped through a 4-inch diameter overland pipe to a channel connecting to the Area II ponds. The overflow from these ponds is into Bell Canyon and thence to the Los Angeles River.[1]

Radiological Contamination Potential: The preliminary MARSSIM classification for the Site 4743 area is Class 1 due to its former use as a tetralin heat exchanger site for the SRE reactor.

Recommended Locations for Soil/Sediment Sampling:

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

Previous characterization studies for the Site 4743 area were focused on delineating the extent of contamination to standards that were applicable at the time. Characterization was not conducted to delineate the extent of contamination consistent with the DTSC/DOE December 2010 AOC. Therefore, additional characterization is recommended for the Site 4743 area. This includes the following Site 4743 areas and appurtenances:

- The flat and low-lying areas on and surrounding Site 4743 where open storage was identified from aerial photographs. Radionuclides originating from Buildings 4143 and/or Site 4743 may have migrated to these areas via surface water flow or airborne releases.

- The drainage channel located in the region of the site that connects to the SRE retention pond.

2.1.21 Building 4753 Area

Site Description: The Building 4753 area comprised Building 4753 and the land surrounding it located north of Building 4143 in the SRE complex at the end of E Street. Building 4753 was constructed in about 1957 as the primary sodium fill tank vault.[2] Figure 2.1.21a provides a current photograph. The location of Building 4753 is shown in Figure 1.3.

Building Features: Building 4753 was a below grade concrete vault to facilitate containment and shielding. The vault contained the main primary sodium circuit piping and components

[1] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.

including the fill/drain tank. A nitrogen gas atmosphere was maintained in the vault to provide cooling and dehumidification of the cell and to prevent ignition of leaking sodium.[1, 2]

Former Use(s): Building 4753 housed a storage vault for sodium used in the SRE's primary cooling loop.[2]

Information from Interviewees: None to date.

Radiological Incident Reports: Rockwell reported in 1981 that radioactive contamination occurred when a manhole cover was separated from the primary sodium fill/drain tank after draining primary sodium from the tank into 55-gallon drums.[3]

Current Use: Building 4753 was demolished in the early 1980s.[2]

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

- In 1981, at the start of dismantling activities, approximately 7,400 gallons of sodium were stored in the primary fill tank under a 1-pound-per-square-foot gauge nitrogen cover gas. The sodium was "slightly" radioactive. A piping system was fabricated to facilitate draining the sodium from the primary fill tank into 55-gallon drums. A differential pressure between the primary fill tank cover gas and the 55-gallon drum cover gas was used to transfer the sodium into the drums. A total of 158 drums containing 55,000 pounds of radioactive sodium were shipped to Hanford, Washington, for storage and future use. The below-grade structure was then removed and the area was backfilled and paved.[2] Fill soils placed in the excavation consisted of imported soils exported from an off-site borrow site as well as on-site native soils local to the building sites.[4]

- In September 1982, ANL completed a verification survey of the SRE complex. This included instrument and smear surveys and analysis of material samples. ANL found that Building 4753 and its surrounding area had been decontaminated to below limits specified in the Draft ANSI Standard No. N13.12 and NRC 1982 guidelines.[5]

- In 1983, Rockwell conducted a radiological survey in the area of Building 4753. The survey area was designated as SRE Building 143. Survey results indicated a maximum below-grade reading of less than 0.1 mrad/h for surface gamma radiation, and below-grade soil samples were found to have less than 100 pCi/g of gross detectable beta

[1] Rockwell International, *Sodium Reactor Experiment Decommissioning Final Report*, Report No. ESG-DOE-13403, August 15, 1983, pp. 15-16, 53, 196.
[2] Owen, R. K., *Radiological Survey Plan, Support of D & D Program Operations at T-143 (SRE)*, Rockwell International Report No. N704TP990008, September 15, 1981, p. 3.
[3] Owen, R. K., *Radiological Survey Plan, Support of D & D Program Operations at T-143 (SRE)*, Rockwell International Report No. N704TP990008, September 15, 1981, p. 3.
[4] Pacific Materials Laboratory, Inc., *Final Compaction Test Report – Structural Backfill of Former Buildings 4143 and 4003 Test Cells, Area IV Rocketdyne, Santa Susana Field Laboratory, Ventura County, CA*, January 2, 2001.
[5] Argonne National Laboratory, *Post Remedial Action Survey Report for the Sodium Reactor Experiment (SRE) Facility, Santa Susana Field Laboratories, Rockwell International, Ventura County, California*, DOE-EV-0005-46, ANL-OHS/HP-84-101, February 1984, pp. 1-3, 15.

activity, with an average of 51 pCi/g. All survey results were below Rockwell's applicable limits for release for unrestricted use.[1]

Radiological Use Authorizations: The DOE released the area for unrestricted use on July 23, 1985.[2]

Former Radiological Burial or Disposal Locations: None found.

Aerial Photographs: Aerial photographs show undeveloped land until the 1957 photograph when a rectangular pad is seen in the location of Building 4753. This is also seen in the 1959, approximately 1960, 1965, 1967, 1972, and 1978 photographs. An excavated area is seen in the location of Site 4753 in the 1980 photograph. Open storage in the location of Building 4753 is observed in the 1983 photograph. A cleared area is seen in the location of Building 4753 in the 1988 and 1995 photographs. A vegetated area is seen in the location of Building 4753 in the 2005 and 2009 photographs.[3]

Radionuclides of Concern: Building 4753 was the primary fill tank vault for the SRE. Possible radionuclides include U-238, U-234, U-235, U-236, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Th-232, H-3, Na-22, Na-24, Cr-51, Mn-54, Fe-59, Co-60, Kr-85, Sr-89, Sr-90, Sb-125, I-129, I-131, Cs-134, Cs-137, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xn-133, Xe-135, Pm-147, Sm-151.[4, 5, 6] All radionuclides of concern listed with the exception of Na-24, Cr-51, Mn-54, Fe-59, Kr-85, Sr-89, I-131, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xe-133, Xe-135, Pm-147 and Sm-151 are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives except for Sm-151 for which no analytical method is available. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Based on general site topography, surface water flows into the drainage channel located north of the site, which connects to the SRE retention pond located northeast of the site. Outflow from the retention pond was initially onto the NBZ and Brandeis-Bardin Institute land. In 1959, a 6-foot diameter overflow pipe and a pumped sump were installed at the confluence of the two main drainage channels upstream of the pond. Water was then pumped through a 4-inch diameter overland pipe to a channel connecting to the Area II ponds. The overflow from these ponds is into Bell Canyon and thence to the Los Angeles River.[7]

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[1] Wallace, J. H., *Radiological Survey Results – Release to Unrestricted Use, SRE Building 143*, Rockwell International Report No. N704TI990038, May 31, 1983, pp. 3-10.
[2] U.S. Department of Energy, *Certification for Unrestricted Use of the Sodium Reactor Experiment (SRE) Complex and the Hot Cave Facility (Bldg. 003)*, July 23, 1985.
[3] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[4] Hart, R. S., *Distribution of Fission Product Contamination in the SRE*, Atomics International Report No. NAA-SR-6890, March 1, 1962, pp. 8-27.
[5] Kinzer, J. and Crawford, A. C., *SRE First Core Fuel*, Atomics International Technical Data Record No. 5301, May 16, 1960, pp. 1-7.
[6] Letter from Heine, W. F., Atomics International, to Proctor, J. F., E. I. du Pont de Nemours & Company, re: *Fission Product and Fissile Content of SRE Fuel*, July 2, 1975.
[7] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.

Radiological Contamination Potential: The preliminary MARSSIM classification for the Building 4753 area is Class 1 due to its former use as a primary fill tank vault for the SRE reactor.

Recommended Locations for Soil/Sediment Sampling:

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

Previous characterization studies for the Building 4753 area were focused on delineating the extent of contamination to standards that were applicable at the time. Characterization was not conducted to delineate the extent of contamination consistent with the DTSC/DOE December 2010 AOC. Therefore, additional characterization is recommended for the Building 4753 area. This includes the following Building 4753 areas and appurtenances:

- The flat and low-lying areas on and surrounding Building 4753 where open storage was identified from aerial photographs. Radionuclides originating from Buildings 4143 and/or 4753 may have migrated to these areas via surface water flow or airborne releases. Building 4753 was attached to Building 4143 that included piping connected to the SRE.

- The drainage channel located north of the site that connects to the SRE retention pond. It is unclear whether this area was decontaminated fully after Rockwell reported in 1981 that radioactive contamination occurred when a manhole cover was separated from the primary sodium fill/drain tank after draining primary sodium from the tank into 55-gallon drums. This channel appears to be the most likely surface-water pathway from the spill area.

2.1.22 Site 4773 Area

Site Description: The Site 4773 area comprised Site 4773, and the land surrounding it located at the extreme east end of the SRE complex at the end of E Street. Site 4773 was constructed in 1956 as a retention pond and dam for the SRE.[1] Figures 2.1.22a and 2.1.22b provide a current photograph and a site layout of Site 4773. The location of Site 4773 is shown in plot plan Figure 2.1.10b. Figure 2.1.22c shows Site 4773 in 1979. Figure 2.1.22d shows an aerial view of the SRE site with the pond in the foreground.

Site Features: Site 4773 was an 800,000-gallon capacity retention pond with a compacted native earth dam. The dam was damaged by storm flow in 1958 and the repairs included the installation of a 1.5-foot diameter valved outlet pipe. A year later, as a result of complaints from downstream property owners, additional repairs included the installation of a 6-foot diameter overflow pipe and a pumped sump located at the confluence of the two main drain channels upstream of the pond. The sump collected all stormwater from the SRE. The pump, acting on an automatic level switch in the sump, pumped the water at 350 gpm through a 4-inch diameter overland pipe to a channel connecting to the Area II ponds. When the sump filled with silt, it was abandoned in place and the pump suction inlet was changed to a raft floating on the SRE retention pond. In 1977, the pond was at about 1/8 capacity (100,000 gallons); it was weed infested and algae laden. An unknown quantity of silt from the SRE had been deposited on the

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

bottom. The last known cleanout was in 1958 as part of the dam repair project. The 800,000-gallon capacity pond was below the 16 million gallon requirement for regulation and licensing by the California Department of Dam Safety.[1] A site layout plan is presented in Figure 2.1.22b. Figure 2.1.22c shows the pond in 1979. Figure 2.1.22d shows an aerial view of the SRE site with the pond in the foreground.

A septic sewer system was installed above and southwest of the retention pond as part of the original SRE site improvement. It was designed to be the non-radioactive sanitary waste disposal system for Buildings 4143 and 4003, according to Rockwell. Laboratories and radioactive facilities were not connected to it, but were provided with isolation tanks, according to Rockwell. When the central sewer system was built in 1961, the sewer line was connected to it by an ejector pump. The septic tank and leach field were then abandoned in place. In 1977, a 6-inch-diameter pump out stand pipe extended above the ground on the south end of the abandoned septic tank. There was no other physical evidence of the abandoned septic system on the surface at that time.[2]

An industrial waste system, constructed in parallel with the sanitary sewer system, terminated in a dry well located adjacent to the leach field. This was installed during the first improvement to the site, presumably in about 1958. Waste water overflowing from the dry well flowed into the concrete channel connected to the sump and pond. AI claimed that the connections to the industrial waste line may have permitted chemical concentrations of cooling water algicides.[2]

Former Use(s): Site 4773 was the retention pond and drainage control dam for wastewater from the SRE complex, which operated between 1957 and 1964. No selected impervious materials were placed in the pond or dam. The pond was originally designed for natural seepage and evaporation to control the seasonal water level and provide capacity for winter storm water collection. After 1964, storm water runoff was the only source of water to the SRE pond, according to Rockwell.[2, 3]

Information from Interviewees: None to date.

Radiological Incident Reports: No official incident reports have been compiled for this site. A chronology of radiological incidents cited in Rockwell's reports is as follows:

- During operations, the liquid waste storage tanks overflowed near Building 4653, the intermediate radioactive waste vault, contaminating soil in the run-off area. The spill was cleaned up shortly afterward.[4]

- In 1964, the draining of test water from the new liquid radioactive waste tanks T2 and T3 sent radioactive solutions to the SRE pond and subsequently to the Area II ponds.

[1] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, pp. 6-7.
[2] Groundwater Resources Consultants, Inc., *Assessment of Pond Sediments in R2, SRE and Perimeter Ponds at the Rockwell International Corporation Rocketdyne Division, Santa Susana Field Laboratory, Ventura County, California*, Report No. 8640M-101, July 26, 1990, pp. 4-5.
[3] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, pp. 6-7.
[4] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, pp. 6-7.

Reportedly, the total release did not exceed 60 µCi. The concentration of radioactivity in the SRE retention pond was less than 2 pCi/cm^3, and in the Area II ponds was 0.1 pCi/cm^3. Co-60 was found to contribute about 5 percent of the radioactivity.[1]

Current Use: Site 4773 retention pond was demolished in about 1988.

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

- In 1979, Rockwell drained the SRE pond and allowed it to dry out. According to Rockwell, all areas of the pond bottom that exceeded 100 pCi/g gross detectable beta activity, were removed and disposed of as radioactive waste. After this decontamination process, Rockwell collected soil samples from the pond bottom, and the pond was subsequently returned to service. Soil sampling results indicated that all samples were below 100 pCi/g, with a mean value of 29 pCi/g. All survey results were below Rockwell's applicable limits for release for unrestricted use.[1]

- In September 1982, ANL completed a verification survey of the SRE complex. This included three soil samples collected at the edge of the pond to about a 2-inch depth. ANL found that Site 4773 and its surrounding area had been decontaminated to below limits specified in the Draft ANSI Standard No. N13.12 and NRC 1982 guidelines.[2]

- In March 1983, Rockwell recommended that water being held in the SRE pond be pumped to the Rockwell water reclamation system and the bottom gate valve be opened to allow for natural runoff.[3]

- In 1990, Groundwater Resources Consultants (GRS) collected 14 sediment samples from the SRE pond. Cs-137 was detected in "low" concentrations at all pond sample locations. GRS considered these concentrations to be reflective of atmospheric fallout. Cs-137 concentrations ranged from 0.033 pCi/g to 1.90 pCi/g. No other man-made gamma emitters were detected. Natural emitters Pb-212, Pb-214, and K-40 were also detected at all locations. GRS considered the concentrations of Pb-212 and Pb-214 to be indicative of the natural Th-232 and U-238 decay series, respectively. Gross alpha and gross beta activity were not elevated above GRS' background levels. The highest gross alpha activity found was 13.1 ± 3.86 pCi/g in a pond outflow sediment sample, and the highest gross beta activity was 35.6 ± 5.57 pCi/g in a pond outflow sediment sample.[4]

- Based on GRS' chemical sampling results, on December 3, 1990, the California Regional Water Quality Control Board requested that Rockwell remove all contaminated sediments

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[1] Wallace, J. H., *Radiological Survey results – Release to Unrestricted use, SRE Region VII*, Rockwell International Report No. N704TI990033, May 13, 1983, pp. 7-9.
[2] Argonne National Laboratory, *Post Remedial Action Survey Report for the Sodium Reactor Experiment (SRE) Facility, Santa Susana Field Laboratories, Rockwell International, Ventura County, California*, DOE-EV-0005-46, ANL-OHS/HP-84-101, February 1984, pp. 1-3, 15.
[3] Rockwell International internal letter from P. L. Kleinsmith to K. Johns, re: *Deactivation of SRE Retention Pond*, March 28, 1983.
[4] Groundwater Resources Consultants, Inc., *Assessment of Pond Sediments in R2, SRE and Perimeter Ponds at the Rockwell International Corporation Rocketdyne Division, Santa Susana Field Laboratory, Ventura County, California*, Report No. 8640M-101, July 26, 1990, pp. 13-24.

from the pond and stockpile them on the facility for further treatment or move them to an appropriate disposal location. Soil verification samples were requested to determine that all contaminated sediments had been removed. A new sampling station was also requested to be installed in the vicinity of the SRE pond discharge point to verify that rainfall runoff was not causing contaminants to migrate off-site.[1]

- On December 4, 1990, Rockwell responded stating that the company would excavate a 10- by 10- by 4-foot deep portion of the pond at the northern inflow area (the only significantly contaminated area) and stockpile the soil on Visquene® while analyzing three soil samples. Previously, in 1979, Rockwell had removed contamination from the pond and determined that remaining soils were below their acceptable limits for release to unrestricted use. The disposition of the soil would depend upon the analytical results.[2] The HSA team has obtained no additional information about the soil stockpile or analytical results.

- In July 2000, Boeing excavated and surveyed for radiological contamination the drainage lines, septic tank (for Buildings 4003, 4143, and 4163) and leach field. Instrument measurements and wipe samples were collected from the septic tank and associated piping. Boeing found no man-made gamma emitting radionuclides from gamma spectroscopy of concrete debris from the septic tank. The septic tank was full of a mixture of debris and soil. Boeing collected seven samples from the debris within the septic tank, its inlet pipes, and its outlet pipes. Using gamma spectroscopy, Boeing detected Cs-137 in the inlet pipes and inlet chamber in concentrations up to 2.5 pCi/g. These materials were packaged as radioactive waste per Boeing's policy. Boeing also collected four soil samples from beneath the septic tank, but no man-made radionuclides were identified in these samples. Boeing collected seven soil/gravel samples along the length of the leach field lines. The highest concentration detected was Cs-137 at 0.65 pCi/g, which Boeing considered to be consistent with its local background level in 2001.[3]

Radiological Use Authorizations: The DOE released the area for unrestricted use on July 23, 1985.[4]

Former Radiological Burial or Disposal Locations: The pond, the septic sewer system, and the industrial waste system were all disposal locations for waste water.[1] Radioactive contamination was found in the pond

Aerial Photographs: Aerial photographs show undeveloped land until the 1957 photograph when an irregularly shaped impoundment with a dam on its east side are seen in the location of Site 4773. In the 1959 photograph, the impoundment appears to have increased in size by about 50 percent. The impoundment appears unchanged in the approximately 1960, 1965, 1967, 1972,

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[1] Letter from J. E. Ross, California Regional Water Quality Control Board, to S. R. Lafflam, Rockwell International Corporation, re: *SRE Pond Modification*, December 3, 1990.
[2] Letter from J. T. Crone, Rockwell International, to J. Ross, California Regional Water Quality Control Board, re: SRE Pond Modifications, December 4, 1990.
[3] Letter from B. D. Sujata, The Boeing Company, to J. Evans, County of Ventura, re: *Information Regarding Permit – Septic Tank and Leach Field*, October 23, 2001.
[4] U.S. Department of Energy, *Certification for Unrestricted Use of the Sodium Reactor Experiment (SRE) Complex and the Hot Cave Facility (Bldg. 003)*, July 23, 1985.

and 1978 photographs. The impoundment appears to have shrunk by about 50 percent in the 1980 and 1983 photographs. The impoundment appears to be vegetated and without water in the 1988 and 1995 photographs. In the 2005 and 2009 photographs, the end of a pipe can be seen near where the dam was previously located.[1]

Radionuclides of Concern: Site 4773 was the retention pond and drainage control dam for the SRE. Radiologically contaminated water is known to have flowed to the pond. Possible radionuclides include U-238, U-234, U-235, U-236, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Th-232, H-3, Na-22, Na-24, Cr-51, Mn-54, Fe-59, Co-60, Kr-85, Sr-89, Sr-90, Sb-125, I-129, I-131, Cs-134, Cs-137, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xn-133, Xe-135, Pm-147, Sm-151.[2, 3, 4] All radionuclides of concern listed with the exception of Na-24, Cr-51, Mn-54, Fe-59, Kr-85, Sr-89, I-131, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xe-133, Xe-135, Pm-147 and Sm-151 are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives except for Sm-151 for which no analytical method is available. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Up until 1958, **s**urface water from the SRE complex flowed directly into the SRE retention pond. After 1958, a pumped sump collected water from the SRE areas. The pump, controlled by an automatic level switch in the sump, pumped the water at 350 gpm through a 4-inch diameter overland pipe to a channel connecting to the Area II ponds. The overflow from these ponds is into Bell Canyon and thence to the Los Angeles River.[5]

Radiological Contamination Potential: The preliminary MARSSIM classification for the Site 4773 area is Class 1 due to its former use as the retention pond and drainage control dam for the SRE reactor.

Recommended Locations for Soil/Sediment Sampling:

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

Previous characterization studies for the Site 4773 area were focused on delineating the extent of contamination to standards that were applicable at the time. Characterization was not conducted to delineate the extent of contamination consistent with the DTSC/DOE December 2010 AOC. Therefore, additional characterization is recommended for the Site 4773 area. This includes the following Site 4773 areas and appurtenances:

- Areas within and underneath the former pond and upgradient areas that lead to this pond. Radionuclides originating from Building 4143 may have migrated to these areas via surface water flow or airborne releases.

[1] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[2] Hart, R. S., *Distribution of Fission Product Contamination in the SRE*, Atomics International Report No. NAA-SR-6890, March 1, 1962, pp. 8-27.
[3] Kinzer, J. and Crawford, A. C., *SRE First Core Fuel*, Atomics International Technical Data Record No. 5301, May 16, 1960, pp. 1-7.
[4] Letter from Heine, W. F., Atomics International, to Proctor, J. F., E. I. du Pont de Nemours & Company, re: *Fission Product and Fissile Content of SRE Fuel*, July 2, 1975.
[5] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.

- The areas of the Buildings 4003, 4143, and 4163 septic tank and leach field. It is not clear that a full site characterization has been conducted in these areas.

- The dry well located adjacent to the leach field. If the dry well has not been demolished, this is an area where radiologically contaminated water may have accumulated.

- The sump located upstream of the pond. If the sump has not been demolished, this is an area where radiologically contaminated water may have accumulated.

- The outlet pipe located at the east end of the pond. This is an area where radiologically contaminated water may have accumulated.

- Locations downhill from the pond. Outflow from the pond originally followed along a path to the NBZ. Multiple spills occurred at the pond over time and the water would have flowed to lower elevations.

- Locations below the dam. Because the dam was earthen, water would have flowed under and around the dam to reach lower elevations.

2.2 Group 2

The Group 2 index map is presented in Figure 2.2. Following Figure 2.2, the site photograph and layout drawings for each building area within HSA-6 Group 2 are presented. HSA-6 Group 2 includes three building areas containing the radioactive laundry buildings and electronics shop.

2.2.1 Building 4063 Area

Site Description: The Building 4063 area comprises Building 4063, substation Building 4763, and the land surrounding these two buildings located on E Street. Building 4063 was constructed prior to 1957.[1] Figures 2.2.1a and 2.2.1b provide a current photograph and a floor plan. Figure 2.2.1c provides a plot plan.

Building Features: Building 4063 had two rooms and three doors. A floor plan is presented in Figure 2.2.1b.

Former Use(s): Building 4063 was initially used as an electronics shop, and later as a maintenance service and storage building for non-radiological equipment. After Building 4063 was demolished in 1976, its concrete slab floor was used for storing bottled industrial gases.[1, 2]

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

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[1] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[2] Chapman, J. A., *Radiological Survey of the T513 Parking Lot; Old R/A Laundry Area; Plot 333; and Areas between SRE to RMDF, and KEWB to RMDF*, GEN-ZR-0009, August 26, 1988, pp. 8, 19, 54, 61-64, 77.

Current Use: Building 4063 was demolished to its concrete slab floor in 1976.[2] The slab was removed after 1995.

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

- After the facility was decommissioned and dismantled in 1976, Rockwell performed a radiation survey to ensure that residual radioactivity levels met its unrestricted-use acceptance criteria. Gamma scanning results (14.0 ± 0.25 μR/h) were consistent with Rockwell's background exposure rate of 14.0 ± 0.25 μR/h.[2]

- In 1988, Rockwell conducted a radiological survey to determine whether radioactive material accidentally remained at the site. Building 4063 was part of the Old Radioactive Laundry area that was surveyed for mixed fission products by measuring ambient gamma exposure rates. The radioactive laundry area is discussed below. The maximum exposure rate in the area was 17.72 μR/h. Rockwell's acceptance limit was 5 μR/h above a background level of approximately 15 μR/h. Survey results were below Rockwell's acceptance limits.[2]

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Locations: None found.

Aerial Photographs: Aerial photographs show undeveloped land until the 1957 photograph when a rectangular building is observed that is identified as Building 4063. Building 4063 is seen in photographs from 1959, approximately 1960, 1965, and 1967, but only building slab appears visible in photographs from 1972, 1978, 1980, 1983, 1988, and 1995. In the 2005 and 2009 photographs, the site appears to be vegetated.[1]

Radionuclides of Concern: The research team did not find evidence that radioactive materials were used or stored within Building 4063. However, Building 4063 was located across E street from Parking Lot 4513, which was used by personnel working in Buildings 4030, 4641, and 4064 where radioactive materials were handled. In Building 4064, non-irradiated, fissionable nuclear materials (enriched uranium and plutonium) were stored along with low-level radioactive waste. Building 4063 was also located in the vicinity of the Old Radioactive Laundry area. Potential radioactive contaminants include U-233, U-234, U-235, U-236, U-238, Th-228, Th-232, Pu-238, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Ra-226, Cs-134, Cs-137, Sr-90, H-3, Na-22, K-40, Mn-54, Fe-55, Co-60, Ni-59, Ni-63, Eu-152, Eu-154, Pm-147, Ta-182.[2] All radionuclides of concern listed, with the exception of Mn-54, Pm-147 and Ta-182, are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives and do not meet the criteria for analysis. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Based on general site topography, surface water flows northeast from former Building 4063 to the east-side storm drain on E Street. This storm drain appears to

[1] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[2] Liddy, P., *Area 4064 Final Status Survey Report*, Rocketdyne Report No. RS-00003, March 30, 1999, p. 4.

connect with a drainage channel that transports water south through Area III to a pond in Area II. The overflow from this pond is into Bell Canyon and thence to the Los Angeles River.[1] Radioactive materials do not appear to have been handled in Building 4063, but the site could have become contaminated by surface water and airborne releases from Building 4064.

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4063 area is Class 2, due to its location near Parking Lot 4513 and the Old Radioactive Laundry area.

Recommended Locations for Soil/Sediment Sampling:

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

Previous characterization studies for the Building 4063 area were focused on delineating the extent of contamination to standards that were applicable at the time. Characterization was not conducted to delineate the extent of contamination consistent with the DTSC/DOE December 2010 AOC. Therefore, additional characterization is recommended for the Building 4063 area. This includes the following Building 4063 areas:

- The flat and low-lying areas surrounding Building 4063. Radionuclides originating from Buildings 4064, 4273, and/or 4283 may have migrated to these areas via surface water flow or airborne releases.

2.2.2 Building 4273 Area

Site Description: The Building 4273 area comprised Building 4273, maintenance skid shack Building 4316, and the land surrounding these two buildings located on the north side of E Street at its intersection with 10th Street. Building 4273 was constructed in approximately 1957 as a radioactive laundry.[2] Figure 2.2.2a provides a current photograph. Figure 2.2.1c provides a plot plan.

Building Features: Building 4273 included a radioactive laundry and protective clothing storage area. The research team has not located a more detailed description of this building. The sewer system was not connected to this building, but it may have had a septic tank and leach field.

Former Use(s): Building 4273 was a radioactive laundry. Contaminated laundry from the SRE Building 4143, the Engineering Test Building 4003, and the RMDF Building 4021 was brought to this building for cleaning. Operations were discontinued in 1971.[3]

[1] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[3] Chapman, J. A., *Radiological Survey of the T513 Parking Lot; Old R/A Laundry Area; Plot 333; and Areas between the SRE to RMDF, and KEWB to RMDF*, Energy Technology Engineering Center Report No. GEN-ZR-0009, August 26, 1988, pp. 8, 19, 54, 61, 63-64, 77, 79.

Information from Interviewees: In 2010, a number of former workers were interviewed about their experiences at the SSFL. One remembered the radioactive laundry. Excerpts from his comments are presented below.

- "Everything including people and equipment would be decontaminated. Everything had to be cleaned before you left at night and it was smear tested every day. We wore booties and paper whites. The booties would be laundered up there on the hill. The laundry re-circulated the water at the SRE."[1] This former employee worked at the SSFL in the 1950s.

Radiological Incident Reports: None found.

Current Use: Building 4273 was demolished to its concrete slab floor in 1976.[2] The slab was removed after 1995.

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

- After the facility was decommissioned and dismantled in 1976, Rockwell performed a radiation survey to ensure that residual radioactivity levels met its unrestricted-use acceptance criteria. Gamma scanning results (15.3 ± 0.27 μR/h) were consistent with Rockwell's background exposure rate of 14.0 ± 0.25 μR/h. [2]

- In 1988, Rockwell conducted a radiological survey to determine whether radioactive material accidentally remained at the site. Building 4063 was part of the Old Radioactive Laundry area that was surveyed for mixed fission products by measuring ambient gamma exposure rates. The maximum exposure rate in the area was 17.72 μR/h. Rockwell's acceptance limit was 5 μR/h above a background level of approximately 15 μR/h. Survey results were below Rockwell's acceptance limits.[2]

Radiological Use Authorizations: The DOE released the area for unrestricted use on July 23, 1985.[2]

Former Radiological Burial or Disposal Locations: None found.

Aerial Photographs: Aerial photographs show undeveloped land until the 1957 photograph when a rectangular-shaped building is identified as Building 4273. Building 4273 can be seen in the 1959 and approximately 1960 photographs. In the 1965 photograph, an additional rectangular section can be seen that is identified as Building 4316, the maintenance skid shack. This can also be seen in the 1967 and 1972 photographs. A building slab is observed in photographs from 1978, 1980, 1983, 1988, and 1995. A vegetated area is seen in the location of Building 4273 in the 2005 and 2009 photographs.[3]

Radionuclides of Concern: Building 4273 was used as part of SRE operations. Possible radionuclides include U-238, U-234, U-235, U-236, Pu-239, Pu-240, Pu-241, Pu-242, Am-241,

[1] Interview No. 106 of former employee conducted by the U.S. DOE and EPA, September 2010.
[2] U.S. Department of Energy, *Certification for Unrestricted Use of the Sodium Reactor Experiment (SRE) Complex and the Hot Cave Facility (Bldg. 003)*, July 23, 1985.
[3] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.

Th-232, H-3, Na-22, Na-24, Cr-51, Mn-54, Fe-59, Co-60, Kr-85, Sr-89, Sr-90, Sb-125, I-129, I-131, Cs-134, Cs-137, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xn-133, Xe-135, Pm-147, Sm-151.[1, 2, 3] All radionuclides of concern listed with the exception of Na-24, Cr-51, Mn-54, Fe-59, Kr-85, Sr-89, I-131, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xe-133, Xe-135, Pm-147 and Sm-151 are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives except for Sm-151 for which no analytical method is available. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Building 4273 was located east of a drainage divide. The location of former wastewater lines and storm drains is unknown. Based on general site topography, surface water flows in a northeasterly direction from the site. Ultimately, surface water would discharge to a channel connecting to the Area II ponds. The overflow from these ponds is into Bell Canyon and thence to the Los Angeles River.[4]

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4273 area is Class 1. Items of radioactive laundry were washed and dried in Building 4237 for approximately 14 years. It is not apparent where wastewater from laundry operations discharged or that a full radiological characterization of the area was conducted.

Recommended Locations for Soil/Sediment Sampling:

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

It is not apparent where wastewater from laundry operations discharged. In addition, previous characterization studies for the Building 4273 area were focused on delineating the extent of contamination to standards that were applicable at the time. Characterization was not conducted to delineate the extent of contamination consistent with the DTSC/DOE December 2010 AOC. Therefore, additional characterization is recommended for the Building 4273 area. This includes the following Building 4273 areas:

- The flat and low-lying areas surrounding Building 4273. Radionuclides originating from Building 4143 may have migrated to these areas as a result of cleaning operations.

- Because little is known about laundry storage areas, site operations, and wastewater and discharge, a comprehensive soil sampling program is warranted at Building 4273.

2.2.3 Building 4283 Area

Site Description: The Building 4283 area comprised Building 4283 and the land surrounding it located on the north side of E Street at the intersection with 10th Street. Building 4283 was

[1] Hart, R. S., *Distribution of Fission Product Contamination in the SRE*, Atomics International Report No. NAA-SR-6890, March 1, 1962, pp. 8-27.
[2] Kinzer, J. and Crawford, A. C., *SRE First Core Fuel*, Atomics International Technical Data Record No. 5301, May 16, 1960, pp. 1-7.
[3] Letter from Heine, W. F., Atomics International, to Proctor, J. F., E. I. du Pont de Nemours & Company, re: *Fission Product and Fissile Content of SRE Fuel*, July 2, 1975.
[4] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.

constructed in approximately 1963 as a radioactive laundry.[1] Figure 2.2.3a provides a current photograph. Figure 2.2.1c provides a plot plan.

Building Features: Building 4283 included a radioactive laundry and protective clothing storage area. The research team has not located a more detailed description of this building. The sewer system was not connected to this building, but it may have had a septic tank and leach field in conjunction with Building 4273.

Former Use(s): Building 4283 was a radioactive laundry. Contaminated laundry from the SRE Building 4143, the Engineering Test Building 4003, and the RMDF Building 4021 was brought to this building for cleaning. Operations were discontinued in 1971.[2]

Information from Interviewees: In 2010, a number of former workers were interviewed about their experiences at the SSFL. One remembered the radioactive laundry. Excerpts from his comments are presented below.

- “Everything including people and equipment would be decontaminated. Everything had to be cleaned before you left at night and it was smear tested every day. We wore booties and paper whites. The booties would be laundered up there on the hill. The laundry re-circulated the water at the SRE.”[3] This former employee worked at the SSFL in the 1950s.

Radiological Incident Reports: None found.

Current Use: Building 4283 was demolished in approximately 1976.[2] The slab was removed after 1995.

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

- After the facility was decommissioned and dismantled in 1976, Rockwell performed a radiation survey to ensure that residual radioactivity levels met its unrestricted-use acceptance criteria. Gamma scanning results (15.3 ± 0.27 μR/h) were consistent with Rockwell’s background exposure rate of 14.0 ± 0.25 μR/h.[2]

- In 1988 Rockwell conducted a radiological survey of the Building 4283 area as part of a survey of five areas that had been used to support nuclear-related facilities. Gamma exposure rates were measured to determine whether mixed fission products remained at the site. The maximum exposure rate in the area was 17.72 μR/h. Rockwell’s acceptance limit was 5 μR/h above a background level of approximately 15 μR/h. Survey results were below Rockwell’s acceptance limits.[2]

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[1] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[2] Chapman, J. A., *Radiological Survey of the T513 Parking Lot; Old R/A Laundry Area; Plot 333; and Areas between the SRE to RMDF, and KEWB to RMDF*, Energy Technology Engineering Center Report No. GEN-ZR-0009, August 26, 1988, pp. 8, 19, 61, 63-64, 77, 79.
[3] Interview No. 106 of former employee conducted by the U.S. DOE and EPA, September 2010.

Radiological Use Authorizations: The DOE released the area for unrestricted use on July 23, 1985.[1]

Former Radiological Burial or Disposal Locations: None found.

Aerial Photographs: Aerial photographs show undeveloped land until the approximately 1960 photograph when disturbed ground is observed. In the 1965 photograph, a rectangular-shaped building is identified as Building 4283. This can be seen in the 1967 and 1972 photographs. A building slab is observed in the 1978, 1980, 1983, 1988, and 1995 photographs. A vegetated area is seen in the location of Building 4283 in the 2005 and 2009 photographs.[2]

Radionuclides of Concern: Building 4283 was used as part of SRE operations. Possible radionuclides include U-238, U-234, U-235, U-236, isotopes of plutonium Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Th-232, H-3, Na-22, Na-24, Cr-51, Mn-54, Fe-59, Co-60, Kr-85, Sr-89, Sr-90, Sb-125, I-129, I-131, Cs-134, Cs-137, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xn-133, Xe-135, Pm-147, Sm-151.[3, 4, 5] All radionuclides of concern listed with the exception of Na-24, Cr-51, Mn-54, Fe-59, Kr-85, Sr-89, I-131, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xe-133, Xe-135, Pm-147 and Sm-151 are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives except for Sm-151 for which no analytical method is available. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Building 4283 was located east of a drainage divide. The location of former wastewater lines and storm drains is unknown. Based on general site topography, surface water flows in a northeasterly direction from the site. Ultimately, surface water would discharge to a channel connecting to the Area II ponds. The overflow from these ponds is into Bell Canyon and thence to the Los Angeles River.[6]

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4283 area is Class 1. Items of radioactive laundry were washed and dried in Building 4237 for approximately 8 years. It is not apparent where wastewater from laundry operations discharged or that a full radiological characterization of the area was conducted.

Recommended Locations for Soil/Sediment Sampling:

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

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[1] U.S. Department of Energy, *Certification for Unrestricted Use of the Sodium Reactor Experiment (SRE) Complex and the Hot Cave Facility (Bldg. 003)*, July 23, 1985.
[2] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[3] Hart, R. S., *Distribution of Fission Product Contamination in the SRE*, Atomics International Report No. NAA-SR-6890, March 1, 1962, pp. 8-27.
[4] Kinzer, J. and Crawford, A. C., *SRE First Core Fuel*, Atomics International Technical Data Record No. 5301, May 16, 1960, pp. 1-7.
[5] Letter from Heine, W. F., Atomics International, to Proctor, J. F., E. I. du Pont de Nemours & Company, re: *Fission Product and Fissile Content of SRE Fuel*, July 2, 1975.
[6] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.

It is not apparent where wastewater from laundry operations discharged. In addition, previous characterization studies for the Building 4283 area were focused on delineating the extent of contamination to standards that were applicable at the time. Characterization was not conducted to delineate the extent of contamination consistent with the DTSC/DOE December 2010 AOC. Therefore, additional characterization is recommended for the Building 4283 area. This includes the following Building 4283 areas:

- The flat and low-lying areas surrounding Building 4283. Radionuclides originating from Building 4143 may have migrated to these areas as a result of cleaning operations.

- Becaise little is known about laundry storage areas, site operations, and wastewater and discharge, a comprehensive soil sampling program is warranted at Building 4283.

2.3 Group 3

The Group 3 index map is presented in Figure 2.3. Following Figure 2.3, the site photograph and layout drawings for each building area within HSA-6 Group 3 are presented. HSA-6 Group 3 includes four building areas containing the fuel element storage facility and SRE support buildings.

2.3.1 Building 4014 Area

Site Description: The Building 4014 area comprises Building 4014, substation Building 4783, and the land surrounding these two buildings located on E Street. Building 4014 was constructed prior to August 1957.[1, 2] Figure 2.3.1a provides a current photograph. Figure 2.3.1b shows the floor plan. The location of Building 4014 is shown in Figure 2.3.

Building Features: Building 4014, originally 2,100 square-feet in area, changed its shape and size over the years. In 1977, Building 4014 was replaced with a 2,400-square-foot prefabricated galvanized steel building on a concrete slab with translucent fiberglass skylights, electrical lighting and power, and a fire detection system. Figure 2.3.1b shows the floor plan. Buildings 4033, 4043, and 4053 were demolished in the process.[3]

Former Use(s): Building 4014 was a storage building for metallic sodium. In April 1994, 81 55-gallon drums of surplus new product sodium were stored in Building 4014 together with 3 drums and 8 wooden boxes of potassium, 3 drums of lithium, 2 drums and 1 box of NaK, 8 NaK pressure transducers, 1 NaK loop, and 1 NaK loading cart.[4, 5] In May 1995, the DOE was looking for an end user for the sodium.[6] In March 1996, Disposal Authorization No. 16134 indicated that the drums were to be delivered to Surplus Sales within 10 days of financial

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[1] Rockwell International, *Area IV Radiological Characterization Survey*, A4CM-ZR-0011, Rev. A, August 15, 1996, pp. 35, 55-58.
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[3] Rockwell International, *Construction Specification for Sodium Storage Facility Building 014, Santa Susana Facility, Ventura County, California*, Specification No. 303-014-1, May 10, 1977.
[4] Rockwell International, *Status of Material in B/014*, circa April 1994.
[5] Rockwell International Inventory of Building 014, April 14, 1994.
[6] U.S. Department of Energy letter from L. Marik to M. Jensen, Rockwell International, re: *ETEC Bulk Sodium*, May 11, 1995.

approval.[1] On June 3, 1996, Rockwell indicated that Building 4014 had been cleared of DOE and Energy Technology Engineering Center (ETEC) materials and equipment, but equipment or materials belonging to Protective Services and Surplus Sales remained in Building 4014.[2] On June 21, 1996, Rockwell granted permission to Industrial Security to store fire department equipment in Building 4014.[3]

Information from Interviewees: None to date.

Radiological Incident Reports: None found.
Current Use: Building 4014 was demolished in 2003.[4]

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

- In 1988, Rockwell surveyed for radioactive contaminants the Building 4513 parking lot, adjacent to Building 4014, as part of a larger study. Rockwell found the mean exposure rate at Parking Lot 4513 to be 14.0 ± 0.25 μR/h.[5]

- In 1994 and 1995, Rockwell conducted a radiological characterization survey in Area IV that included Building 4014. The purpose of this survey was to locate and characterize any previously unknown areas of elevated radioactivity in Area IV. Rockwell estimated background to be 15.6 μR/h. Rockwell's acceptable limit was less than 5 μR/h above background. Survey results were below Rockwell's acceptance limits.[1]

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Locations: None found.

Aerial Photographs: Aerial photographs show undeveloped land until the 1957 photograph when a small rectangular building is observed that is identified as Building 4014. Building 4014 appears to have increased in size in the 1959 photograph. This addition is identified as two separate buildings 4033 and 4043. The approximately 1960 photograph shows an additional piece that makes the building L-shaped. This piece is identified as separate Building 4053. The roof of Building 4014 changes and becomes rectangular in the 1978 photograph. This may indicate that a new building has been constructed on the site of the old one. No changes are observed in the 1980, 1983, 1988, and 1995 photographs. In the 2005 photograph, a ground scar appears where Building 4014 was located. Undeveloped land appears in the location of Building 4014 in the 2009 photograph.[6]

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[1] Rockwell International email from S. L. Samuels to J. H. Washington, re*: B/014*, circa 1996.
[2] Rockwell International email from R. D. Meyer to M. E. Lee, re: *B/014 Evacuation by ETEC*, June 3, 1996.
[3] Rockwell International email from M. J. Gabler to D. Bunch, re: *Use of DOE Building 4014 by Industrial Security*, June 21, 1996.
[4] Boeing letter from B. K. Ludwig to J. Flores, Ventura County Air Pollution Control District, re: *Demolish Building 4014, Area IV, Santa Susana Field Laboratory*, May 19, 2003.
[5] Chapman, J., *Radiological Survey of the T513 Parking Lot; Old R/A Laundry Area; Plot 333; and Areas between the SRE to RMDF, and KEWB to RMDF*,ETEC Report No. GEN-ZR-0009, pp. 54, 77, 79.
[6] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.

Radionuclides of Concern: The research team did not find evidence that radioactive materials were used or stored within Building 4014. However, Building 4014 was located adjacent to Parking Lot 4513, which was used by personnel working in Buildings 4030, 4641, and 4064 where radioactive materials were handled. In Building 4064, non-irradiated, fissionable nuclear materials (enriched uranium and plutonium) were stored along with low-level radioactive waste. Potential radioactive contaminants include U-233, U-234, U-235, U-236, U-238, Th-228, Th-232, Pu-238, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Ra-226, Cs-134, Cs-137, Sr-90, H-3, Na-22, K-40, Mn-54, Fe-55, Co-60, Ni-59, Ni-63, Eu-152, Eu-154, Pm-147, Ta-182.[1] All radionuclides of concern listed, with the exception of Mn-54, Pm-147 and Ta-182, are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives and do not meet the criteria for analysis. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Based on general site topography, surface water flows northeast from former Building 4014 to the storm drain on the other side of E Street. This storm drain appears to connect with a drainage channel that transports water south through Area III to a pond in Area II. The overflow from this pond is into Bell Canyon and thence to the Los Angeles River.[2] Radioactive materials do not appear to have been handled in Building 4014, but the site could have become contaminated by surface water and airborne releases from Building 4064.

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4014 area is Class 2, due to its location near Building 4064.

Recommended Locations for Soil/Sediment Sampling:

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

Previous characterization studies for the Building 4014 area were focused on delineating the extent of contamination to standards that were applicable at the time. Characterization was not conducted to delineate the extent of contamination consistent with the DTSC/DOE December 2010 AOC. Therefore, additional characterization is recommended for the Building 4014 area. This includes the following Building 4014 areas:

- The flat and low-lying areas surrounding Building 4014. Radionuclides originating from Building 4064 may have migrated to these areas via surface water flow or airborne releases.

2.3.2 Building 4053 Area

Site Description: The Building 4053 area comprised Building 4053, two skid shacks numbered Buildings 4033 and 4043, and the land surrounding these three buildings located on E Street. Building 4053 was constructed prior to 1962.[3] Figures 2.3.2a and 2.3.2b provide a current photograph and a floor plan. The location of Building 4053 is shown in Figure 2.3.

[1] Liddy, P., *Area 4064 Final Status Survey Report*, Rocketdyne Report No. RS-00003, March 30, 1999, p. 4.
[2] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.
[3] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.

Building Features: Building 4053 was on foundations connected to utilities.[1] Building 4053 had one room, a sliding door, and a canopy. It was located adjacent to and south of Building 4014. Buildings 4033 and 4043 were joined and shared a canopy. Floor plans of Buildings 4053, 4033 and 4043 are presented in Figure 2.3.2b.

Former Use(s): Building 4053 was a Fire Department services building. Building 4033 was a storage building and Building 4043 was an instrument storage building.[1]

Information from Interviewees: In 2010, a number of former workers were interviewed about their experiences at the SSFL. One remembered Building 4053. Excerpts from his comments are presented below.

- "Building 4043 was used exclusively for warehousing non-radioactive spare parts for SRE."[2] This former employee worked at the SSFL between 1958 and 1968.

Radiological Incident Reports: None found.

Current Use: Building 4053 was detached from its foundation and relocated in 1977. Buildings 4033 and 4043 were bulldozed and removed in 1977.[2]

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

- In 1988, Rockwell surveyed for radioactive contaminants the Building 4513 parking lot, adjacent to Building 4053, as part of a larger study. Rockwell found the mean exposure rate at Parking Lot 4513 to be 14.0 ± 0.25 µR/h.[3]

- In 1994 and 1995, Rockwell conducted a radiological characterization survey in Area IV that included Building 4053. The purpose of this survey was to locate and characterize any previously unknown areas of elevated radioactivity in Area IV. Rockwell estimated background to be 15.6 µR/h. Rockwell's acceptable limit was less than 5 µR/h above background. Survey results were below Rockwell's acceptance limits.[4]

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Locations: None found.

Aerial Photographs: Aerial photographs show undeveloped land until the 1957 photograph when a parking lot is identified adjacent to the site of Building 4053. Building 4053 appears in the approximately 1960 photograph and is seen up to the 1978 photograph when a new roof and/or new building appear(s) to have been constructed. No changes are observed in the 1980,

[1] Rockwell International, *Construction Specification for Sodium Storage Facility Building 014, Santa Susana Facility, Ventura County, California*, Specification No. 303-014-1, May 10, 1977.
[2] Interview No. 300 of former worker conducted by the DOE and EPA on July 16, 2010, p. 2.
[3] Chapman, J., *Radiological Survey of the T513 Parking Lot; Old R/A Laundry Area; Plot 333; and Areas between the SRE to RMDF, and KEWB to RMDF*,ETEC Report No. GEN-ZR-0009, pp. 54, 77, 79.
[4] Rockwell International, *Area IV Radiological Characterization Survey*, A4CM-ZR-0011, Rev. A, August 15, 1996, pp. 35, 55-58.

1983, 1988, and 1995 photographs. In the 2005 and 2009 photographs, a ground scar appears where Building 4053 had previously been located.[1]

Radionuclides of Concern: The research team did not find evidence that radioactive materials were used or stored within Building 4053. However, Building 4053 was located adjacent to Parking Lot 4513, which was used by personnel working in Buildings 4030, 4641, and 4064 where radioactive materials were handled. In Building 4064, non-irradiated, fissionable nuclear materials (enriched uranium and plutonium) were stored along with low-level radioactive waste. Potential radioactive contaminants include U-233, U-234, U-235, U-236, U-238, Th-228, Th-232, Pu-238, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Ra-226, Cs-134, Cs-137, Sr-90, H-3, Na-22, K-40, Mn-54, Fe-55, Co-60, Ni-59, Ni-63, Eu-152, Eu-154, Pm-147, Ta-182.[2] All radionuclides of concern listed, with the exception of Mn-54, Pm-147 and Ta-182, are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives and do not meet the criteria for analysis. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Based on general site topography, surface water flows northeast from former Building 4053 to the storm drain on the other side of E Street. This storm drain appears to connect with a drainage channel that transports water south through Area III to a pond in Area II. The overflow from this pond is into Bell Canyon and thence to the Los Angeles River.[3] Radioactive materials do not appear to have been handled in Building 4053, but the site could have become contaminated by surface water and airborne releases from Building 4064.

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4053 area is Class 2, due to its location near Building 4064.

Recommended Locations for Soil/Sediment Sampling:

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

Previous characterization studies for the Building 4053 area were focused on delineating the extent of contamination to standards that were applicable at the time. Characterization was not conducted to delineate the extent of contamination consistent with the DTSC/DOE December 2010 AOC. Therefore, additional characterization is recommended for the Building 4053 area. This includes the following Building 4053 areas:

- The flat and low-lying areas surrounding Building 4053. Radionuclides originating from Building 4064 may have migrated to these areas via surface water flow or airborne releases.

[1] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[2] Liddy, P., *Area 4064 Final Status Survey Report*, Rocketdyne Report No. RS-00003, March 30, 1999, p. 4.
[3] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.

2.3.3 Building 4064 Area

Site Description: The Building 4064 area comprises Building 4064, mechanical equipment slab Site 4864, an extensive side yard, and the land surrounding these areas located on G Street. Building 4064, built in 1958, was the source and special nuclear material storage facility.[1, 2] Figures 2.3.3a through 2.3.3g provide a current photograph and building drawings. The location of Building 4064 is shown in Figure 2.3.

Building Features: Building 4064 was constructed in two phases; the first in 1958 and the second in 1963. The completed building was approximately 50 feet by 90 feet with concrete and block walls. The roof was of corrugated steel with composite roofing material.[3] A floor plan of the completed Building 4064 is presented in Figure 2.3.3b. Phase 1 was a 2,127-square-foot reinforced concrete structure (Room 110 and office Room 100) with 11-inch thick walls on a concrete slab floor. The building eave height was 16 feet, and the structure was open bay except for a 12-foot by 13-foot material handling area in the southeast corner of the building (Room 104 vault). A fume hood was installed in Room 104.[4]

In Phase 2, a new bay was added to the north of Phase 1 (Room 114) with an overhead roll-up door, 12-inch-thick concrete blocks, increasing the floor area to 4,418 square feet. The total square footage included a 50-square-foot restroom (Room 102). Building 4064 had no sinks or processing equipment. The restroom was the only source of water. Waste water was released to a septic system prior to 1961. On the northwest corner was a small supply and storage room of about 50 square feet (Room 116). The concrete slab floors were covered with 12-inch square vinyl-asbestos tiles. In 1980, the facility received a new roof, the interior wall surfaces were patched and painted; the floor tile was removed and replaced; the rest room and office were restored; asphalt was patched; plumbing was repaired; and a window air conditioner was installed in the office.

Storage racks were constructed to accommodate fuel. Each room was ventilated by dedicated blowers through a plenum containing pre-filters and HEPA filters. The fume hood in Room 104 exhausted through the south filter plenum.[3] Building 4064 was built to meet AEC criteria for vaults for the storage of fissionable material. It was equipped with intrusion alarms.[5] Building 4064 was surrounded by an 8-foot tall alarmed perimeter chain-link fence topped with a double roll of barbed tape. The building doors were alarmed with intrusion alarms, and all rooms were equipped with motion detectors. All alarms sounded at the plant security headquarters.[6] The Building 4064 side yard was a trapezoidal area of approximately 4,500 square feet.[4, 7, 8] The

[1] Shah, S. N., *Final Report, Decontamination and Decommissioning of Fuel Storage Facility 4064*, Boeing Report EID-04600, September 11, 1999, pp. 14-15.
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[3] Email from W. J. Gerritsen to P. B. Ramirez, re: *Permit for Demolition of Building 4064*, May 28, 1997.
[4] Dahl, F. C. and Tuttle, J, *Final Radiological Survey Report of Building 064 Interior*, ETEC Report No. SSWA-ZR-0001, January 14, 1994, pp. 9-17.
[5] Boeing Environmental Affairs, Fact Sheet, *Building 4064 – Fuel Storage Facility*, February 10, 2000.
[6] Remley, M. E. General Storage Data for Buildings 064 and 022, October 7, 1977.
[7] Shah, S. N., *Final Report, Decontamination and Decommissioning of Fuel Storage Facility 4064*, Boeing Report EID-04600, September 11, 1999, pp. 14-15.
[8] Vitkus, T. J., *Verification Survey of Buildings 005, 023, and 064 Santa Susana Field Laboratory, Rockwell International, Ventura County, California*, ORISE 94/K-14, October 1994, pp. 1-4, 20.

fenced area is presented in Figure 2.3.3c, and the side yard is presented in Figure 2.3.3d. Figure 2.3.3e presents a plot plan.

Building 4064 had a 750-gallon septic tank that was connected to a 120-linear-foot leach field. The leach field was located approximately 20 feet east of Building 4064, near a boulder northeast of Building 6064.[1] The Building 4064 leach field was removed in 1998/1999 and the area was backfilled by regrading onsite soils.[2] In the early 1960s, Building 4064 was connected to the site sewage system. Figure 2.3.3f shows the connection to the sewage system and the location of the leach field, while Figure 2.3.3g presents the plumbing layout.

Former Use(s): Building 4064 was designed and built as a special nuclear material and source radioactive material storage building. It was used for storing packaged items of source material (natural uranium, depleted uranium, thorium) and special nuclear materials (enriched uranium, plutonium, and U-233) of various forms and configurations. Originally the north (Room 114) and south (Room 110 and 104 vault) contained steel racks for storing material. The south side was primarily used for the storage of highly enriched uranium and plutonium bearing items; the north side was primarily used for source material and "low" enriched uranium storage.[3]

Enriched uranium powders and source material powder packages were split into smaller units or combined into larger units in a glove box located in Room 104. The glove box was removed from Building 4064 at an unknown time. Plutonium was handled only in a packaged form; never as a loose powder.[4] No plutonium repackaging took place other than by transferring sealed packages between containers. Transfers of solid metallic forms of material were generally handled in the glove box, but sometimes larger pieces were transferred and repackaged within the vault. During the shut-down and termination of the SNAP program, excess Zr-U (enriched uranium) alloy material was sectioned into lengths suitable for packaging for shipment in DOE containers. This was done in Room 104. The floor was covered with plastic sheeting and the Zr-U was sectioned using a hack saw.[3]

During the early 1960s, the metal racks in the south half of Room 110 were removed in order to store material in "bird cages" and drums. This storage included large quantities of special nuclear material recoverable scrap. At this time, the fenced yard areas in the front, side, and back of Building 4064 were used to store 55-gallon drums of low-level enriched recoverable scrap. This material was shipped off-site in the mid-to-late 1960s and early 1970s. Rockwell claimed that residual contamination from handling bare metallic pieces was from enriched uranium, natural uranium, depleted uranium, and thorium. Most reactor contracts had ended by the early 1980s. No special nuclear material powders were handled or repackaged after 1980. After all fissionable material had been removed, miscellaneous equipment and containers of radioactive

[1] ICF Kaiser Engineers, *Current Conditions Report and Draft RCRA Facility Investigation Work Plan, Area IV Santa Susana Field Laboratory, Ventura County, California, Part 1 – Current Conditions Report Volume 1*, October 1993, pp. 4-8, 4-87.
[2] Montgomery Watson Harza, *DOE Leach Fields (Area IV AOC) RCRA Facility Investigation Report, Santa Susana Field Laboratory, Ventura County, California, Draft*, October 2003, pp. 2-3.
[3] Remley, M. E. General Storage Data for Buildings 064 and 022, October 7, 1977.
[4] Chapman, J. A., *Radiological Survey of the Source and Special Nuclear Material Storage Vault-Building T64*, GEN-ZR-0005, August 19, 1988, pp. 7, 16-21.

waste (principally soil) were stored in Building 4064. In 1993, all nuclear material was removed and Building 4064 was decontaminated.[1]

Information from Interviewees: In 2010, a number of former workers were interviewed about their experiences at the SSFL. One had knowledge of Building 4064. Excerpts from his comments are presented below:

- "When I was a fork lift operator I hauled SNAP 8 and 10 fuels to a storage facility. I also hauled remnants from the SRE rupture to Building 64, "The Vault." I did not package the remnants; I just hauled the box from one area to another. I wore a film badge and dosimeter while doing this work though." This interviewee worked at the SSFL between 1963 and 1999.[2]

Radiological Incident Reports: There have been several incidents associated with Building 4064 that could have resulted in a release to the environment. The following table provides information presented in an incidents database provided by Boeing. Summaries of the incident reports are provided following the table, when available.

Building 4064 Incident Report Summary

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A0523	3/10/1959	SS VAULT SSFL		PERSONNEL ENTERED VAULT AREA WITHOUT REQUIRED FILM BADGES.
A0028	2/18/1963	YARD SS VAULT	MFP	CASK DRAIN PLUG RUSTED OUT DRAINING CONTAMINATED WATER ONTO GROUND.
N/A	5/3/1963	SS VAULT	U	CANS OF UC EXPLODED INSIDE SSFL VAULT.
A0468	10/8/1964	SS VAULT	U	CAN OF UC EXPLODED INSIDE A "BIRDCAGE" SHIPPED TO SSFL VAULT.
A0622	7/20/1967	SSFL SS VAULT	U3O8	OUTSIDE TRANFER OF U POWDER CAUSED INCREASED ACTIVITY IN VEGETATION SAMPLES.
A0095	1/12/1982	VAULT		RAS ALARM RESPONSE.
A0109	9/21/1982	VAULT		RESPONSE TO RAS ALARM AT SS VAULT.
A0218	6/8/1992	STORAGE RACKS	U	EMPLOYEE STACKING FUEL STORAGE RACKS CUT HAND.
A0663	8/8/1995	SIDE YARD	Cs-137	PERFORMING THE MODIFIED AREA IV TRANSIENT SURVEY IN GRID R24S25, A HOT SPOT WAS FOUND.

[1] ICF Kaiser Engineers, *Current Conditions Report and Draft RCRA Facility Investigation Work Plan, Area IV Santa Susana Field Laboratory, Ventura County, California, Part 1 – Current Conditions Report Volume 1*, October 1993, pp. 4-8, 4-87.
[2] Interview No. 3 of former employee conducted by the EPA, September 2010.

Building 4064 Incident Report Summary (continued)

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A0687	9/28/1998	SIDE YARD	Cs-137	EXCAVATED 6 CUBIC YARDS OF Cs-137 CONTAMINATED SOIL.

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

- On March 10, 1959, an employee entered the storage vault without a film badge and it was not known how long he was in the vault. The employee was reminded on other occasions to wear his film badge (Incident Report A0523).[1]

- On February 18, 1963, soil east of the exclusion fence at the SS Vault was found to be contamination during a routine survey. Three additional surveys revealed an area of 700 square feet of asphalt and soil contaminated with mixed fission products to a maximum of 700 mrad/h at 2 inches. It was deduced that the contamination resulted from a cask containing irradiated Seawolf submarine reactor fuel pins. The cask was received at the vault, stored, transferred to the Hot Lab for inspection, and returned to the vault for storage. After storing the fuel pins for 1.5 to 2 years it was shipped back to Westinghouse around May 1962. Sometime during this last storage period, it is believed that the drain plug rusted through, permitting fluid contaminated within the cask to spill onto the asphalt. A soil sample showed 8,340 pCi/g beta-gamma gross radioactivity, including 1×10^6 dpm/g of Cs-137 and 2×10^5 dpm/g of Cs-134. Alpha activity was negligible in all samples. Approximately 2,365 gallons of soil and asphalt were removed at the vault to reduce the maximum contamination level to 0.5 mrad/h. Three inches of soil was removed from all the contaminated soil areas and 80 percent of the areas were found to be free of contamination upon resurveying. The remaining areas were excavated up to 1.5 feet. Fill soil was brought in by the maintenance department to return the soil levels to their previous level (Incident Report A0028).[2, 3]

- On May 3, 1963, an explosion occurred in the north vault of Building 4064. The sources of the explosion were a 1-gallon can containing 8.3 kilograms of uranium carbide (3.7 percent enriched U-235) in the form of fines and pieces, and a 1-gallon can containing 2.5 kilograms of uranium carbide (4.9 percent enriched U-235) comprising sintered pieces. The fuel in both cans was immersed in Redline 60 oil. The explosion was believed to have been caused by the release of hydrogen gas from degrading uranium carbide. After 20 minutes elapsed, the AI Fire Department entered the vault and smothered the cans with Metal X. According to AI, a smear survey confirmed that contaminated had been confined to the interior of the vault. The cans were removed and the vault was decontaminated using kerosene and K-pads. AI planned to remove approximately 10 square feet of asphalt floor tiles where the cans had been located.[4]

[1] Loba, M. L., Internal Letter, *Re: Violation of Health Phys. Practices*, March 13, 1959.
[2] Badger, F. H., North American Aviation Internal Letter, re*: Contamination Incident SS Vault Santa Susana*, November 11, 1965.
[3] Moore, J. D., Atomics International Internal Letter, re*: Radioanalysis Report*, February 22, 1963.
[4] Coonce, G. L., Atomics International Internal Letter, re*: UC Fire at Building 064,* May 8, 1963.

- On October 8, 1964, a custodian found black oxidized powder deposited on the inside of a "bird cage" container. Investigation revealed that uranium carbide had oxidized blowing the lid off one 1-gallon can and warping the bottom of the container. The inside of the can was surveyed at 5×10^3 dpm/100 cm^2 alpha. Contamination levels on the concrete dock of the Building 064 increased to 200 dpm/100 cm^2 alpha from a "clean" level. Evidence suggested that an inert atmosphere had not been sufficiently established in the 1-gallon container (Incident Report A0468).[1]

- On July 20, 1967, an investigation was performed to identify reasons for increased alpha activity in vegetation samples between Building 4064 and the fire station. It was determined that uranium carbide and uranium oxide powder had been transferred from one 55-gallon drum to another in the Building 4064 storage yard. The drum from which material had been removed was still located in the yard on a piece of plastic sheeting and visible amounts of uranium oxide powder remained. The plastic was folded carefully and disposed of as radioactive waste. No "significant" surface contamination was found in areas other than the plastic sheeting and vegetation samples collected between Building 4064 and the fire station. Personnel were cautioned about procedures for transferring radioactive materials or opening drums of radioactive materials (Incident Report A0622).[2]

- On January 12, 1982, an alarm went off in Building 4064. Crews arrived at the building to check it out and the all clear was given within an hour of arriving on the scene. The cause for the alarm was unknown and the alarm was to be checked by maintenance (Incident Report A0095).[3]

- On September 21, 1982, an alarm went off in Building 4064. Crews arrived at the building to check it out and the all clear was given within an hour of arriving at the scene. The cause for the alarm was unknown and the alarm was to be checked by maintenance (Incident Report A0109).[4]

- On June 8, 1992, an employee was stacking storage racks on a pallet when he cut the palm of his hand. No detectable activity was noted on the employee's hand or the storage racks, despite concern for fixed U-235 contamination under paint on the fuel storage racks (Incident Report A0218).[5]

- On August 8, 1995, a hot spot of approximately 1 square foot was identified during an Area IV survey in grid number R24S25. The hot spot was measured at 10,000 cpm or 46 μR/h. Per Rockwell's procedure, a 1 meter ambient survey was performed, but it was

[1] Owen, D. E., Atomics International Internal Letter, re*: Incident Report, Building 064 Vault, 10-8-64,* October 27, 1964.
[2] Alexander, R. E., Atomics International, re*: Radiation Safety Unit Weekly Newsletter for Period Ending July 22, 1967*, August 2, 1967.
[3] Bradbury, S. M., Rockwell International Internal Letter, re*: Radiological Safety Incident Report, Building 064, 1/12/82*, Unknown Date.
[4] Bradbury, S. M., Rockwell International Internal Letter, re*: Radiological Safety Incident Report, Building 064, 9/21/82*, September 22, 1982.
[5] Wallace, J. H., Rockwell International Internal Letter, re*: Radiological Safety Report, T064 South Vault, 6/8/92*, June 17, 1992.

below the 5 μR/h above background limit for classifying as a hot spot. However, the Building 4064 sideyard was a formally remediated facility so the discovery was reported to the Area IV survey project manager. The hot spot was roped off and a sample was taken. The sample contained 271 pCi/g of Cs-137. The Cs-137 concentration was too low to be considered an inhalation hazard and the surface radiation was only three times background so there were no specific safety concerns. According to Rockwell, the discovery of contamination did not warrant a formal occurrence report because Building 4064 was not yet released for unrestricted use. The hot spot had been identified in a verification survey by the Oak Ridge Institute for Science and Education (ORISE), but had not been properly communicated to Rockwell. The discovery was cited as an example of the importance of walk-about surface gamma surveying used in the Area IV characterization survey (Incident Report A0663).[1] The exact location of this hot spot has not been identified, but it appears to be west of Building 4064.

- On September 28, 1998, ORISE discovered an area of elevated soil contamination in the side yard. The area measured approximately 18 feet by 6 feet and was located on the sloping bank between 10th Street and the Building 4064 parking lot. A total of 6 cubic yards of soil were excavated until radiation levels reached background levels. ORISE resurveyed the area, verified that radiation levels were normal, and collected two soil samples. Rockwell collected additional samples to confirm that the remediation had been successful (Incident Report A0687).[2] The exact location of this hot spot has not been identified, because it is unclear to which sloping bank the reference is made.

Current Use: Building 4064 was demolished in 1997 together with the removal of a septic tank and leach field.[3] The dimensions of the excavation made during building demolition are unknown.

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

- In 1988, Rockwell conducted a radiological survey of the source and special nuclear material storage vault, fenced-in storage yard, and 2-acre surrounding area at Building 4064. The concrete ramps leading to rooms 110 and 114 were found to exhibit alpha radioactivity in higher rates than all other areas surveyed. This alpha activity was concluded to arise from natural elements in the concrete that were not removable. Ambient gamma exposure rate measurements made within the fenced-in storage yard showed a contaminated area bordering and outside of the eastern fence. According to Rockwell, no contamination was detected inside the fenced-in storage yard. Ambient gamma exposure rate measurements made outside the fence in the 2-acre area showed an area of about 4,000 square feet contaminated with Cs-137. Two soil samples collected from an area of greatest exposure rate showed a Cs-137 radioactivity concentration of 2,500 pCi/g, regarded as 2,500 times Rockwell's background concentration. Beta

[1] McGinnis, E. R., Rockwell International Internal Letter, re*: Radiological Incident Report, Soil Contamination Found in T064 Sideyard, 8/8/95,* August 25, 1995.
[2] Rutherford, R., Rockwell International Incident Report, re*: Verification Survey,* September 28, 1998.
[3] Shah, S. N., *Final Report, Decontamination and Decommissioning of Fuel Storage Facility 4064,* Boeing Report EID-04600, September 11, 1999, pp. 14-18.

activity was measured at 1,200 pCi/g in the area of greatest contamination. Further remedial action was recommended.[1]

- In 1990, Rockwell removed topsoil from portions of a 4,500 square-foot area of the Building 4064 side yard where Cs-137 had been found. Additional gamma exposure surveys and soil analyses were performed. Rockwell concluded that residual radioactivity levels at the Building 4064 side yard were within 1990 regulatory limits. This included the fenced-in yard and the 2-acre surrounding area. The average measured concentration of Cs-137 was 4.9 pCi/g. Rockwell's derived soil concentration limit was 60.4 pCi/g for Cs-137. Rockwell recommended that these areas be released for use without radiological restrictions.[2, 3, 4]

- In December 1991, Rockwell prepared a work plan for the decommissioning and decontamination of Building 4064.[5] In March 1992, Rockwell prepared instructions for the removal, size reduction, and disposal of the radiologically contaminated filter plenums located on the north and south sides of Building 4064. These were to be packaged and transferred to the RMDF.[6] In March 1992, Rockwell also prepared instructions for decontaminating the interior structural surfaces (walls, ceilings, floors, storage racks) of Building 064. Waste cleaning materials were to be transferred to the RMDF.[7]

- In 1992, Rockwell surveyed a 6,580-square-foot area comprising the fenced-in yard that surrounded Building 4064 to assess its radiological condition. The area was divided into grid blocks. Alpha activity, beta activity, and gamma exposure rate measurements were made, and samples of soil and asphalt were collected for laboratory analysis to measure concentration levels of man-made residual radioactivity. All alpha surface activity levels were found to be below Rockwell's acceptance limit of 5,000 dpm/100 cm^2. All beta surface activity levels were found to be below Rockwell's acceptance limit of 5,000 dpm/100 cm^2. All gamma exposure rates were found to be below Rockwell's acceptance limit of 5 µR/h above Rockwell's background rate of 15.3 µR/h. Rockwell concluded that the fenced-in yard met its criteria for release for unrestricted use.[8]

- In June 1992, ORISE performed a final verification survey during which gamma surface scans and soil sampling and analysis identified three Cs-137 hotspots in the side yard.

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[1] Chapman, J. A., *Radiological Survey of the Source and Special Nuclear Material Storage Vault-Building T64*, GEN-ZR-0005, August 19, 1988, pp. 2, 91-92.
[2] Subbraman, G. and Oliver, B. M., *Final Decontamination and Radiological Survey of the Building T064 Side Yard*, Rockwell International, N704SRR990031, October 30, 1990, pp. 5, 56-57.
[3] Rockwell International Letter from G. G. Gaylord to R. Liddle, U.S. DOE, re: *Final Survey of Radiological Decontamination of Building 064 Side Yard*, December 11, 1990.
[4] Rockwell International Letter from G. G. Gaylord to D. Williams, U.S. DOE, re: *Building 064 Side Yard Survey*, April 29, 1993.
[5] Richards, C. D., *D & D Work Plan for Building 064, Environmental Restoration*, ETEC Report No. SSWA-AN-001, December 12, 1991.
[6] Richards, C. D., *Building 064 Removal of Filter Plenum Systems*, ETEC Report No. SSWA-SOP-003, March 10, 1992.
[7] Richards, C. D., *Building 064 Structural Surfaces, Final Clean*, ETECReport No. SSWA-SOP-004, March 25, 1992.
[8] Kneff, D. W., Tuttle, R. J., and Subbraman, G., *Radiological Assessment of the Building T064 Fenced-in Yard*, Rockwell International, N704SRR990035, January 12, 1994, pp. 10, 40-41.

This indicates that Rockwell's previous cleanup was incomplete. Rockwell subsequently remediated the hotspots and revised the Building 4064 side yard guidelines to meet a more restrictive 10 mrem/yr maximum dose rate for a residential scenario.[1]

- In 1993, Rockwell removed all known radioactively contaminated equipment, components and structures from Building 4064, as well asbestos containing materials. The equipment in Room 110 included weighing scales, tools, a fume hood, storage racks, empty storage containers, and empty shipping drums. Items stored in Room 114 consisted of contaminated pumps, equipment control consoles, and packaged contaminated soil. All radioactive waste was packaged and shipped to an unnamed disposal facility.[2] Rockwell performed a final radiological survey of the Building 4064 interior to demonstrate regulatory compliance for release for unrestricted use.[3]

- In 1994 and 1995, during the Area IV Radiological Characterization Survey, Rockwell identified two locations, one in the original side yard and one located across G Street as remaining above release limits. Rockwell excavated these areas in 1997 including the removal of an abandoned septic tank and leach field that serviced Building 4064. Rockwell conducted scoping surveys and soil sampling after excavation and concluded that the Building 4064 area beneath the building foundations and surrounding yard areas were below release limits.[4]

- In June 1996, the DOE granted approval to Rockwell to demolish Building 4064. The empty site and the side yard would be combined into one release site.[5]

- In May 1997, a schedule was drawn up for the demolition of Building 4064 in July 1997.[6]

- In May 1998, Boeing reported that it had recently completed soil core sampling of the Building 4064 side yard, including a location across G Street, and core samples under G Street. This was done to verify that the recent excavation activities had removed all subsurface contamination at the site to below DOE-approved cleanup limits. A total of 52 subsurface samples were collected from 14 locations up to depths of 15 feet down to bedrock. The Cs-137 concentrations in these samples ranged from less than 0.02 pCi/g to 0.13 pCi/g with an average of 0.03 pCi/g. According to Boeing, these concentrations were below the Cs-137 cleanup standard of 9.2 pCi/g in 1998 and typical of local background at that time. Uranium and thorium isotopes and K-40 concentrations were also typical of background.[7]

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[1] Vitkus, T. J., *Verification Survey of the Old Conservation Yard, Building 064 Side Yard, and Building 028, Santa Susana Field Laboratory, Rockwell International, Ventura County, California*, ORISE 93/J-107, October 1993, pp. 5-11.
[2] Waite, P., *Building 064 D&D Operations Final Report*, ETEC Report No. SSWA-AR-0002, August 13, 1993, p. 8.
[3] Dahl, F. C. and Tuttle, R. J., *Final Radiological Survey Report of Building 064 Interior*, ETEC Report No. SSWA-ZR-0001, January 14, 1994, pp. 17-19.
[4] Liddy, P, *Area 4064 Final Status Survey Report*, Rocketdyne Report No. RS-00003, March 30, 1999, pp. 6, 25-26.
[5] U.S. Department of Energy Letter from M. Lopez to M. Lee, re: *Demolition of Building 064*, June 25, 1996.
[6] Email from W. J. Gerritsen to P. B. Ramirez, re: *Permit for Demolition of Building 4064*, May 28, 1997.
[7] Boeing Letter from M Lee to M. Lopez, U.S. Department of Energy, re: *Building 064 Side Yard*, May 13, 1998.

- In late 1998, Rockwell performed a final status survey and ORISE and the DHS conducted final verification surveys following the demolition of Building 4064 and the yard. Analysis of soil samples collected after excavation of Building 4064 indicated that Cs-137 activity was below the release limit of 9.2 pCi/g. The agency confirmed that the site could be released for unrestricted use.[1, 2]

- On January 31, 2005, the DOE released Building 4064 for unrestricted use.[3]

Radiological Use Authorizations: The following radiological use authorization was assigned to Building 4064.

- Use Authorization No. 139, dated about 1989, for radiological material storage and decontamination at Building 4064.[4]

Former Radiological Burial or Disposal Locations: A septic tank and leach field were associated with Building 4064.

Aerial Photographs: Aerial photographs show undeveloped land until the 1959 photograph when a square building is observed that is identified as Building 4064. Building 4064 looks the same in the approximately 1960 photograph, but in the 1965 photograph it appears to have doubled in size. In the 1967 photograph, open storage is observed on the north, west, and east sides of Building 4064. In the 1983 photograph, a probable stain is identified outside the southwest corner of Building 4064. In the 1995 photograph, the quantity of open storage has been reduced significantly. In the 2005 and 2009 photographs, Building 4064 is no longer present and the site is vegetated.[5]

Radionuclides of Concern: In Building 4064, non-irradiated, fissionable nuclear materials (enriched uranium and plutonium) were stored along with low-level radioactive waste. Potential radioactive contaminants include U-233, U-234, U-235, U-236, U-238, Th-228, Th-232, Pu-238, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Ra-226, Cs-134, Cs-137, Sr-90, H-3, Na-22, K-40, Mn-54, Fe-55, Co-60, Ni-59, Ni-63, Eu-152, Eu-154, Pm-147, Ta-182.[6] All radionuclides of concern listed, with the exception of Mn-54, Pm-147 and Ta-182, are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives and do not meet the criteria for analysis. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Based on general site topography, surface water flows northeast from former Building 4064 to the storm drain near the side yard on G Street. This storm drain appears

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[1] Lupo, R. K., *Confirmatory Survey, Building 4064 Site, Santa Susana Field Laboratory, Boeing-Rocketdyne, Ventura County, California*, California Department of Health Services, Radiologic Health Branch, December 30, 1998, p. 5.
[2] Boeing Internal Letter from J. Shao to P. Rutherford, re: *Soil Sampling Results for Building 064 Area at SSFL (Revision)*, September 24, 1998.
[3] U.S. Department of Energy Letter from M. Lopez to M. Lee, re: *Release of Building 4064*, January 31, 2005.
[4] Rockwell International Internal Letter from V. J. Schaubert to J. P. Page, re: *User Authorization, Building 064 North Vault*, April 24, 1989.
[5] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[6] Liddy, P., *Area 4064 Final Status Survey Report*, Rocketdyne Report No. RS-00003, March 30, 1999, p. 4.

to connect with a drainage channel that transports water south through Area III to in the Area II ponds. The overflow from this pond is into Bell Canyon and thence to the Los Angeles River.[1]

Radiological Contamination Potential: The preliminary MARSSIM classification for the Building 4064 area is Class 1, due to its location within the ETEC, and its former use as storage building for radioactive source and special nuclear materials and radioactive waste.

Recommended Locations for Soil/Sediment Sampling:

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

Information is lacking regarding the excavation activities at Building 4064. In addition, previous characterization studies for the Building 4064 area were focused on delineating the extent of contamination to standards that were applicable at the time. Characterization was not conducted to delineate the extent of contamination consistent with the DTSC/DOE December 2010 AOC. Therefore, additional characterization is recommended for the Building 4064 area. This includes the following Building 4064 areas and appurtenances:

- The flat and low-lying areas surrounding Building 4064, particularly on the north, west and east sides where open storage was identified in aerial photographs. Radionuclides originating from Building 4064 may have migrated to these areas via surface water flow or airborne releases.

- The site of the probable stain identified from aerial photographs outside the southwest corner of Building 4064.

- The former 750-gallon septic tank and leach field area. Boeing excavated, removed, and surveyed this area in 1997, but it is not clear that this area was thoroughly investigated and decontaminated.

- The storm drain located northeast of the site that connects to ponds in Areas II and III.

- The sanitary sewer line located south of the site. If radionuclides were released into the sanitary sewer system, residual contamination may exist in the materials surrounding the sewer lines.

2.3.4 Parking Lot 4513 Area

Site Description: The Parking Lot 4513 area comprised Parking Lot 4513, Time Clock Building 4333, and the land surrounding these located near the intersection of 10th and E Streets. Parking Lot 4513 was constructed prior to 1959.[2] Figure 2.3.4a provides a current photograph. The location of Parking Lot 4513 is shown in Figure 2.3.

[1] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.

Building Features: Parking Lot 4513 was an asphalt parking lot located on the east side of 10th Street.

Former Use(s): Parking Lot 4513 was used by personnel working in Buildings 4030, 4064, and 4641. Radioactive materials were handled in all of these buildings surrounding the site.[1]

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: Parking Lot 4513 is vegetated and is no longer used.

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

- In 1988, Rockwell surveyed for radioactive contaminants the Building 4513 parking lot as part of a survey of five sites that were used to support nuclear-related facilities. The parking lot surface and Building 4333 were surveyed for mixed fission products by measuring ambient gamma exposure rates. Rockwell found the mean exposure rate at Parking Lot 4513 to be 14.0 ± 0.25 μR/h.[2]

- In 1994 and 1995, Rockwell conducted a radiological characterization survey in Area IV that included Parking Lot 4513. The purpose of this survey was to locate and characterize any previously unknown areas of elevated radioactivity in Area IV. Rockwell estimated background to be 15.6 μR/h. Rockwell's acceptable limit was less than 5 μR/h above background. Survey results were below Rockwell's acceptance limits.[1]

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Locations: None found.

Aerial Photographs: Aerial photographs show undeveloped land until the 1957 photograph when a parking lot can be seen that is identified as Parking Lot 4513. In the 1959 photograph, the area of Parking Lot 4513 appears to have increased. No significant change is observed in the approximately 1960, 1965, 1967, 1972, 1978, 1980, 1983, 1988, and 1995 photographs. A vegetated area is seen in the location of Parking Lot 4513 in the 2005 and 2009 photographs.[3]

Radionuclides of Concern: The research team did not find evidence that radioactive materials were handled in Parking Lot 4513. However, Parking Lot 4513 was used by personnel working in Buildings 4030, 4641, and 4064 where radioactive materials were handled. In Building 4064, non-irradiated, fissionable nuclear materials (enriched uranium and plutonium) were stored along

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[1] Chapman, J. A., *Radiological Survey of the T513 Parking Lot; Old R/A Laundry Area; Plot 333; and Areas between the SRE to RMDF, and KEWB to RMDF*, ETEC Report No. GEN-ZR-0009, August 26, 1988, pp. 3, 8, 15-19, 27, 51-62, 77-79.
[2] Chapman, J., *Radiological Survey of the T513 Parking Lot; Old R/A Laundry Area; Plot 333; and Areas between the SRE to RMDF, and KEWB to RMDF*,ETEC Report No. GEN-ZR-0009, pp. 54, 77, 79.
[3] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.

with low-level radioactive waste. Potential radioactive contaminants include U-233, U-234, U-235, U-236, U-238, Th-228, Th-232, Pu-238, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Ra-226, Cs-134, Cs-137, Sr-90, H-3, Na-22, K-40, Mn-54, Fe-55, Co-60, Ni-59, Ni-63, Eu-152, Eu-154, Pm-147, Ta-182.[1] All radionuclides of concern listed, with the exception of Mn-54, Pm-147 and Ta-182, are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives and do not meet the criteria for analysis. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Based on general site topography, surface water flows northeast from Parking Lot 4513 to the storm drain on the other side of E Street. This storm drain appears to connect with a drainage channel that transports water south through Area III to a pond in Area II. The overflow from this pond is into Bell Canyon and thence to the Los Angeles River.[2] It is unknown whether radioactive materials were handled in Parking Lot 4513, but the site could have become contaminated by surface water and airborne releases from Building 4064.

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Parking Lot 4513 area is Class 2, due to its location near Building 4064.

Recommended Locations for Soil/Sediment Sampling:

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

Previous characterization studies for the Parking Lot 4513 area were focused on delineating the extent of contamination to standards that were applicable at the time. Characterization was not conducted to delineate the extent of contamination consistent with the DTSC/DOE December 2010 AOC. Therefore, additional characterization is recommended for the Parking Lot 4513 area. This includes the following Parking Lot 4513 areas:

- The flat and low-lying areas surrounding and including Parking Lot 4513. Radionuclides originating from Building 4064 may have migrated to these areas via surface water flow or airborne releases.

2.4 Group 4

The Group 4 index map is presented in Figure 2.4. Following Figure 2.4, the site photograph and layout drawings for each building area within HSA-6 Group 4 are presented. HSA-6 Group 4 includes five building areas containing the contaminated medical/storage facility and the new salvage yard.

2.4.1 Building 4040 Area

Site Description: The Building 4040 area comprises Building 4040, fire truck canopy Building 4624, and the land around these two buildings located on G Street. Building 4040 was

[1] Liddy, P., *Area 4064 Final Status Survey Report*, Rocketdyne Report No. RS-00003, March 30, 1999, p. 4.
[2] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.

constructed in approximately 1966.[1, 2] Figures 2.4.1a and 2.4.1b provide a current photograph and floor plan. A plot plan is presented in Figure 2.4.1c.

Building Features: Building 4040 was an approximately 848-square-foot single-story building constructed with galvanized steel walls and roof anchored to a concrete floor. Water drained from the shower and wash basins in Room 109 to a special holding tank, located east of Building 4040. A negative pressure ventilation system, with intake and outlet absolute filters, was provided for Rooms 103 and 109. Emergency power was provided for the facility. The building entrance at the southwest corner of Building 4040 was designated as the ambulance entrance and the entrance to be used by contaminated personnel. The north entrance was for attending and support personnel.[3] A floor plan is presented in Figure 2.4.1b.

Former Use(s): Building 4040 was first designated as a protective services control center. In the 1970s, it was an emergency medical and decontamination facility that housed an interim sick bay with bed facilities for four persons, medical office, a waiting room, a health physics counting laboratory for sealed check sources, and a laboratory for a low-background alpha/beta counting system to analyze air and wipe samples. In 1984, it was an office supply storage building.[2]

Information from Interviewees: In March 2000, a former worker interviewed by Montgomery Watson Harza stated that an incinerator was present at Building 4040. He believed that it was used for document and photograph burning, a standard historic practice.[4]

Radiological Incident Reports: None found.

Current Use: Building 4040 was demolished in 1997.

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

- In February 1996, Rockwell conducted direct frisk surveys, a smear survey, and an ambient gamma survey in Building 4040. Results were below Rockwell's acceptable limits of 20 dpm/100 cm^2 of alpha activity and 100 dpm/100 cm^2 of beta activity. Ambient gamma radiation was measured at levels between 10 and 12 μR/h.[5]

- In May 1997, Boeing conducted a survey of the floor and under the floor tiles in Building 4040. No detectable activity was found above Boeing's alpha background of 6cpm and beta background of 100 cpm.[6, 7]

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[1] Energy Technology Engineering Center, *Site Development and Facility Utilization Planning: FY 1984-FY 1989*, N-083E-A02-DV001, Rev. A, April 1984.
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[3] Atomics International, *Emergency Medical and Decontamination Facility, Building 040 – Santa Susana*, no date.
[4] Montgomery Watson Harza interview conducted March 25, 2000 to discuss source of ash at Building 4040.
[5] Rockwell International, *Radiation Survey Report, Building T040*, (internal document), February 1996.
[6] Internal letter from P. D. Rutherford to G. E. Shindler, Boeing North American, Inc., re: Radiological Status of Building T040 (4040), April 29, 1997.
[7] Rockwell International Radiation Survey Report, Building T040, May 1, 1997.

Radiological Use Authorizations: It is not known under what use authorization operations in Building 4040 were conducted. Building 4040 was located outside of the ETEC boundary, so use of radioactive materials in Building 4040 would have been authorized by the CDPHE under Radioactive Material License No. 0015-59.

Former Radiological Burial or Disposal Locations: Boeing observed an ash pile outside Building 4040 during site inspections, and in response, implemented erosion control measures at this location.[1]

Aerial Photographs: Aerial photographs show undeveloped land until the 1967 photograph when a rectangular building is observed that is identified as Building 4040. The 1967 photograph shows open storage located south of Building 4040. This remains throughout the 1970s and 1980s, but disappears from the June 1995 photograph. Building 4040 is no longer present in the 2005 photograph. Undeveloped land appears in the location of Building 4040 in the 2009 photograph.[2]

Radionuclides of Concern: Sealed radioactive sources were stored in Building 4040. Low-level radioactive air and wipe samples may have been analyzed in Building 4040.[3] Possible radionuclides include U-233, U-234, U-235, U-236, U-238, Th-228, Th-232, Pu-238, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Ra-226, Cs-134, Cs-137, Sr-90, H-3, Na-22, K-40, Mn-54, Fe-55, Co-60, Ni-59, Ni-63, Eu-152, Eu-154, Pm-147, Ta-182.[4] All radionuclides of concern listed, with the exception of Mn-54, Pm-147 and Ta-182, are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives and do not meet the criteria for analysis. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: A storm drain is located west of the northwest corner of Building 4040. Based on general site topography, surface water in the vicinity of Building 4040 flows into this storm drain, which appears to connect with a drainage channel that transports water south through Area III to a pond in Area II. The overflow from this pond is into Bell Canyon and thence to the Los Angeles River.[5]

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4040 area is Class 2, due to its past use as a laboratory for a low-level background alpha/beta counting system to analyze air and wipe samples and its location near the New Salvage Yard.

Recommended Locations for Soil/Sediment Sampling:

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

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[1] Montgomery Watson Harza, *Group 6 – Northeastern Portion of Area IV, RCRA Facility Investigation Report, Santa Susana Field Laboratory, Ventura County, California, Volume 1*, September 2006, pp. 3-2 – 3-3.
[2] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[3] Internal letter from P. D. Rutherford to G. E. Shindler, Boeing North American, Inc., re: Radiological Status of Building T040 (4040), April 29, 1997.
[4] Liddy, P., *Area 4064 Final Status Survey Report*, Rocketdyne Report No. RS-00003, March 30, 1999, p. 4.
[5] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.

Previous characterization studies for the Building 4040 area were focused on delineating the extent of contamination to standards that were applicable at the time. Characterization was not conducted to delineate the extent of contamination consistent with the DTSC/DOE December 2010 AOC. Therefore, additional characterization is recommended for the Building 4040 area. This includes the following Building 4040 areas and appurtenances:

- The flat land around the footprints of Buildings 4040 and 4624. Radionuclides originating from Building 4040 may have migrated to this area via surface water flow or airborne releases.

- The location of open storage south of Building 4040 identified from aerial photographs. This may have been related to the ash piles identified during site inspections. If radioactively contaminated personal protective equipment was burned, then the ash pile should be sampled, if till present.

- The storm drain located near the northwest corner of Building 4040. If radiological materials were released from Building 4040, they may have migrated to the storm drain network during precipitation events.

2.4.2 Building 4114 Area

Site Description: The Building 4114 area comprised Building 4114 and the land surrounding it located on E Street. Building 4114 was a trailer that was located on Parking Lot 4511, located at the former main gate to Area IV, in about June 1978. Building 4114 was located south of the old salvage yard and barrel storage yard. [1] Figures 2.4.2a and 2.4.2b provide a current photograph and a floor plan.

Building Features: Building 4114 had a single and a double door entering into a treatment room and an emergency medical room, respectively. It contained a restroom, a shower, a basin, a refrigerator, two cots, a surgical table, three laboratory benches, three tables, a desk, a file cabinet and four wall cabinets. It was connected to the sanitary sewer and the local water supply. It was also furnished with a 150-gallon tank and a HEPA filter.[2] Figure 2.4.2b shows a floor plan and piping layout.

Former Use(s): Building 4114 was a decontamination trailer for radiologically contaminated personnel, but according to Rockwell's Radiation and Nuclear Safety Manager in 1989, Building 4114 was never used for this purpose, and had no unnatural radioactivity in it.[3] It is assumed that this trailer was set up for radiological emergencies, which never eventuated.

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

[1] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[2] Rockwell International, *Santa Susana Field Laboratory Radioactive Decontamination Trailer Piping,* Drawing No. PEWR 75732-RI, March 3, 1977.
[3] Rockwell International internal letter from R. J. Tuttle to R. T. Lancet, re: *Decommissioning of Decontamination Trailer,* August 28, 1989.

Current Use: Building 4114 was removed in approximately 1989. Its final destination is unknown.[3]

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

- In 1994 and 1995, Rockwell conducted a radiological characterization survey in Area IV that covered the area of former Building 4114. The purpose of this survey was to locate and characterize any previously unknown areas of elevated radioactivity in Area IV. Rockwell estimated background to be 15.6 µR/h. Rockwell's acceptable limit was less than 5 µR/h above background. Survey results were below Rockwell's acceptance limits.[1]

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Locations: None found.

Aerial Photographs: Aerial photographs show undeveloped land until the 1980 photograph when a long rectangular building is observed that is identified as Building 4114. Building 4114 is observed in 1983 and 1988 photographs, but can no longer be seen in the 1995 photograph. A vegetated area can be seen in the 2005 and 2009 photographs.[2]

Radionuclides of Concern: The research team did not find evidence that high activity radioactive materials were used or stored within Building 4114. However, there is some potential that radionuclides associated with the nearby ESG salvage yard may have migrated to the area surrounding Building 4114 (see Section 2.5.2 for a discussion of the ESG salvage yard). Radioactive items in the ESG salvage yard were transported from the SRE area. Radionuclides associated with the operations of the SRE include U-238, U-234, U-235, Pu-238, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Th-232, H-3, Na-22, Na-24, Cr-51, Mn-54, Fe-59, Co-60, Kr-85, Sr-89, Sr-90, Sb-125, I-129, I-131, Cs-134, Cs-137, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xn-133, Xe-135, Pm-147, Sm-151.[3, 4, 5] All radionuclides of concern listed with the exception of Na-24, Cr-51, Mn-54, Fe-59, Kr-85, Sr-89, I-131, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xe-133, Xe-135, Pm-147 and Sm-151 are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives except for Sm-151 for which no analytical method is available. Table 3.3 presents a summary of contaminants of concern.

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[1] Rockwell International, *Area IV Radiological Characterization Survey*, Final Report, Volume I, A4CM-ZR-0011, Revision A, August 15, 1996, pp. 22-24.
[2] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[3] Hart, R. S., *Distribution of Fission Product Contamination in the SRE*, Atomics International Report No. NAA-SR-6890, March 1, 1962, pp. 8-27.
[4] Kinzer, J. and Crawford, A. C., *SRE First Core Fuel*, Atomics International Technical Data Record No. 5301, May 16, 1960, pp. 1-7.
[5] Letter from Heine, W. F., Atomics International, to Proctor, J. F., E. I. du Pont de Nemours & Company, r: *Fission Product and Fissile Content of SRE Fuel*, July 2, 1975.

Drainage Pathways: Based on general site topography, surface water flows west from the Building 4114 area to a drainage channel connecting to the Area II ponds. The overflow from these ponds is into Bell Canyon and thence to the Los Angeles River.[1]

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4114 area is Class 2, due to its location near the ESG salvage yard area.

Recommended Locations for Soil/Sediment Sampling:

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

Previous characterization studies for the Building 4114 area were focused on delineating the extent of contamination to standards that were applicable at the time. Characterization was not conducted to delineate the extent of contamination consistent with the DTSC/DOE December 2010 AOC. Therefore, additional characterization is recommended for the Building 4114 area. This includes the following Building 4114 areas and appurtenances:

- The flat and low-lying areas surrounding Building 4114. Radionuclides originating from the ESG salvage yard may have migrated to these areas via surface water flow or airborne releases.

- The drainage channel located west of the site that connects to ponds in Areas II and III.

2.4.3 Parking Lot 4511 Area

Site Description: The Parking Lot 4511 area comprised Parking Lot 4511, Guard Shacks 4113 and 4623, and the land surrounding these located on E Street, near the former main gate to Area IV. Parking Lot 4511 was constructed prior to 1962.[2] Figure 2.4.3a provides a current photograph.

Building Features: Parking Lot 4511 was an asphalted area in two parts located west of and across E Street from the barrel storage yard, near the former main gate to Area IV.

Former Use(s): Parking Lot 4511 served as a parking lot for the main gate and for personnel working in the ESG salvage yard, the barrel storage yard, and adjacent areas. Some radioactively contaminated materials were stored the ESG salvage yard from the 1950s until 1977.

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: Parking Lot 4511 on the north side of E Street is currently vegetated and no longer in use. Parking Lot 4511 on the south side of E Street remains asphalted.

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[1] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.

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

- In 1994 and 1995, Rockwell conducted a radiological characterization survey in Area IV that covered the area of Parking Lot 4511. The purpose of this survey was to locate and characterize any previously unknown areas of elevated radioactivity in Area IV. Rockwell estimated background to be 15.6 µR/h. Rockwell's acceptable limit was less than 5 µR/h above background. Survey results were below Rockwell's acceptance limits.[1]

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Locations: Open storage of some radioactive items was sited east of the north side of Parking Lot 4511.[2]

Aerial Photographs: Aerial photographs show undeveloped land until the 1959 photograph when a parking area can be seen on the south side of E Street that is identified as the first part of Parking Lot 4511. In the approximately 1960 photograph a parking lot can also be seen on the north side of E Street as well. Both parts of Parking Lot 4511 can be seen in the 1965 photograph. In the 1967 photograph, the north side parking lot appears to have increased in area by about 100 percent. No change is observed in the 1972, 1978, 1980, 1983, 1988, and 1995 photographs. A vegetated area is seen in the location of Site 4511 in the 2005 and 2009 photograph.[2]

Radionuclides of Concern: Site 4511 was a parking lot located near the Area IV main gate. The site is not expected to be radiologically contaminated, but contamination may have migrated to the site via surface water flow or airborne releases from the ESG salvage yard and barrel storage yard. Possible radionuclides include U-238, U-234, U-235, U-236, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Th-232, H-3, Na-22, Na-24, Cr-51, Mn-54, Fe-59, Co-60, Kr-85, Sr-89, Sr-90, Sb-125, I-129, I-131, Cs-134, Cs-137, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xn-133, Xe-135, Pm-147, Sm-151.[3, 4, 5] All radionuclides of concern listed with the exception of Na-24, Cr-51, Mn-54, Fe-59, Kr-85, Sr-89, I-131, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xe-133, Xe-135, Pm-147 and Sm-151 are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives except for Sm-151 for which no analytical method is available. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Based on general site topography, surface water flows southwest from the west side of Parking Lot 4511 to a drainage channel and is transported south to the Area II ponds. The overflow from these ponds is into Bell Canyon and thence to the Los Angeles

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[1] Rockwell International, *Area IV Radiological Characterization Survey*, Final Report, Volume I, A4CM-ZR-0011, Revision A, August 15, 1996, pp. 22-24.
[2] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[3] Hart, R. S., *Distribution of Fission Product Contamination in the SRE*, Atomics International Report No. NAA-SR-6890, March 1, 1962, pp. 8-27.
[4] Kinzer, J. and Crawford, A. C., *SRE First Core Fuel*, Atomics International Technical Data Record No. 5301, May 16, 1960, pp. 1-7.
[5] Letter from Heine, W. F., Atomics International, to Proctor, J. F., E. I. du Pont de Nemours & Company, r: *Fission Product and Fissile Content of SRE Fuel*, July 2, 1975.

River.[1] It is unknown whether radioactive materials were handled in Parking Lot 4511, but the site could have become contaminated by surface water and airborne releases from the ESG salvage yard and barrel storage yard..

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Site 4511 area is Class 2, due to its location near the ESG salvage yard and the barrel storage yard.

Recommended Locations for Soil/Sediment Sampling:

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

Previous characterization studies for the Parking Lot 4511 area were focused on delineating the extent of contamination to standards that were applicable at the time. Characterization was not conducted to delineate the extent of contamination consistent with the DTSC/DOE December 2010 AOC. Therefore, additional characterization is recommended for the Parking Lot 4511 area. This includes the following Parking Lot 4511 areas and appurtenances:

- The flat and low-lying areas on and surrounding Site 4511. Radionuclides originating from the ESG salvage yard may have migrated to these areas via surface water flow or airborne releases.
- The drainage channel located west of the site that connects to ponds in Areas II and III.

2.4.4 Parking Lot 4540 Area

Site Description: The Parking Lot 4540 area comprised Parking Lot 4540 and the land surrounding it on G Street near the corner with E Street.[2] It was constructed prior to 1965. Figure 2.4.4a provides a current photograph. The location of Parking Lot 4540 is shown in Figure 2.4.

Building Features: Parking Lot 4540 was a paved parking lot located south of Building 4040.

Former Use(s): Parking Lot 4540 was the parking lot for Building 4040. Following the demolition of Building 4040 in 1997, Parking Lot 4540 was no longer used.

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: Parking Lot 4540 is part of G Street.

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

Radiological Use Authorizations: None found.

[1] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.

Former Radiological Burial or Disposal Locations: None found.

Aerial Photographs: Aerial photographs show undeveloped land until the 1965 photograph when a parking lot can be seen that is identified as Parking Lot 4540. The 1967 photograph, Building 4040 can be seen located north of Parking Lot 4540. No significant change is observed in the 1972 photograph. The 1967 photograph shows open storage located south of Building 4040. This remains throughout the 1970s and 1980s, but disappears from the June 1995 photograph. A vegetated area is seen in the former location of Parking Lot 4540 in the 2005 and 2009 photographs.[1]

Radionuclides of Concern: Sealed radioactive sources were stored in Building 4040 (see Section 2.4.1 for a discussion of Building 4040). Low-level radioactive air and wipe samples may have been analyzed in Building 4040.[2] Radionuclides originating from Buildings 4040 and/or 4064 may have migrated to this area via surface water or airborne releases. Possible radionuclides include U-233, U-234, U-235, U-236, U-238, Th-228, Th-232, Pu-238, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Ra-226, Cs-134, Cs-137, Sr-90, H-3, Na-22, K-40, Mn-54, Fe-55, Co-60, Ni-59, Ni-63, Eu-152, Eu-154, Pm-147, Ta-182.[3] All radionuclides of concern listed, with the exception of Mn-54, Pm-147 and Ta-182, are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives and do not meet the criteria for analysis. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Based on general site topography, surface water in the vicinity of Parking Lot 4540 flows into a storm drain located near the northwest corner of former Building 4040. This storm drain appears to connect with a drainage channel that transports water south through Area III to a pond in Area II. The overflow from this pond is into Bell Canyon and thence to the Los Angeles River.[4] It is unknown whether radioactive materials were handled in Parking Lot 4540, but the site could have become contaminated by surface water and airborne releases from Building 4040.

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Parking Lot 4540 area is Class 2, because of the former use of Building 4040 and because no radiological investigation has been conducted in this area.

Recommended Locations for Soil/Sediment Sampling:

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

Previous characterization studies for the Parking Lot 4540 area were focused on delineating the extent of contamination to standards that were applicable at the time. Characterization was not conducted to delineate the extent of contamination consistent with the DTSC/DOE December

[1] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[2] Internal letter from P. D. Rutherford to G. E. Shindler, Boeing North American, Inc., re: *Radiological Status of Building T040 (4040)*, April 29, 1997.
[3] Liddy, P., *Area 4064 Final Status Survey Report*, Rocketdyne Report No. RS-00003, March 30, 1999, p. 4.
[4] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.

2010 AOC. Therefore, additional characterization is recommended for the Parking Lot 4540 area. This includes the following Parking Lot 4540 areas and appurtenances:

- The flat land on former Parking Lot 4540. Radionuclides originating from Buildings 4040 and/or Building 4064 may have migrated to this area via surface water flow or airborne releases.

- The location of open storage on the site identified from aerial photographs, South of Building 4040.

2.4.5 Site 4583-New Area

Site Description: The Site 4583-New area comprised Site 4583-New and the land surrounding it located on the south side of E Street near Building 4114 and the main gate. Site 4583-New was developed in 1977 as a new salvage yard.[1] Figures 2.4.5a provides a current photograph. Figure 2.4.5b provides a plot plan. The location of Site 4583-New is shown in Figure 2.4.

Building Features: Site 4583-New was accessed by a paved road off G Street. It occupied an area of approximately 0.5 acres south of G Street, was fenced, relatively flat, and was covered with loose dirt and weeds. A drainage ditch extending downhill from the SRE pond formed the western boundary of Site 4583-New. The ditch connected to the Area II ponds.[2]

Former Use(s): Site 4583-New was developed as the new salvage yard after the ESG salvage yard was closed in 1977. All salvageable, non-radioactive materials were moved to the site in and after 1977. Items included used equipment and drums. In 1988, the site was cluttered with items of large metal equipment and scrap metal. Because a number of radioactive spills occurred at the SRE, radioactive contamination is possible in the drainage ditch along the western boundary of Site 4583-New.[2,3]

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: Site 4583-New is a vegetated area no longer in use.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): In 1988, Rockwell conducted a radiological survey of the ESG salvage yard, barrel storage yard, and new salvage yard to determine whether any residual contamination remained from former storage operations. The areas were surveyed for fixed and removable alpha/beta contamination. Rockwell measured ambient gamma exposure rates and collected soil samples for analysis. At the new salvage yard, Rockwell found gamma exposure rate distributions to be equivalent to natural background. Rockwell's background was 15.3 μR/h with an acceptable limit of less than 5 μR/h above background. The average ambient gamma exposure rate was found to be 13.5

[1] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[2] Chapman, J. A., *Radiological Survey of the ESG Salvage Yard (Old), Rocketdyne Barrel Storage Yard, and New Salvage Yard (T583)*, ETEC Report No. GEN-ZR-0008, August 22, 1988, pp. 2-3, 15-26, 57-80.
[3] Description of New Conservation Yard, Boeing North American document, p. 4.

μR/h. Rockwell collected three soil samples from the drainage ditch in the new salvage yard at depths down to 2 feet. Rockwell also collected two soil samples from the ditch north of G Street. Samples were analyzed for U-238 (0.87 pCi/g average), Th-232 (0.76 pCi/g average), K-40 (21.99 pCi/g average) and Cs-137 (0.18 pCi/g average). Survey results were below Rockwell's acceptance limits in the new salvage yard.[2]

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Locations: Site 4583-New was a disposal location for non-radiologically contaminated items.

Aerial Photographs: Aerial photographs show undeveloped land until the 1978 photograph when open storage is observed on an irregularly shaped area that is identified as Site 4583-New. This is also observed in the 1980 photograph. In the 1983 photograph, the area of Site 4583-New appears to have increased in size. In the 1988 photograph, the area appears to have decreased in size. Refuse containers are observed in the 1995 photograph. A vegetated area without open storage of materials is observed in the 2005 and 2009 photographs.[1]

Radionuclides of Concern: Controls were reportedly implemented at the new salvage yard to ensure that no radioactive materials or radioactively contaminated materials were stored there. However, radionuclides originating from Building 4064 may have migrated to this area via surface water flow or airborne releases. Possible radionuclides include U-233, U-234, U-235, U-236, U-238, Th-228, Th-232, Pu-238, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Ra-226, Cs-134, Cs-137, Sr-90, H-3, Na-22, K-40, Mn-54, Fe-55, Co-60, Ni-59, Ni-63, Eu-152, Eu-154, Pm-147, Ta-182.[2] All radionuclides of concern listed, with the exception of Mn-54, Pm-147 and Ta-182, are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives and do not meet the criteria for analysis. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Based on general site topography, surface water from Site 4583-New flows south to the drainage channel that forms the western and southern boundaries of the new salvage yard. This channel is connected to the Area II ponds. This drainage channel also transported water pumped from the SRE retention pond.[3] Radioactive materials were not supposed to have been handled at Site 4583-New, but the site could have become contaminated by surface water and airborne releases from Building 4064.

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Site 4583-New area is Class 1. It is not apparent that a full radiologic characterization of the area was conducted.

Recommended Locations for Soil/Sediment Sampling:

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

[1] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[2] Liddy, P., *Area 4064 Final Status Survey Report*, Rocketdyne Report No. RS-00003, March 30, 1999, p. 4.
[3] Chapman, J. A., *Radiological Survey of the ESG Salvage Yard (Old), Rocketdyne Barrel Storage Yard, and New Salvage Yard (T583)*, ETEC Report No. GEN-ZR-0008, August 22, 1988, pp. 16.

Previous characterization studies for the Site 4583-New area were focused on delineating the extent of contamination to standards that were applicable at the time. Characterization was not conducted to delineate the extent of contamination consistent with the DTSC/DOE December 2010 AOC. Therefore, additional characterization is recommended for the Site 4583-New area. This includes the following Site 4583-New areas and appurtenances:

- The flat land and low lying areas on Site 4583-New. Radionuclides may have been deposited on soil via wind and precipitation events.
- The drainage channel located on the western and southern sides of the site that transports surface water southward. If radionuclides were released on other areas of the site, they may have migrated to the drainage channel during precipitation events.

- The sanitary sewer line located in the southern region of the site. If radionuclides were released into the sanitary sewer system, residual contamination may exist in the materials surrounding the sewer line.

2.5 Group 5

The Group 5 index map is presented in Figure 2.5. Following Figure 2.5, the site photograph and layout drawings for each building area within HSA-6 Group 5 are presented. HSA-6 Group 5 includes four building areas containing the Old Salvage Yard and fuel oil storage tanks.

2.5.1 Building 4320 Area

Site Description: The Building 4320 area comprised Building 4320, concrete Pad 4737 that supported four oil pumps, and the land surrounding these located on C Street near 3rd Street. Building 4320 was constructed in approximately 1978 as a fuel oil control/pump building.[1, 2] Figures 2.5.1a and 2.5.1b provide a current photograph and a floor plan.

Building Features: Building 4320, built on ESG salvage yard property, was a 500-square-foot prefabricated steel building (20 feet wide by 25 feet long and 10 feet high) including a restroom, mounted on a concrete pad and connected through two pumping stations to two 1.5 million gallon fuel tanks by carbon steel pipes from 3 to 6 inches in diameter. A transformer was located outside Building 4320 as were four 15-horsepower oil pumps. The area surrounding Building 4320 was fenced and paved with asphalt parking areas.[2, 3, 4] A 20,000-gallon fiberglass diesel/fuel oil underground storage tank (UT-28) was located on the east side of Building 4320.[5] Figure 2.5.1b presents a floor plan of Building 4320.

Former Use(s): Building 4320 was the tank unloading station and distribution system control center used to pump fuel oil from aboveground holding Tanks 4731 (1.5 million gallons) and 4732 (1.5 million gallons) to Tank 4735 (86,000 gallons), located in HSA-5B. A 20,000-gallon

[1] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[2] The Boeing Company, *Building Reconnaissance Report, Building 320*, November 15, 1996, pp. 31-32.
[3] Letter from N. L. Mattera, The Boeing Company, to A. Brown, Ventura County Air Pollution Control District, March 3, 1999.
[4] Jassak, R., *Sodium Components Test Installation Fuel Oil Storage and Distribution System Demolition and Waste Minimization Study*, Rockwell International Report No. 355-XT-0126, February 18, 1998, pp. 7, 20.
[5] Rockwell International, *Underground Tank Removal Reports, Volume I of II,* July 13, 1994.

underground storage tank (UT-28) was used as a holding tank during the transfer of fuel from tanker trucks to the aboveground storage tanks. In May 1988, Rockwell hired a contractor to excavate and remove UT-28 under tank abandonment permit No. 913. The contractor inspected UT-28 for holes, and checked the soil using a HNu portable ionization detector. No holes were found in the tank, and no petroleum contamination was detected in the soil.[5, 1, 2]

Information from Interviewees: In September 2002, Montgomery Watson Harza interviewed a former worker who stated that the SRE discharge pipeline was installed after the fuel farm was constructed. He stated that the pipeline led to the concrete sump near UT-28, which had a motor in it to pump out the contents into the drainage channel at the ESG salvage yard. This sump also collected runoff from each of the two tank bermed areas.[3]

Radiological Incident Reports: None found.

Current Use: Building 4320 was demolished in 1999.[4]

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): Only one radiological survey at this site appears to have been conducted, as follows:

- In 1994 and 1995, Rockwell conducted an Area IV Radiological Characterization Survey that included Building 4320. This survey was designed to locate and characterize any previously unknown areas of elevated radioactivity. Rockwell's background radiation was 15.6 µR/h with an acceptable limit of less than 5 µR/h above background. Survey results were below Rockwell's acceptance limits.[5]

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Locations: None found.

Aerial Photographs: Aerial photographs show undeveloped land until the 1978 photograph when a rectangular-shaped building is identified as Building 4320. A trailer, located south of Building 4320, also appears in this photograph. In the 1980 photograph, 12 vertical tanks are identified where the trailer was previously located. In the 1983, and 1988 photographs, a ground scar is seen located east of the tanks. Building 4320 can also be seen in photographs from 1980, 1983, and 1988. In the 1995 photograph, the ground around Building 4320 appears to have been cleared and a fence erected. A vegetated area is seen in the location of Building 4320 in the 2005 and 2009 photographs.[6]

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[1] Letter from P. B. Ramirez, Boeing North American, Inc., to Robert Laughlin, County of Ventura, February 22, 1999.
[2] Pendleberry, S. L., *Demolition Specification Removal of Fuel Oil Storage and Distribution System*, ETEC Report No. GEN-SP-00051 Rev. NEW, November 2, 1998.
[3] Montgomery Watson Harza, Telephone Discussion Notes re: SRE Discharge Pipeline, ASTs, and UT-28 Details, September 26, 2002.
[4] Letter from P. B. Ramirez, Boeing North American, Inc., to Robert Laughlin, County of Ventura, February 22, 1999.
[5] Rockwell International, *Area IV Radiological Characterization Survey, Final Report, Volume I*, Report No. A4CM-ZR-0011, Revision A, August 15, 1996, pp. 22-24.
[6] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.

Radionuclides of Concern: The research team did not find evidence that radioactive materials were used or stored within Building 4320. However, the site was previously part of the ESG salvage yard and it is not apparent that a full radiologic characterization of the area was conducted. Possible radionuclides include U-238, U-234, U-235, U-236, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Th-232, H-3, Na-22, Na-24, Cr-51, Mn-54, Fe-59, Co-60, Kr-85, Sr-89, Sr-90, Sb-125, I-129, I-131, Cs-134, Cs-137, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xn-133, Xe-135, Pm-147, Sm-151.[1, 2, 3] All radionuclides of concern listed with the exception of Na-24, Cr-51, Mn-54, Fe-59, Kr-85, Sr-89, I-131, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xe-133, Xe-135, Pm-147 and Sm-151 are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives except for Sm-151 for which no analytical method is available. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: The location of former wastewater lines and storm drains is unknown. Based on general site topography, surface water flows in a southerly direction from the site to a drainage channel located north of E Street. From this channel, surface water is ultimately transported to the Area II ponds. The overflow from these ponds is into Bell Canyon and thence to the Los Angeles River.[4] Radioactive materials do not appear to have been handled in Building 4320, but the site could have become contaminated by surface water and airborne releases from the ESG salvage yard.

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Building 4320 area is Class 1. It is not apparent that a full radiological characterization of the area was conducted.

Recommended Locations for Soil/Sediment Sampling:

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

Previous characterization studies for the Building 4320 area were focused on delineating the extent of contamination to standards that were applicable at the time. Characterization was not conducted to delineate the extent of contamination consistent with the DTSC/DOE December 2010 AOC. Therefore, additional characterization is recommended for the Building 4320 area. This includes the following Building 4320 areas and appurtenances:

- The flat and low-lying areas surrounding Building 4320. Radionuclides originating from Building 4143 may have migrated to these areas via surface water flow or airborne releases.
- The east side of Building 4320. A former worker stated that the SRE discharge pipeline from the pond was connected to a concrete sump located near UT-28, which had a motor

[1] Hart, R. S., *Distribution of Fission Product Contamination in the SRE*, Atomics International Report No. NAA-SR-6890, March 1, 1962, pp. 8-27.
[2] Kinzer, J. and Crawford, A. C., *SRE First Core Fuel*, Atomics International Technical Data Record No. 5301, May 16, 1960, pp. 1-7.
[3] Letter from Heine, W. F., Atomics International, to Proctor, J. F., E. I. du Pont de Nemours & Company, re: *Fission Product and Fissile Content of SRE Fuel*, July 2, 1975.
[4] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.

in it to pump out the contents into the drainage channel at the old salvage yard. Radiological contamination from the SRE may have been transported to the sump.

- The location of the tanks south of Building 4320 identified in aerial photographs.
- The location of a ground scar east of the tanks, above, identified in aerial photographs.
- The location of the trailer south of Building 4320 identified in aerial photographs.

2.5.2 Site 4583-Old Area

Site Description: The Site 4583-Old area comprised Site 4583-Old, a shack Building 4313, a concrete pad Site 4737, and the land surrounding these located on the north side of E Street near Building 4114.[1] This site was first used in 1952 as a salvage yard and later included a barrel storage yard. Figures 2.5.2a provides a current photograph. Figure 2.5.2b provides a historical photograph taken in 1963. Figure 2.5.2c presents a plot plan.

Building Features: Site 4583-Old was a 3-acre area comprising mostly natural terrain that was used between 1952 and 1977 as a salvage yard.[2] Figure 2.5.2b presents a 1963 aerial view of Site 4583-Old in the foreground beyond the power plant.

Former Use(s): Site 4583-Old was known as the conservation yard and later as the old ESG salvage yard. This area incorporated a barrel storage yard. Excess salvageable items were stored at Site 4583-Old and, eventually, its extent spread to surrounding areas. Part of this growth expanded into the barrel storage yard, located immediately south of the ESG salvage yard. Although not operated as a radiologically-controlled facility, Rockwell surveyed these areas for contamination. Rockwell states that there was no deliberate dumping or placing or radioactive materials on the site, but because there were no radiological controls, radiologically contaminated items were found on the site during radiation surveys.

In 1969, the barrel storage yard was converted to a material storage area for Plant Services, which relinquished control of the area in 1986 to Rockwell's Transportation Department. The ESG salvage yard was used extensively during the 1960s and 1970s before it was closed in 1977 and cleared of materials. Some of the material from the ESG salvage yard was transported off site. Rockwell conducted radiation surveys on material and the general area to avoid moving any contaminated items to the new storage yard. In 1988, shipping trailers and casks were stored in the old barrel storage yard. In the early 1980s, the ESG salvage yard became a fuel tank farm, located on U.S. Government optioned land. The barrel storage yard was located on Rockwell-owned land. The areas were fenced in 1982. In 1999, Rockwell demolished the fuel tank farm and associated piping.[3, 4]

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

[2] Vitkus, T. J., *Verification Survey of the Old Conservation Yard, Building T064 Side Yard, and Building T028, Santa Susana Field Laboratory, Rockwell International, Ventura County, California*, Oak Ridge Institute for Science and Education Report No. ORISE 93/J-107, October 1993, pp. 2-11.

[3] Chapman, J. A., *Radiological Survey of the ESG Salvage Yard (Old), Rocketdyne Barrel Storage Yard, and New Salvage Yard (T583)*, ETEC Report No. GEN-ZR-0008, August 22, 1988, pp. 2-3, 15-26, 57-80.

[4] Subbaraman, G. and Oliver, B. M., *Final Decontamination and Radiological Survey of the Old Conservation Yard,* Rockwell International Report No. N704SRR990030, August 16, 1990, pp. 5-7.

Information from Interviewees: In 2010, a number of former workers were interviewed about their experiences at the SSFL. Two remembered Site 4583-Old. Excerpts from their comments are presented below.

- "We got surrounded by a wildfire in Simi Valley at one time and I came up to work after the fire had gone through the valley. I saw that the fire had come up the hill. It didn't do any damage at the edge of the hill, but it jumped to the salvage yard as the old conservation yard was also known, and it got hot enough that it fused stainless steel piping together. It takes over 2,000 degrees Fahrenheit to fuse stainless steel together. There were also some lead acid batteries in there, glass cases that were melted down, and some puddles of aluminum."[1] This former employee worked at the SSFL between 1967 and 1985.

- "I was in and out of the Conservation Yard three or four times a day as a forklift driver. There were items there, scrap that also came from the DeSoto plant. The items were scrapped out to different dealers with best prices. There were no hazardous materials at the Conservation Yard to my knowledge."[2] This former employee worked at the SSFL for 35 years.

Radiological Incident Reports: There has been one incident associated with Site 4583-Old that could have resulted in a release to the environment. The following table provides information presented in an incidents database provided by Boeing. Summaries of the incident reports are provided following the table, when available.

Site 4583-Old Incident Report Summary

Incident File Name	Date of Incident	Location of Incident	Isotopes	Description of Incident
A0288	1/15/1976	CONSERVATION YARD	MFP	CONTAMINATED DRUMS AND SOIL DISCOVERED AT CONSERVATION YARD ETC.

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

- On January 15, 1976, a radioactive spill was detected at the conservation yard with a pug survey meter. The spill spread across the conservation yard access road and terminated in an equipment holding area. Contamination was found on barrels (up to 800 mrad/h), pallets (up to 2 mrad/h), and in the surrounding area (up to 35 mrad/h). Other contaminated items were discovered at the conservation yard, although it is not clear from the incident report when these items were discovered. Contaminated items included a barrel (5 mrad/h), several pallets (up to 8 mrad/h), a concrete block (3 mrad/h), and a radioactive liquid waste drum (5 mrad/h). A barrel was found down the hill on the Simi Valley side of the conservation yard (2 mrad/h), and a pair of gloves belonging to the conservation yard operator (0.3 mrad/h). Externally contaminated barrels appeared to have resulted from a double stacked barrel of radioactive liquid that corroded and leaked out on to the drums and pallet below. As for the source of the contaminated liquid that

[1] Interview No. 255 of former worker conducted by the DOE and EPA in 2010, p. 6.
[2] Interview No. 290 of former worker conducted by the DOE, September 2010.

caused the spill, there were not any significant leads, but the liquid was thought to be a cleaning solution. The area was secured and radioactively contaminated asphalt, soil, barrels and pallets were removed to the RMDF for disposition (Incident Report A0288).[1]

Current Use: Site 4583-Old is a vegetated area no longer in use.

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

- In 1988, Rockwell conducted a radiological survey of the ESG salvage yard, barrel storage yard, and new salvage yard to determine whether any residual contamination remained from former storage operations. The areas were surveyed for fixed and removable alpha/beta contamination. Ambient gamma exposure rates were measured and soil samples were collected and analyzed. At the ESG salvage yard, Rockwell found gamma exposure rate distributions to be equivalent to what it characterized as natural background except in a low-lying area (puddle in spring) in the southwest corner of the barrel storage yard. Rockwell's background was 15.3 µR/h and an acceptable limit was less than 5 µR/h above background. The average ambient gamma exposure rate was found to be 14.7 µR/h, while the puddle had a reading of 27.9 µR/h. Rockwell collected two soil samples in a ditch on the western side of the ESG salvage yard, three in the northern area, and three in the region of the barrel storage yard puddle where soil was discolored,. Survey results were below Rockwell's acceptance limits except for elevated levels of Cs-137 in the southwest corner of the barrel storage yard. Rockwell recommended that this area be remediated.[2]

- In 1989, Rockwell removed the top layer of soil in a 20- by 20-foot area in the barrel storage yard where Cs-137 contamination had been identified in 1988. Rockwell performed additional gamma exposure surveys and soil analyses. The average measured ambient gamma exposure rate in the decontaminated area was 14.2 µR/h. The average measured Cs-137 activity present in the decontaminated area was 13.1 pCi/g compared to the average of 81.4 pCi/g prior to decontamination. Survey results were below Rockwell's acceptance limits.[3]

- In 1993, ORISE performed a verification survey of the ESG storage yard. Activities included document reviews, surface scans, surface activity measurements, soil sampling, and sample analysis. Soil sample analysis confirmed Rockwell's results and conclusions. ORISE concluded that the area met its requirements for unrestricted use.[4]

- In 1994 and 1995, Rockwell conducted an Area IV Survey. Parts of the ESG salvage yard were surveyed, but no elevated radiation levels were observed over Rockwell's

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[1] Harris, J. and Badger, F., Rockwell International Internal Letter, *Re: Conservation Yard Spill*, February 6, 1976.
[2] Chapman, J. A., *Radiological Survey of the ESG Salvage Yard (Old), Rocketdyne Barrel Storage Yard, and New Salvage Yard (T583)*, ETEC Report No. GEN-ZR-0008, August 22, 1988, pp. 2-3, 15-26, 57-80.
[3] Subbaraman, G. and Oliver, B. M., *Final Decontamination and Radiological Survey of the Old Conservation Yard*, Rockwell International Report No. N704SRR990030, August 16, 1990, pp. 5-7, 42-52.
[4] Vitkus, T. J., *Verification Survey of the Old Conservation Yard, Building T064 Side Yard, and Building T028, Santa Susana Field Laboratory, Rockwell International, Ventura County, California*, Oak Ridge Institute for Science and Education Report No. ORISE 93/J-107, October 1993, pp. 2-11.

estimated ambient background of between 14 and 18 μR/h.[1] In December 1995, the California Department of Health Services notified Rockwell that it had found no residual contamination exceeding the 1995 limits for unrestricted use, so the site could be released for unrestricted use.[2]

- In March 2000, Boeing conducted a beta/gamma instrument survey of debris on the ESG salvage yard following brush clearing. No activity above Boeing's estimated ambient background was detected. Boeing collected 40 wipe samples and counted them for gross alpha and gross beta activity. Results were below Boeing's alpha and beta removable release limits of 1,000 dpm/100 cm^2 for mixed fission products and U. They were also below Boeing's alpha removable release limits for Pu of 20 dpm/100 cm^2, and the beta removable release limits for Sr-90 of 200 dpm/100 cm^2. Four surface soil samples were also collected. Survey results were below Boeing's acceptance limits.[3]

- In November and December 2006, Cabrera Services, Inc. (Cabrera) conducted a characterization and final status survey of five sites within Area IV that included the ESG salvage yard. The survey was designed in accordance with MARSSIM guidance. Cabrera conducted a gamma walkover survey of 20 percent of the salvage yard area and collected 15 soil samples. A small area of elevated activity was identified south of a large rock outcropping, so an additional surface soil sample was collected. Cabrera found that none of the soil samples indicated radionuclide concentrations above their respective derived concentration guideline levels. Off-site laboratory analysis did not identify any non-gamma emitting radionuclides of concern above their derived concentration guideline levels.[4]

- In February 2008, ORISE conducted visual inspections, surface scans, and soil sampling of selected areas that included the ESG salvage yard. Gamma radiation surface scans did not identify any locations with elevated direct radiation. Radionuclide concentrations in three soil samples were compared to the modified Cs-137 and Eu-152 release limits of 4.7 pCi/g for Cs-137, and 2.8 pCi/g for Eu-152. All three sample results were lower than the release limits for Cs-137 and Eu-152.[5]

Radiological Use Authorizations: On December 21, 1995, the DHS released Site 4583-Old for unrestricted use. No action by NRC was necessary.[6]

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[1] Rutherford, P., *Area IV Radiological Characterization Survey Final Report*, ETEC Report No. A4CM-ZR-0011, August 15, 1995, pp. 21-24.
[2] California Department of Health Services Letter from G. Wong to P. D. Rutherford, re: *Rocketdyne's Letter Dated July 6, 1995 with Attachments Concerning the Release of Buildings T029, T028 and OCY*, December 21, 1995.
[3] Letter from M. Lee, The Boeing Company, to R. Lupo, California Department of Health Services, May 12, 2000.
[4] Cabrera Services, Inc., *Final Status Survey Report:Final Status Survey Post Historical Site Assessment Sites, Block 1, Santa Susana Field Laboratory, Ventura County, California*, March 2007, pp. 1, 19, 31, 39, Attachment 1, p. 12.
[5] Vitkus, T. J., *Independent Verification Survey Report of the Building 4059 Site (Phase B); Post Historical Site Assessment Sites, Block 1; and Radioactive Materials Handling Facility Holdup Pond (Site 4614), Santa Susana FieldLaboratory, The Boeing Company, Ventura County, California, Final Report*, Oak Ridge Institute for Science and Education, June 2008, pp. 4, 10-11, A-7, A-14, B-1 – B3.
[6] California Department of Health Services Letter from G. Wong to P. D. Rutherford, re:*Rocketdyne's Letter Dated July 6, 1995 with Attachments Concerning the Release of Buildings T029, T028 and OCY*, December 21, 1995.

Former Radiological Burial or Disposal Locations: Site 4583-Old was a material disposal facility.

Aerial Photographs: Aerial photographs show undeveloped land until the 1957 photograph when open storage is observed on an irregularly shaped area that is identified as the ESG salvage yard. This is also observed in 1959, approximately 1960, 1965, 1967, 1972, 1978, 1980, and 1983 photographs. Truck trailers and possible standing liquid are observed in the 1988 photograph. Truck trailers are also observed in the 1995 photograph. A vegetated area without open storage of materials is observed in the 2005 and 2009 photographs.[1]

Radionuclides of Concern: Radioactive and non-radioactive materials from the SRE were brought to Site 4583-Old for storage. Possible radionuclides include U-238, U-234, U-235, U-236, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Th-232, H-3, Na-22, Na-24, Cr-51, Mn-54, Fe-59, Co-60, Kr-85, Sr-89, Sr-90, Sb-125, I-129, I-131, Cs-134, Cs-137, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xn-133, Xe-135, Pm-147, Sm-151.[2, 3, 4] All radionuclides of concern listed with the exception of Na-24, Cr-51, Mn-54, Fe-59, Kr-85, Sr-89, I-131, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xe-133, Xe-135, Pm-147 and Sm-151 are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives except for Sm-151 for which no analytical method is available. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Based on general site topography, surface water from Site 4583-Old flows south and southwest into nearby drainage channels that transport water south through Area III to a pond in Area II. The overflow from this pond is into Bell Canyon and thence to the Los Angeles River.[5]

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Site 4583-Old area is Class 1 because of its former use as a storage area for radioactive materials, and because it is not apparent that a full radiologic characterization of the area was conducted.

Recommended Locations for Soil/Sediment Sampling:

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

Previous characterization studies for the Site 4583 area were focused on delineating the extent of contamination to standards that were applicable at the time. Characterization was not conducted to delineate the extent of contamination consistent with the DTSC/DOE December 2010 AOC. Therefore, additional characterization is recommended for the Site 4583 area. This includes the following Site 4583 areas and appurtenances:

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[1] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[2] Hart, R. S., *Distribution of Fission Product Contamination in the SRE*, Atomics International Report No. NAA-SR-6890, March 1, 1962, pp. 8-27.
[3] Kinzer, J. and Crawford, A. C., *SRE First Core Fuel*, Atomics International Technical Data Record No. 5301, May 16, 1960, pp. 1-7.
[4] Letter from Heine, W. F., Atomics International, to Proctor, J. F., E. I. du Pont de Nemours & Company, re: *Fission Product and Fissile Content of SRE Fuel*, July 2, 1975.
[5] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.

- The flat land and low lying areas on Site 4583. Radionuclides originating from items of SRE equipment stored at the site may have been deposited on soil via wind and precipitation events.

- The location of the possible standing liquid on the west side of the barrel yard identified in aerial photographs

- The drainage channel located on the west side of the site that transports surface water southward. If radionuclides were released at the site, they may have migrated to the drainage channel during precipitation events.

2.5.3 Site 4731 Area

Site Description: The Site 4731 area comprised Site 4731 and the land surrounding it located north of C Street in the ESG salvage yard. Site 4731 was developed in about 1977 to house a bulk fuel oil storage tank.[1] Figures 2.5.3a and 2.5.3b provide a current photograph and demolition details. The location of the tank is shown in Figure 2.5.

Building Features: Site 4731 was located on the ESG salvage yard property. It was a fenced area that housed one of two 74-foot diameter fuel oil storage tanks that stood 49 feet high and contained 1.5 million gallons of fuel oil. The above-ground vented tank was fabricated in Pittsburgh in 1976.[2] It had above-ground piping and was supported on a sand base with asphaltic/soil containment berms. Demolition details for the tank are presented in Figure 2.5.3b.[3]

Former Use(s): Site 4731 was part of the ETEC fuel oil storage and distribution system that included two 1.5-million gallon tanks (Sites 4371 and 4732), an 86,000-gallon day tank (Site 4735), a 500-square-foot steel frame and siding control center (Building 4320), two pumping stations, 0.75 miles of piping (most above ground), electrical lines, conduits, fencing, supports, foundations, and paving. The bulk fuel oil was removed and sold in 1990. Residual oil was drained in 1991.[4]

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: The fuel oil tank at Site 4731 was demolished in 1999.[3, 5]

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

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[1] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[2] Boeing Corporation, Statement of Work, *Removal of ETEC Fuel Oil Storage and Distribution System*, October 14, 1997, p. 2.
[3] Letter from P. B. Ramirez, Boeing North American, Inc., to R. Laughlin, County of Ventura, re: *Building 4320 and Tanks Demolition Project*, February 22, 1999.
[4] Memorandum from DOE Oakland Operations Office to J. Neville, DOE/OAK NEPA Compliance Officer, February 16, 1999, p. 1.
[5] Pendleberry, S. L., *Removal of Fuel Oil Storage and Distribution System*, ETEC Report No. GEN-SP-00051, March, 26, 1999, pp. 5-7.

- In 1976, prior to the relocation of the salvage yard, Rockwell conducted a radiation survey of Site 4731 to confirm that the area contained no radiological contamination. Ambient gamma scanning identified an average exposure rate of 14.7 ±0.26 µR/h, which was consistent with Rockwell's background exposure rate.[1]

- In 1994 and 1995, Rockwell conducted a radiological characterization study in Area IV that included Site 4731. The purpose of the study was to locate and characterize previously unknown areas of elevated radioactivity in Area IV. Survey methods included an ambient gamma survey, a walk-about gamma survey, and soil sampling and analysis. Rockwell's average local background was estimated to be 15.6 µR/h. Rockwell's acceptable limit was less than 5 µR/h above background. Survey results were below Rockwell's acceptance limits.[2]

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Locations: None found.

Aerial Photographs: Aerial photographs show undeveloped land until the 1959 photograph when open storage is seen in the location of Site 4731. This is also seen in the approximately 1960, 1965, 1967, and 1972 photographs. In the 1978 photograph, a large round tank is observed with a berm around it and a pipeline connecting to it. This is seen in the 1980, 1983, 1988, and 1995 photographs. A vegetated area is seen in the location of Site 4731 in the 2005 and 2009 photographs.[3]

Radionuclides of Concern: The research team did not find evidence that radioactive materials were used or stored within the Site 4731 area. However, the site was previously part of the ESG salvage yard and it is not apparent that a full radiologic characterization of the area was conducted. Possible radionuclides include U-238, U-234, U-235, U-236, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Th-232, H-3, Na-22, Na-24, Cr-51, Mn-54, Fe-59, Co-60, Kr-85, Sr-89, Sr-90, Sb-125, I-129, I-131, Cs-134, Cs-137, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xn-133, Xe-135, Pm-147, Sm-151.[4, 5, 6] All radionuclides of concern listed with the exception of Na-24, Cr-51, Mn-54, Fe-59, Kr-85, Sr-89, I-131, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xe-133, Xe-135, Pm-147 and Sm-151 are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives except for Sm-151 for which no analytical method is available. Table 3.3 presents a summary of contaminants of concern.

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[1] Chapman, J. A., *Radiological Survey of the ESG Salvage Yard (OLD), Rocketdyne Barrel Storage Yard, and New Salvage Yard (T583)*, ETEC Report No. GEN-ZR-0008, August 22, 1988, p. 17.
[2] Rutherford, P., *Area IV Radiological Characterization Survey Final Report*, ETEC Report No. A4CM-ZR-0011, August 15, 1995, pp. 21-24.
[3] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[4] Hart, R. S., *Distribution of Fission Product Contamination in the SRE*, Atomics International Report No. NAA-SR-6890, March 1, 1962, pp. 8-27.
[5] Kinzer, J. and Crawford, A. C., *SRE First Core Fuel*, Atomics International Technical Data Record No. 5301, May 16, 1960, pp. 1-7.
[6] Letter from Heine, W. F., Atomics International, to Proctor, J. F., E. I. du Pont de Nemours & Company, re: *Fission Product and Fissile Content of SRE Fuel*, July 2, 1975.

Drainage Pathways: Based on general site topography, surface water flows in a southerly direction from the site to a drainage channel located north of E Street. From this channel, surface water is ultimately transported to the Area II ponds. The overflow from these ponds is into Bell Canyon and thence to the Los Angeles River.[1] Radioactive materials do not appear to have been handled at Site 4731, but the site could have become contaminated by surface water and airborne releases from the ESG salvage yard.

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Site 4731 area is Class 1. This is because the area was used for the open storage of items of used equipment, some of which were radiologically contaminated, prior to the installation of the fuel storage tank. It is not apparent that a full radiological characterization of the area was conducted.

Recommended Locations for Soil/Sediment Sampling:

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

Previous characterization studies for the Site 4731 area were focused on delineating the extent of contamination to standards that were applicable at the time. Characterization was not conducted to delineate the extent of contamination consistent with the DTSC/DOE December 2010 AOC. Therefore, additional characterization is recommended for the Site 4731 area. This includes the following Site 4731 areas:

- The flat and low-lying areas on and surrounding Site 4731. Radionuclides originating from Building 4143 may have migrated to these areas via surface water flow or airborne releases. This area was used for the open storage of items of used equipment, some of which were radiologically contaminated, prior to the installation of the fuel storage tank.

2.5.4 Site 4732 Area

Site Description: The Site 4732 area comprised Site 4732 and the land surrounding it located north of C Street in the ESG salvage yard. Site 4732 was developed in 1982 to house a bulk fuel oil storage tank.[2] Figure 2.5.4a provides a current photograph. Figure 2.5.4b provides demolition details. The location of the tank is shown in Figure 2.5.

Building Features: Site 4732 was located on the ESG salvage yard property, southwest of Site 4731. It was a fenced area that housed one of two 74-foot diameter fuel storage tanks that stood 49 feet high and contained 1.5 million gallons of fuel oil. The above-ground vented tank was fabricated in Fresno in 1981.[3] It had above-ground piping and was supported on a sand base with asphaltic/soil containment berms. Demolition details for the tank are presented in Figure 2.5.4b.[4]

[1] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[3] Boeing Corporation, Statement of Work, *Removal of ETEC Fuel Oil Storage and Distribution System*, October 14, 1997, p. 2.
[4] Letter from P. B. Ramirez, Boeing North American, Inc., to R. Laughlin, County of Ventura, re: *Building 4320 and Tanks Demolition Project*, February 22, 1999.

Former Use(s): Site 4732 was part of the ETEC fuel oil storage and distribution system that included two 1.5-million gallon tanks (Sites 4731 and 4732), an 86,000-gallon day tank (Site 4735), a 500-square-foot steel frame and siding control center (Building 4320), two pumping stations, 0.75 miles of piping (most above ground), electrical lines, conduits, fencing, supports, foundations, and paving. The bulk fuel oil was removed and sold in 1990. Residual oil was drained in 1991.[1]

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: The fuel oil tank at Site 4732 was demolished in 1999.[3, 2]

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

- In 1976, prior to the relocation of the ESG salvage yard, Rockwell conducted a radiation survey of Site 4732 to confirm that the area contained no radiological contamination. Ambient gamma scanning identified an average exposure rate of 14.7 ±0.26 µR/h, which was consistent with Rockwell's background exposure rate.[3]

- In 1994 and 1995, Rockwell conducted a radiological characterization study in Area IV that included Site 4732. The purpose of the study was to locate and characterize previously unknown areas of elevated radioactivity in Area IV. Survey methods included an ambient gamma survey, a walk-about gamma survey, and soil sampling and analysis. Rockwell's average local background was estimated to be 15.6 µR/h. Rockwell's acceptable limit was less than 5 µR/h above background. Survey results were below Rockwell's acceptance limits.[4]

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Locations: None found.

Aerial Photographs: Aerial photographs show undeveloped land until the approximately 1960 photograph when open storage is seen in the location of Site 4732. This is also seen in the 1965, 1967, and 1972 photographs. Cleared ground is observed in the 1978 and 1980 photographs. A large circular tank is seen in the 1983 photograph. This is also seen in the 1988 and 1995 photographs. A vegetated area is seen in the location of Site 4732 in the 2005 and 2009 photographs.[5]

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[1] Memorandum from DOE Oakland Operations Office to J. Neville, DOE/OAK NEPA Compliance Officer, February 16, 1999, p. 1.
[2] Pendleberry, S. L., *Removal of Fuel Oil Storage and Distribution System*, ETEC Report No. GEN-SP-00051, March, 26, 1999, pp. 5-7.
[3] Chapman, J. A., *Radiological Survey of the ESG Salvage Yard (OLD), Rocketdyne Barrel Storage Yard, and New Salvage Yard (T583)*, ETEC Report No. GEN-ZR-0008, August 22, 1988, p. 17.
[4] Rutherford, P., *Area IV Radiological Characterization Survey Final Report*, ETEC Report No. A4CM-ZR-0011, August 15, 1995, pp. 21-24.
[5] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.

Radionuclides of Concern: The research team did not find evidence that radioactive materials were used or stored within the Site 4732 area. However, the site was previously part of the Old Salvage Yard and it is not apparent that a full radiologic characterization of the area was conducted. Possible radionuclides include U-238, U-234, U-235, U-236, Pu-239, Pu-240, Pu-241, Pu-242, Am-241, Th-232, H-3, Na-22, Na-24, Cr-51, Mn-54, Fe-59, Co-60, Kr-85, Sr-89, Sr-90, Sb-125, I-129, I-131, Cs-134, Cs-137, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xn-133, Xe-135, Pm-147, Sm-151.[1, 2, 3] All radionuclides of concern listed with the exception of Na-24, Cr-51, Mn-54, Fe-59, Kr-85, Sr-89, I-131, Ce-141, Ba (La)-140, Nb-95, Ru-103, Ru-106, Xe-133, Xe-135, Pm-147 and Sm-151 are included in the EPA August 2010 Final Field Sampling Plan for soil sampling in Area IV. The radionuclides omitted from the sampling plan have very short half-lives except for Sm-151 for which no analytical method is available. Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Based on general site topography, surface water flows in a southerly direction from the site to a drainage channel located north of E Street. From this channel, surface water is ultimately transported to the Area II ponds. The overflow from these ponds is into Bell Canyon and thence to the Los Angeles River.[4] Radioactive materials do not appear to have been handled at Site 4732, but the site could have become contaminated by surface water and airborne releases from the ESG salvage yard.

Radiological Contamination Potential: The preliminary MARSSIM Classification for the Site 4732 area is Class 1. This is because the area was used for the open storage of items of used equipment, some of which were radiologically contaminated, prior to the installation of the fuel storage tank. It is not apparent that a full radiological characterization of the area was conducted.

Recommended Locations for Soil/Sediment Sampling:

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

Previous characterization studies for the Site 4732 area were focused on delineating the extent of contamination to standards that were applicable at the time. Characterization was not conducted to delineate the extent of contamination consistent with the DTSC/DOE December 2010 AOC. Therefore, additional characterization is recommended for the Site 4732 area. This includes the following Site 4732 areas:

- The flat and low-lying areas on and surrounding Site 4732. Radionuclides originating from Building 4143 may have migrated to these areas via surface water flow or airborne releases. This area was used for the open storage of items of used equipment, some of which were radiologically contaminated, prior to the installation of the fuel storage tank.

[1] Hart, R. S., *Distribution of Fission Product Contamination in the SRE*, Atomics International Report No. NAA-SR-6890, March 1, 1962, pp. 8-27.
[2] Kinzer, J. and Crawford, A. C., *SRE First Core Fuel*, Atomics International Technical Data Record No. 5301, May 16, 1960, pp. 1-7.
[3] Letter from Heine, W. F., Atomics International, to Proctor, J. F., E. I. du Pont de Nemours & Company, re: *Fission Product and Fissile Content of SRE Fuel*, July 2, 1975.
[4] Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, p. 6.

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3.0 RADIONUCLIDE LIST

3.1 U.S. Atomic Energy Commission Special Nuclear Material License

The first license issued by the AEC for the SSFL site was Special Nuclear Material License No. SNM-21. It was initially issued on April 6, 1956, for use at the Canoga Park site. License No. SNM-21 authorized AI to receive and possess 50 grams of uranium enriched in uranium-235 (U-235) for use in fission counter tubes. License No. SNM-21 was amended 79 times in its 40-year history to increase the number and type of nuclear materials that could be handled at the Canoga Park and SSFL sites. This license was terminated on September 27, 1996. In February 1975, the AEC became known as NRC and License No. SNM-21 became an NRC license. License No. SNM-21 applies to company owned, not federally owned facilities. This license does not apply to the HSA-6 area.

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

On October 3, 1960, the AEC authorized AI, under License No. CX-17, to possess and operate a separable-half type critical experiments facility at power levels not exceeding 200 watts (thermal) in Building 100 (now known as Building 4100). AI conducted this research under contract to the Southwest Atomic Energy Associates of Shreveport, Louisiana. The license permitted the possession “and use of special nuclear materials as follows:

- 25 kilograms of U-233 and 110 kilograms of U-235 as fuel for the reactor;
- 135 grams of U-233, 1,135 grams of U-235, and 135 grams of Pu-239 in foils and capsules for use in connection with operation of the reactor;
- 0.5 gram each of U-233, U-235, and Pu-239 in fission counters for use in connection with operation of the reactor; and
- 32 grams of Pu in encapsulated neutron sources for use in connection with operation of the reactor.”

License No. CX-17 also permitted the possession “and use of source materials as follows:

- 656 kilograms of Th-232 for use in the core and buffer regions of the reactor;
- 700 grams of natural uranium in foils and capsules for use in connection with operation of the reactor; and
- 0.5 gram each of U-234, U-236, and U-238 in fission counters for use in connection with operation of the reactor.”

License No. CX-17 also permitted the possession “and use of 0.5 gram of Np-237 in fission counters for use in connection with operation of the reactor and to possess, but not to separate such byproduct materials as may be produced by operation of the reactor.”

License No. CX-17 was amended ten times before it was terminated on October 6, 1980. It does not apply to the HSA-6 area.

3.3 California Department of Public Health Radioactive Material License

On September 11, 1963, the State of California, Department of Public Health issued Radioactive Material License No. 0015-59 to AI. This license authorized the possession and use of a wide range of radioactive materials at the De Soto Avenue, Canoga Park, and SSFL sites as listed in Table 3.1, below.

Table 3.1
Radioactive Materials Covered by License No. 0015-59

Radioactive Material (element and mass number)	Chemical and/or Physical Form	Maximum Quantity that Licensee may Possess
Any byproduct material between atomic number 3 and 83	Any	7 curies of each byproduct material between atomic number 3 and 83
Antimony-124	Any	50 curies
Iridium-192	Any	70 curies
Cobalt-60	Sealed sources	10 sources not to exceed 400 curies each
Hydrogen-3	Any	550 curies
Polonium-210	Any	150 curies
Any byproduct material	Separated from irradiated thorium and uranium samples	250 microcuries total
Hydrogen-3	Titanium tritide foil (U.S. Nuclear Corporation)	500 millicuries
Hydrogen-3	Titanium tritide foil (U.S. Radium Corporation)	1 curie
Strontium-90	Sealed source (U.S. Nuclear Corporation Model 312)	5 microcuries
Radium-226	Any	2,000 milligrams
Radium-226	Sealed neutron sources	500 milligrams
Cobalt-60	Sealed source (U.S. Nuclear Corporation Model 338)	1 source not to exceed 5 curies
Cobalt-60	Sealed source (Isotopes Specialties Company Model 338)	1 source not to exceed 5 curies
Cerium-144	Sealed source (Isotopes Specialties Company Model 160)	50 microcuries
Iridium-192	Sealed source (Technical Operations Model A424-1)	1 source not to exceed 20 curies
Radium-226	Sealed sources (NRC Equipment Corporation)	Seven sources not to exceed 0.4 milligram each
Strontium-90	Sealed sources	Two sources of 3 millicuries each
Americium-241	Any	2 millicuries
Natural or depleted uranium	Any	20,000 pounds
Natural thorium	Any	700 pounds

This license covered the use and possession of radioactive materials outside the former ETEC boundary: Building 4040, the contaminated medical storage facility, and part of the ESG Salvage Yard in the HSA-6 area. Up until December 1969, there had been 39 amendments to this license. The radioactive materials covered in the 39th amendment are listed in Table 3.2, below.

Table 3.2
Radioactive Materials Covered by License No. 0015-59, Amendment No. 39

Radioactive Material (element and mass number)	Chemical and/or Physical Form	Maximum Quantity that Licensee may Possess
Any radionuclide with atomic number 3 through 83	Any	25 curies for any one radionuclide
Antimony-124	Any	100 curies
Iridium-192	Any	100 curies
Cobalt-60	Sealed sources	10 sources not to exceed 400 curies each
Hydrogen-3	Any	10,000 curies
Polonium-210	Any	150 curies
Krypton-85	Any	100 curies
Neptunium-237	Any	100 microcuries
Radium-226	Any except as neutron sources	5 grams
Radium-226	Sealed neutron sources	500 milligrams
Cobalt-60	Sealed source (U.S. Nuclear Corporation Model 338)	1 source not to exceed 5 curies
Cobalt-60	Sealed source (Isotopes Specialties Company Model 338)	1 source not to exceed 5 curies
Cobalt-60	Sealed source (Lockheed Nuclear Products Drawing 442-1001)	25,000 ± 2,500 curies in 12 sources
Iridium-192	Sealed source (Technical Operations Model A424-1)	4 sources not to exceed 100 curies each
Radium-226	Sealed sources (NRC Equipment Corporation)	Seven sources not to exceed 0.4 milligram each
Califonium-252	Sealed source (Oak Ridge)	2 sources not to exceed 550 microcuries each
Any radionuclide with atomic number 3 through 83	Any	Not to exceed 100 curies for any one radionuclide
Promethium-147	Promethium oxide	150,000 curies
Americium-241	Any	10 curies
Natural or depleted uranium	Any	20,000 pounds
Natural thorium	Any	1,000 pounds
Tantalum-182	Metal	500 curies
Natural or depleted uranium	Any	50,000 pounds
Mixed fission products (Hot Lab)	Any	10,000,000 curies
Any radionuclide with atomic number 3 through 83 (Hot Lab)	Any	100,000 curies for any one radionuclide

This license was amended 64 times up until August 2, 1979, when the license number was changed to No. 0015-70. This license number was changed a second time to No. 0015-19 on December 5, 1996. As of August 27, 2010, there had been 110 amendments to this license. This license applies to buildings outside of the ETEC boundary. In the HSA-6 area, this license applied to Building 4040, and part of the ESG Salvage Yard.

3.4 Radionuclide List to be Used in Soil Sampling

From a review of historical documents and radioactive material licenses issued for the SSFL, all of the radionuclides selected for radiochemical analysis of soil samples are likely to have been used or generated on the SSFL. In the table below, certain radionuclides mentioned in source documents will not be analyzed. These have undergone radioactive decay in excess of 10 half-lives, such that they could no longer be present. These radionuclides include: Na-22, Fe-55, Sb-125, Cs-134, Ce-144, and Po-210. The May 2010 Draft Final Field Sampling Plan for Soil Sampling Area IV Radiological Study Santa Susana Field Laboratory describes the radionuclides contained in soil analytical suites, the sample analytical approach, and provides explanations for deleting certain radionuclides from analysis.

Table 3.3
Summary of Subarea HSA-6 Sites

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

Table 3.3 (continued)
Summary of Subarea HSA-6 Sites

Site No.	Use(s)	Current Status	Potential Radiological Contaminants of Concern	MARSSIM Class
4163	SRE Support, Component Equipment Repair Facility (CERF)	Demolished	U-238, U-234, U-235, U-236, Pu-238, Pu-239+240, Am-241, Th-232, H-3, Co-60, Sr-90, and Cs-137.	1
4183	Fire Pump Building	Demolished	U-238, U-234, U-235, U-236, Pu-238, Pu-239+240, Am-241, Th-232, H-3, Co-60, Sr-90, and Cs-137.	1
4184	SRE Battery Room, Diesel Generator Canopy	Demolished	U-238, U-234, U-235, U-236, Pu-238, Pu-239+240, Am-241, Th-232, H-3, Co-60, Sr-90, and Cs-137.	1
4185	Steam Generator Control Building	Demolished	U-238, U-234, U-235, U-236, Pu-238, Pu-239+240, Am-241, Th-232, H-3, Co-60, Sr-90, and Cs-137.	1
4273	Radioactive Laundry	Demolished	U-238, U-234, U-235, U-236, Pu-238, Pu-239+240, Am-241, Th-232, H-3, Co-60, Sr-90, and Cs-137.	1
4283	Radioactive Laundry	Demolished	U-238, U-234, U-235, U-236, Pu-238, Pu-239+240, Am-241, Th-232, H-3, Co-60, Sr-90, and Cs-137.	1
4320	Fuel Oil Control/Pump Building	Demolished	U-238, U-234, U-235, U-236, Pu-238, Pu-239+240, Am-241, Th-232, H-3, Co-60, Sr-90, and Cs-137.	1
4505	Storage Area/Concrete Pad	Demolished	U-238, U-234, U-235, U-236, Pu-238, Pu-239+240, Am-241, Th-232, H-3, Co-60, Sr-90, and Cs-137.	1
4511	Parking Lot at Main Gate	Removed	U-238, U-234, U-235, U-236, Pu-238, Pu-239+240, Am-241, Th-232, H-3, Co-60, Sr-90, and Cs-137.	2
4513	Parking Lot between Buildings 4064 and 4030	Removed	U-238, U-233, U-234, U-235, U-236, Pu-238, Pu-239+240, Am-241, Th-232, Np-237, Cs-137, Sr-90, H-3, Co-60, Ba-133, Eu-152, and Eu-154.	2
4540	Parking Lot for Building 4040	Part of G Street	U-238, U-233, U-234, U-235, U-236, Pu-238, Pu-239+240, Am-241, Th-228, Th-232, Ra-226, Cs-137, Sr-90, H-3, Co-60, Ni-59, Ni-63, Eu-152, and Eu-154.	2
4583-Old	Old Energy Systems Group (ESG) Salvage Yard (1962-1975)	Removed	U-238, U-234, U-235, U-236, Pu-238, Pu-239+240, Am-241, Th-232, H-3, Co-60, Sr-90, and Cs-137.	1
4583-New	New Salvage Yard (1977-1983)	Demolished	U-238, U-233, U-234, U-235, U-236, Pu-238, Pu-239+240, Am-241, Th-228, Th-232, Ra-226, Cs-137, Sr-90, H-3, Co-60, Ni-59, Ni-63, Eu-152, and Eu-154.	1
4653	Interim Radioactive Waste Vault	Demolished	U-238, U-234, U-235, U-236, Pu-238, Pu-239+240, Am-241, Th-232, H-3, Co-60, Sr-90, and Cs-137.	1
4684	Steam Generator Pad	Demolished	U-238, U-234, U-235, U-236, Pu-238, Pu-239+240, Am-241, Th-232, H-3, Co-60, Sr-90, and Cs-137.	1
4686	Temporary Hot Waste Storage	Demolished	U-238, U-234, U-235, U-236, Pu-238, Pu-239+240, Am-241, Th-232, H-3, Co-60, Sr-90, and Cs-137.	1

Table 3.3 (continued)
Summary of Subarea HSA-6 Sites

Site No.	Use(s)	Current Status	Potential Radiological Contaminants of Concern	MARSSIM Class
4689	Interim Storage Facility for Contaminated Items from the SRE Complex	Demolished	U-238, U-234, U-235, U-236, Pu-238, Pu-239+240, Am-241, Th-232, H-3, Co-60, Sr-90, and Cs-137.	1
4695	SRE Cold Trap Vault	Demolished	U-238, U-234, U-235, U-236, Pu-238, Pu-239+240, Am-241, Th-232, H-3, Co-60, Sr-90, and Cs-137.	1
4703	Water Tower	Demolished	U-238, U-234, U-235, U-236, Pu-238, Pu-239+240, Am-241, Th-232, H-3, Co-60, Sr-90, and Cs-137.	2
4714	Research and Development Shop Work Area associated with Building 4163	Demolished	U-238, U-234, U-235, U-236, Pu-238, Pu-239+240, Am-241, Th-232, H-3, Co-60, Sr-90, and Cs-137.	1
4723	Steam/Sodium Cleaning Pad associated with the SRE	Demolished	U-238, U-234, U-235, U-236, Pu-238, Pu-239+240, Am-241, Th-232, H-3, Co-60, Sr-90, and Cs-137.	1
4724	Hot Oil Sodium Cleaning Facility for the SRE	Demolished	U-238, U-234, U-235, U-236, Pu-238, Pu-239+240, Am-241, Th-232, H-3, Co-60, Sr-90, and Cs-137.	1
4731	Fuel Oil Storage Tank	Demolished	U-238, U-234, U-235, U-236, Pu-238, Pu-239+240, Am-241, Th-232, H-3, Co-60, Sr-90, and Cs-137.	1
4732	Fuel Oil Storage Tank	Demolished	U-238, U-234, U-235, U-236, Pu-238, Pu-239+240, Am-241, Th-232, H-3, Co-60, Sr-90, and Cs-137.	1
4733	Sodium Cleaning Pad for the SRE Complex	Demolished	U-238, U-234, U-235, U-236, Pu-238, Pu-239+240, Am-241, Th-232, H-3, Co-60, Sr-90, and Cs-137.	1
4743	Tetralin Heat Exchanger for the SRE	Demolished	U-238, U-234, U-235, U-236, Pu-238, Pu-239+240, Am-241, Th-232, H-3, Co-60, Sr-90, and Cs-137.	1
4753	SRE Primary Fill Tank Vault	Demolished	U-238, U-234, U-235, U-236, Pu-238, Pu-239+240, Am-241, Th-232, H-3, Co-60, Sr-90, and Cs-137.	1
4773	SRE Waste Water Retention Pond and Dam	Demolished	U-238, U-234, U-235, U-236, Pu-238, Pu-239+240, Am-241, Th-232, H-3, Co-60, Sr-90, and Cs-137.	1

4.0 REACTOR/CRITICALITYFACILITIES/SIGNIFICANT SITES WORKS CITED

4.1 BUILDING 4003

Facility Name	Building No.	Period of Operation	Notes
Engineering Test Building (ETB)	4003	1957-1973	

Building 4003 Cited Documents

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Facility Name	Building No.	Period of Operation	Notes
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Building 4143 Cited Documents

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4.4 SITE 4583-OLD

Facility Name	Building No.	Period of Operation	Notes
Energy Systems Group (ESG) Storage Yard, Old Conservation Yard	4583-Old	1957-1977	

Site 4583-Old Cited Documents

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4.5 SITE 4773

Facility Name	Building No.	Period of Operation	Notes
SRE Pond	4773	1957-1977	

Site 4773 Cited Documents

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

Stelle, A. M., *SRE Activity Requirement No. 27, D & D of Building 143 Retention Pond and Sanitary Sewer*, Rockwell International Report No. N704ACR990024, September 14, 1981, pp. 6-7.

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U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.

Wallace, J. H., *Radiological Survey results – Release to Unrestricted use, SRE Region VII*, Rockwell International Report No. N704TI990033, May 13, 1983, pp. 7-9.

Legend

- HSA Sub-Area 6 Boundary

Centerline Roads
- Primary Roads
- Secondary Roads
- Tertiary Roads

Buildings
- Demolished
- Existing

Surface Water
- Intermittent Stream
- Permanent Stream
- Surface Water
- Lined Channel

Tanks
- Above ground Storage Tank
- Underground Storage Tank
- Unknown Tank Type
- French Drain Holding Tank
- Sump
- Dry Well
- Tank Footprint
- French Drain
- Drainage
- Leach Field
- Septic System

Aerial Photography Data
- Aerial Photography Features
- Septic Tank
- Leach Field / Septic Tank
- Parking Lots
- Drainage
- Drainage Ditch
- Interview Line
- Offsite Seeps and Springs
- Onsite Seeps and Springs
- Drain
- Well

Surface Water Flow
- Surface Water Flow (From Boeing Database, 2008)

Aerial Photography Descriptors

Type	Description
B	Building
CA	Cleared Area
CONT	Container
CR	Crates
DB	Debris
DG	Disturbed Ground
DTM	Dark Tone Material
EX	Excavation
FA	Fill Area
GR	Graded
GS	Ground Scar
HT	Horizontal Tank
IM	Impoundment
LTMM	Light Toned Mounded Material
MTMM	Medium Toned Mounded Material
OS	Open Storage
PA	Processing Area
PL	Pipeline
POSS	Possible
PROB	Probable
SS	Smoke Stack
ST	Stain
S-T	Storage Tank
UO	Unidentified Object
UT	Underground Tank
VT	Vertical Tank
WDA	Waste Disposal Area

Surface Features
- Channel
- Drain
- Drain
- Drainage Divide
- Gutter
- Tank
- Tank
- Vault
- Well

Utilities
- Gas
- Storm Drain
- Sanitary Sewer
- Sanitary Waste
- Water
- Water (Removed)

N

0 50 100 200
Scale In Feet

Historical Site Assessment
Final Technical Memorandum - HSA-6

Plate 1
Subarea HSA-6
Santa Susana Field Laboratory

U.S. EPA Region 9

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

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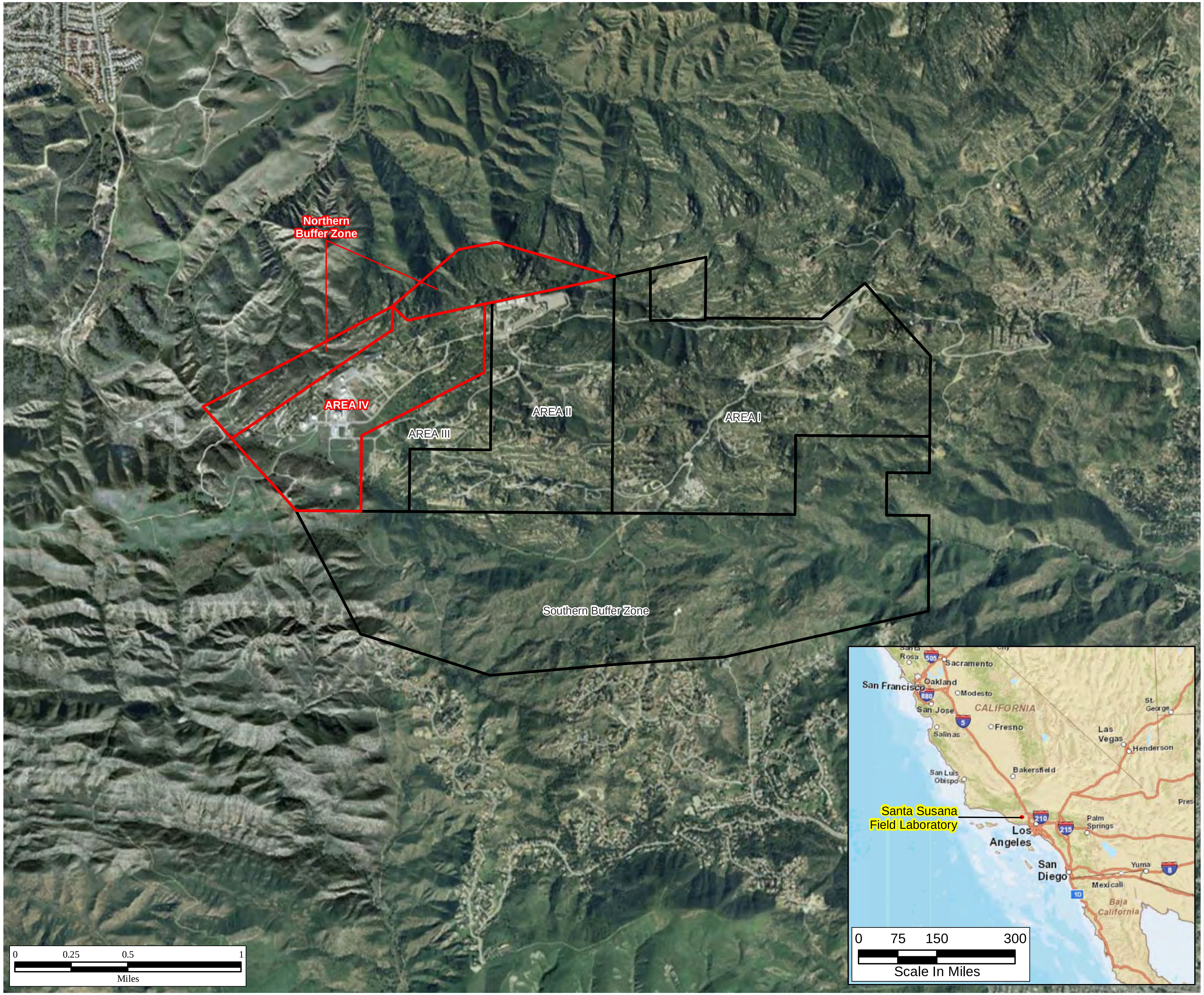
Project: EP9038
Edited: 04/28/11 TJ
Source:Boeing Company, 2008
CIRGIS, 2007

HGL HydroGeoLogic, Inc

Redacted

Figure 1.1
Site Location
Santa Susana Field Laboratory

U.S. EPA Region 9



Legend

EPA Study Area Boundary; Area IV and Northern Buffer Zone

Santa Susana Field Laboratory Property Boundary

N

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Revised: 08/23/2010 TJ
Sorce: CaSil, NAIP 2009; Boeing 2008

HGL HydroGeoLogic, Inc

Redacted

Historical Site Assessment
Final Technical Memorandum - HSA-6

Figure 1.2
General Site Layout for
Area IV/HSA Subareas
Santa Susana Field Laboratory

U.S. EPA Region 9

Legend

HSA Subarea

Buildings

Existing
Removed

0 250 500 1000
Scale In Feet

N

Y:\Santa_Susana\EP9038\TM\HSA_6\(1-02)site_layout.mxd
11/22/2011 tjansen
Project: EP9038
Sorce: Boeing Company, 2008
CIRGIS, 2007

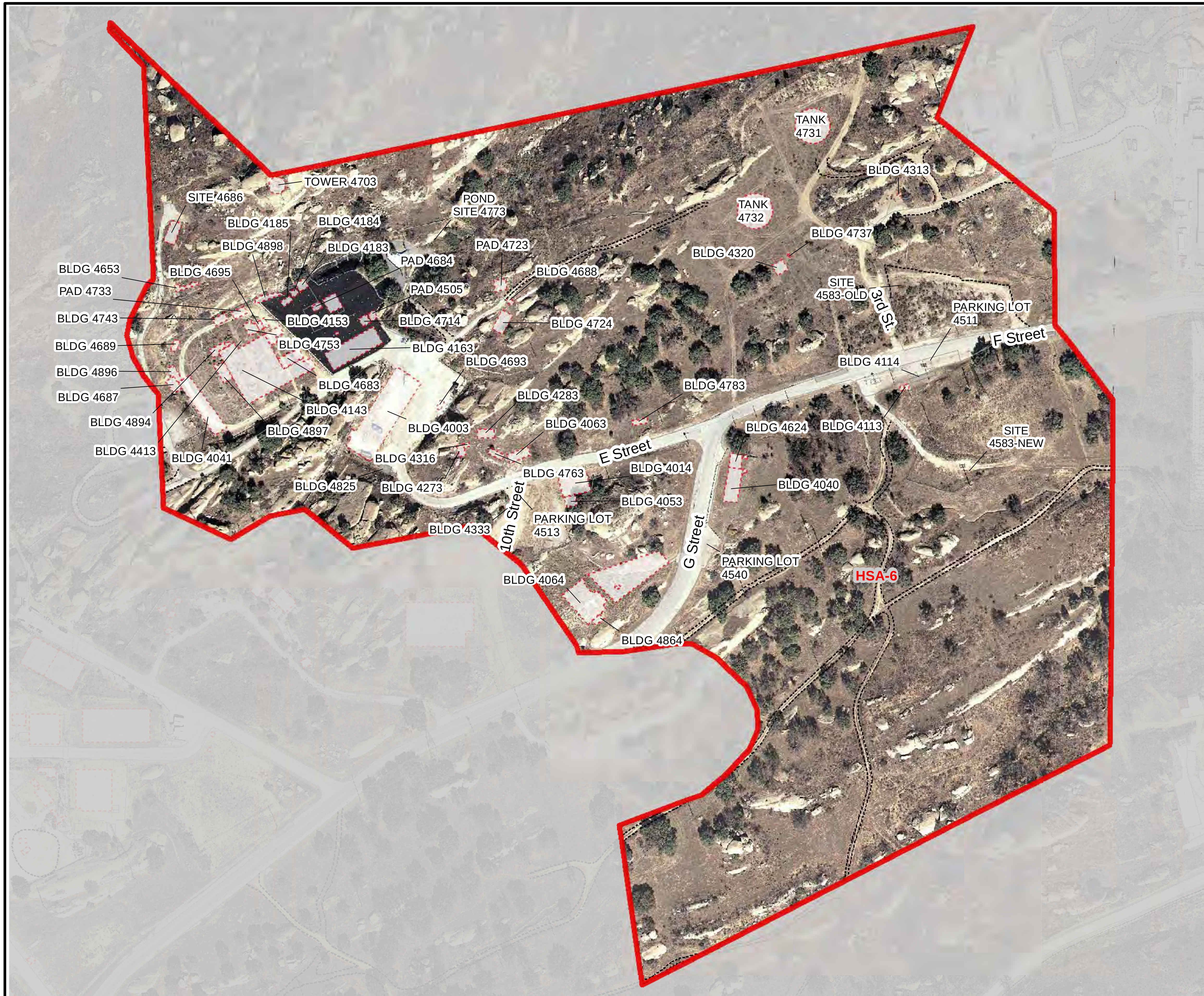
HGL HydroGeoLogic, Inc

Redacted

Historical Site Assessment
Final Technical Memorandum - HSA-6

Figure 1.3
Subarea HSA-6
Santa Susana Field Laboratory

U.S. EPA Region 9



Legend

Buildings

Existing

Removed

N

0 50 100 200

Scale In Feet

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Source:Boeing Company, 2008
CIRGIS, 2007

HGL HydroGeoLogic, Inc

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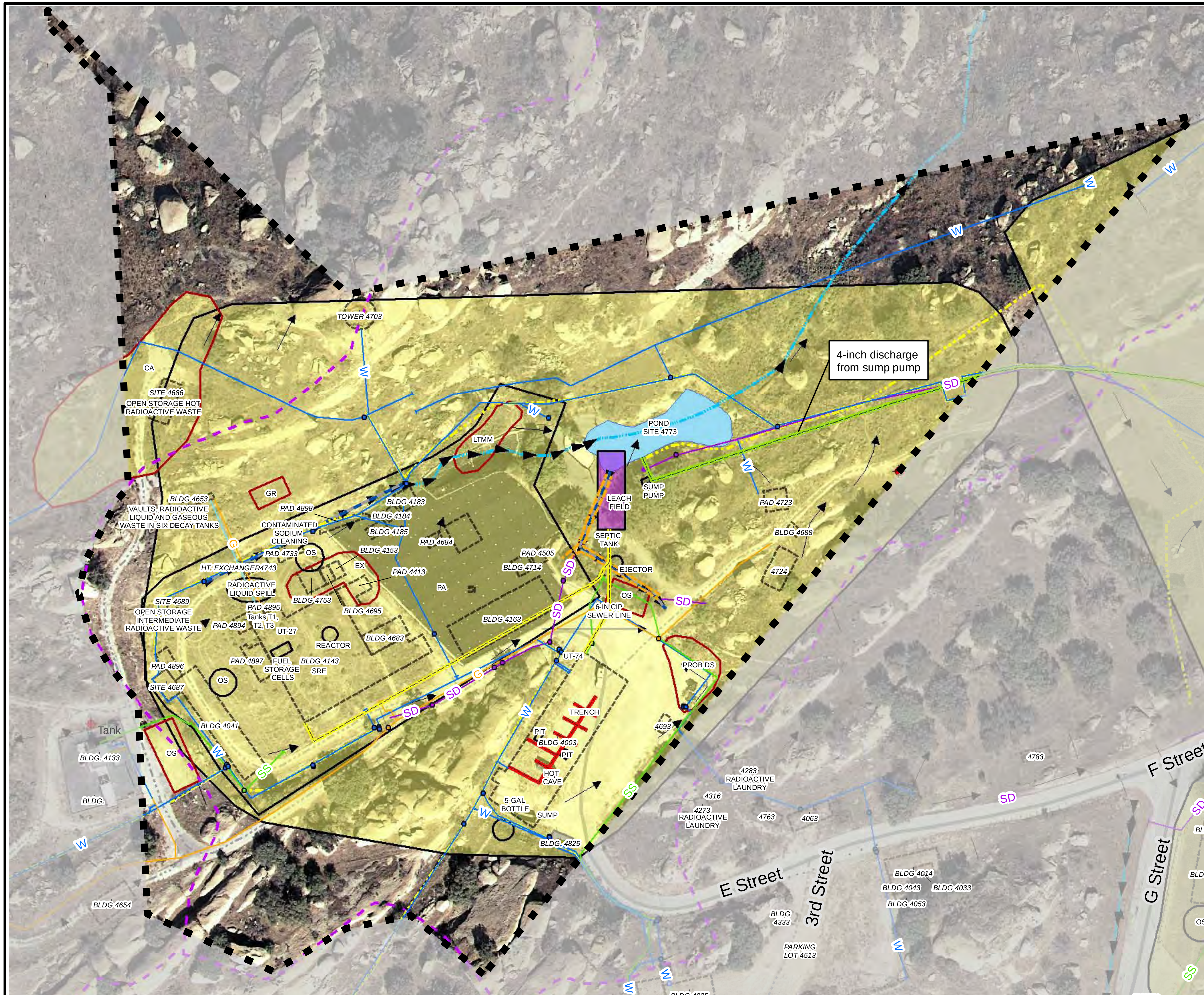

Historical Site Assessment
Final Technical Memorandum - HSA-6

Figure 2.1
Area IV Subarea 6-1
Santa Susana Field Laboratory

U.S. EPA Region 9

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

Legend

- Subarea 6-1 Boundary
- Primary Roads
- Secondary Roads
- Tertiary Roads
- Underground Storage Tank
- Unknown Tank Type
- French Drain Holding Tank
- Sump
- Dry Well
- Tank Footprint
- Above ground Storage Tank
- Demolished Bldg.
- Existing Bldg.
- Parking Lots
- Drainage
- Drainage Ditch
- Interview Line
- Offsite Seeps and Springs
- Onsite Seeps and Springs
- Drain
- Well

B	Building
CA	Cleared Area
CONT	Container
CR	Crates
DB	Debris
DG	Disturbed Ground
DTM	Dark Tone Material
EX	Excavation
FA	Fill Area
GR	Graded
GS	Ground Scar
HT	Horizontal Tank
IM	Impoundment
LTMM	Light Toned Mounded Material
MTMM	Medium Toned Mounded Material
OS	Open Storage
PA	Processing Area
PL	Pipeline
POSS	Possible
PROB	Probable
SS	Smoke Stack
ST	Stain
S-T	Storage Tank
UO	Unidentified Object
UT	Underground Tank
VT	Vertical Tank
WDA	Waste Disposal Area

Aerial Photography Data

- Aerial Photography Features
- Septic Tank
- Leach Field
- Parking Lots

Surface Water

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

Utilities

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

Surface Water Flow
(From Boeing Database, 2008)

0 25 50 100
Scale In Feet

N

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Sorce: Boeing Company, 2008
CIRGIS, 2007

HGL
HydroGeoLogic, Inc

Redacted

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Revised: 10/20/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.1a
Building 4003
Site Photograph

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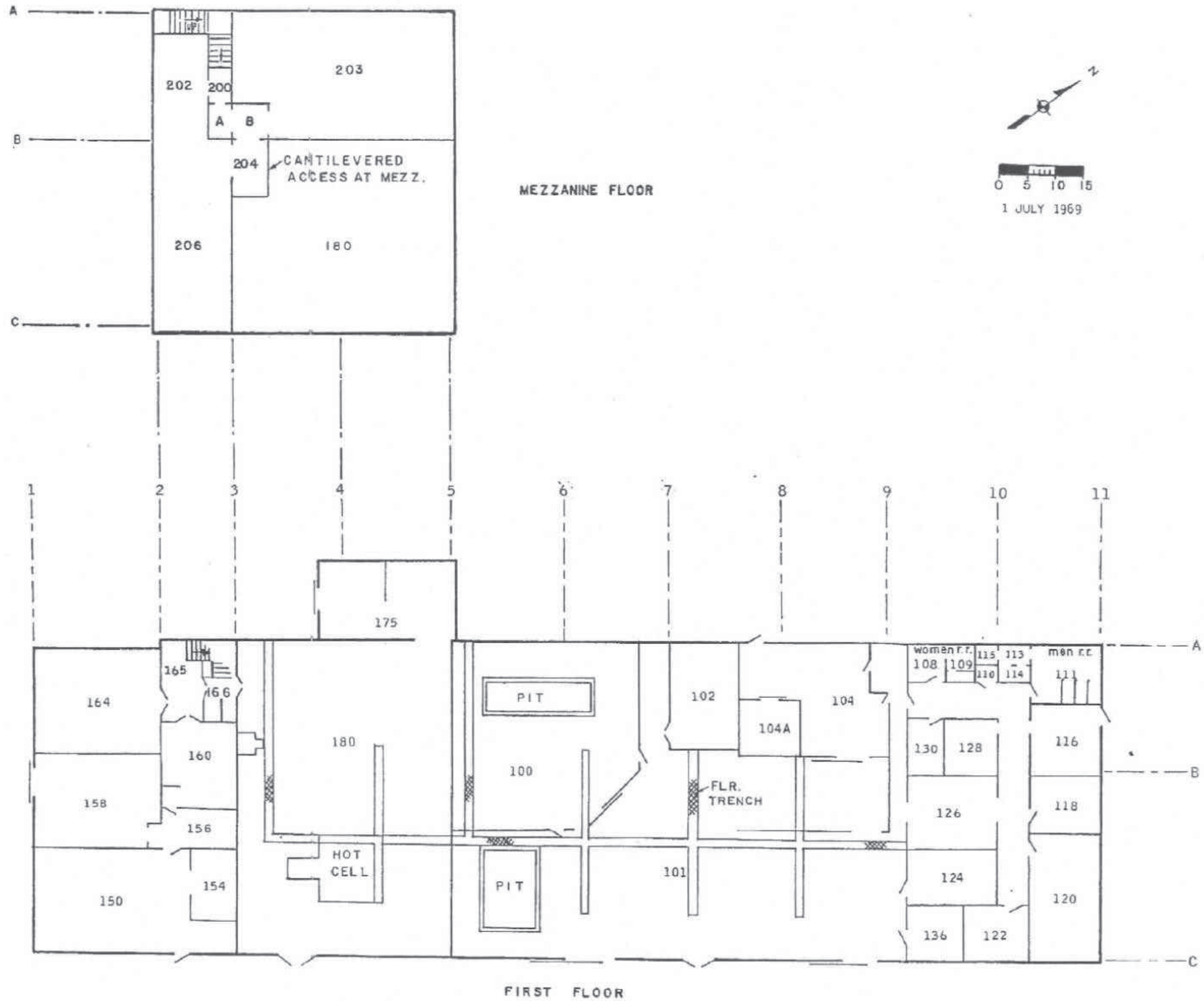

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U.S. EPA Region 9

Figure 2.1.1b
Building 4003
Floor Plan

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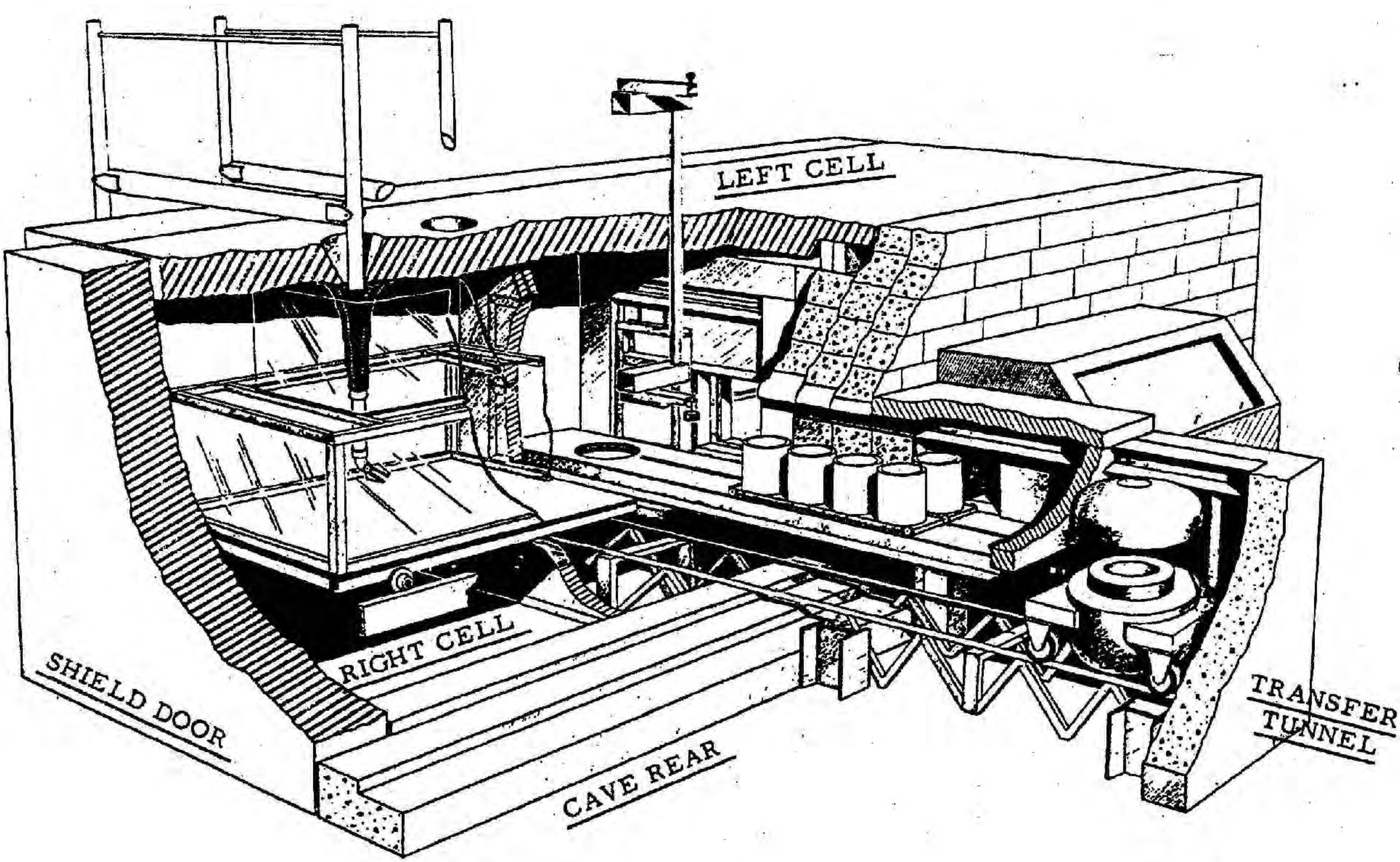
Revised: 09/02/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.1c
Building 4003
Aerial Photograph
1974

Redacted



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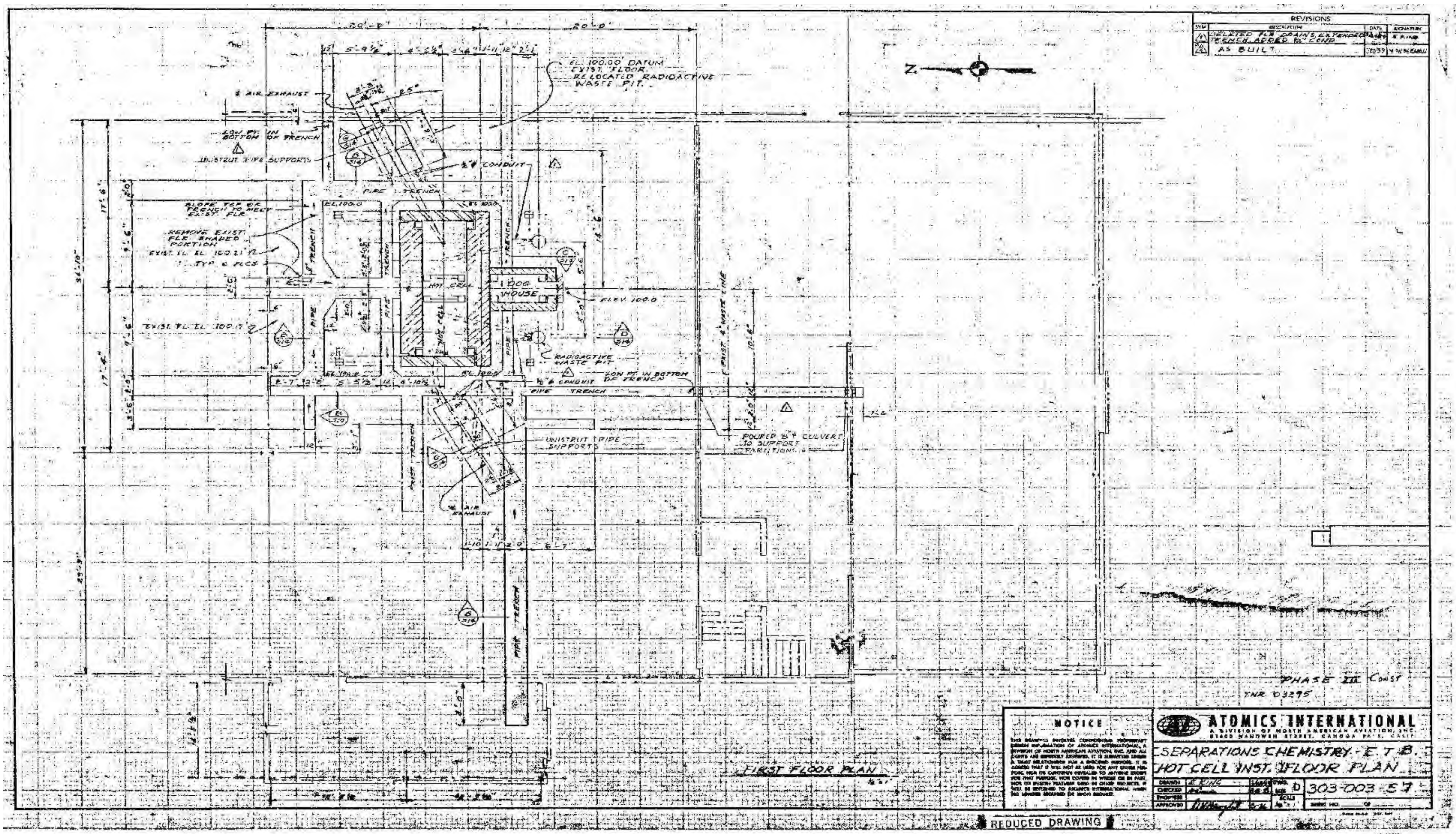
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.1d
Building 4003
Hot Cave Layout

Redacted



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U.S. EPA Region 9

Figure 2.1.1e
Building 4003
Hot Cell (Cave)
Floor Plan

Redacted

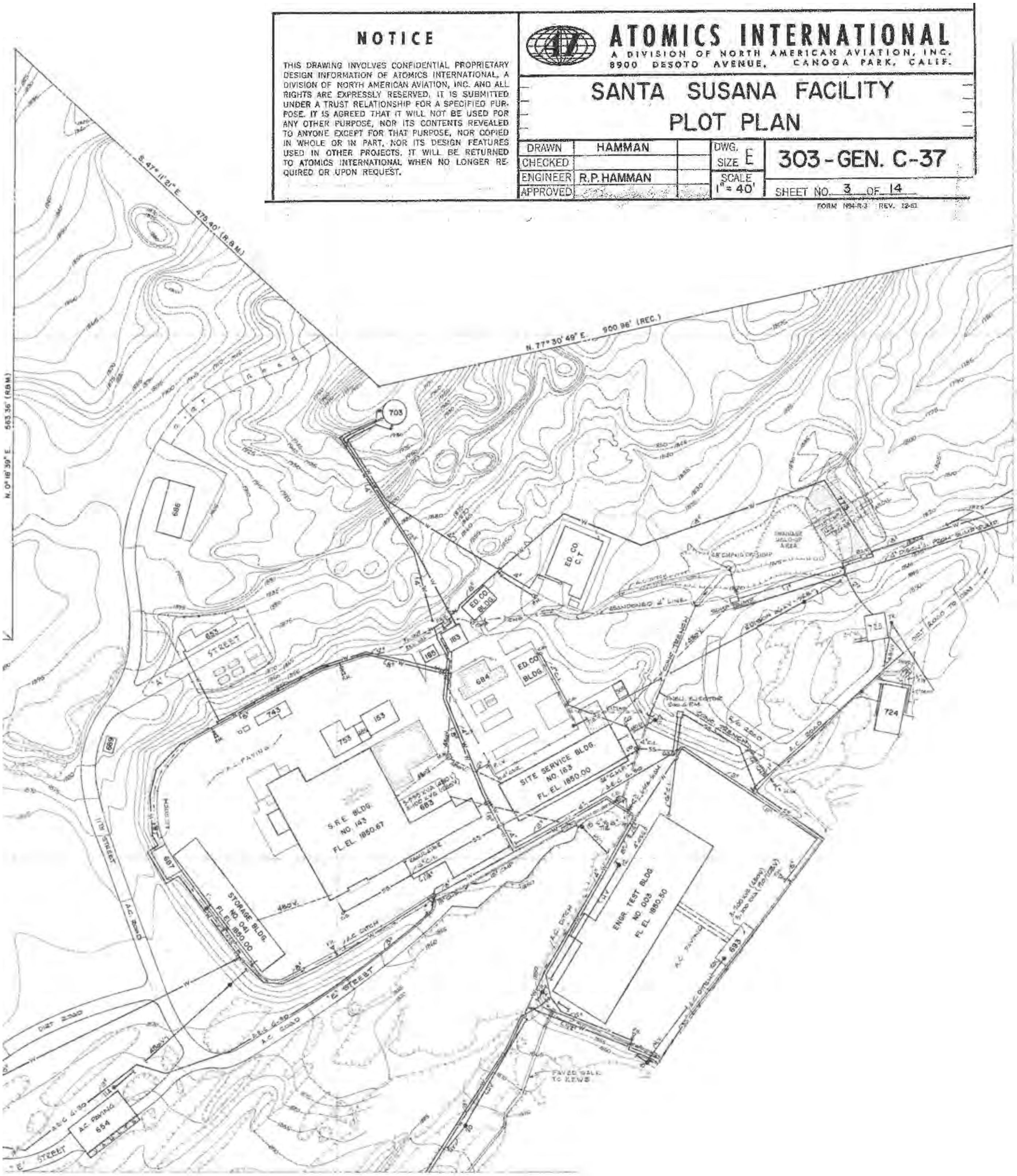

Figure 2.1.1f
Building 4003
Plot Plan

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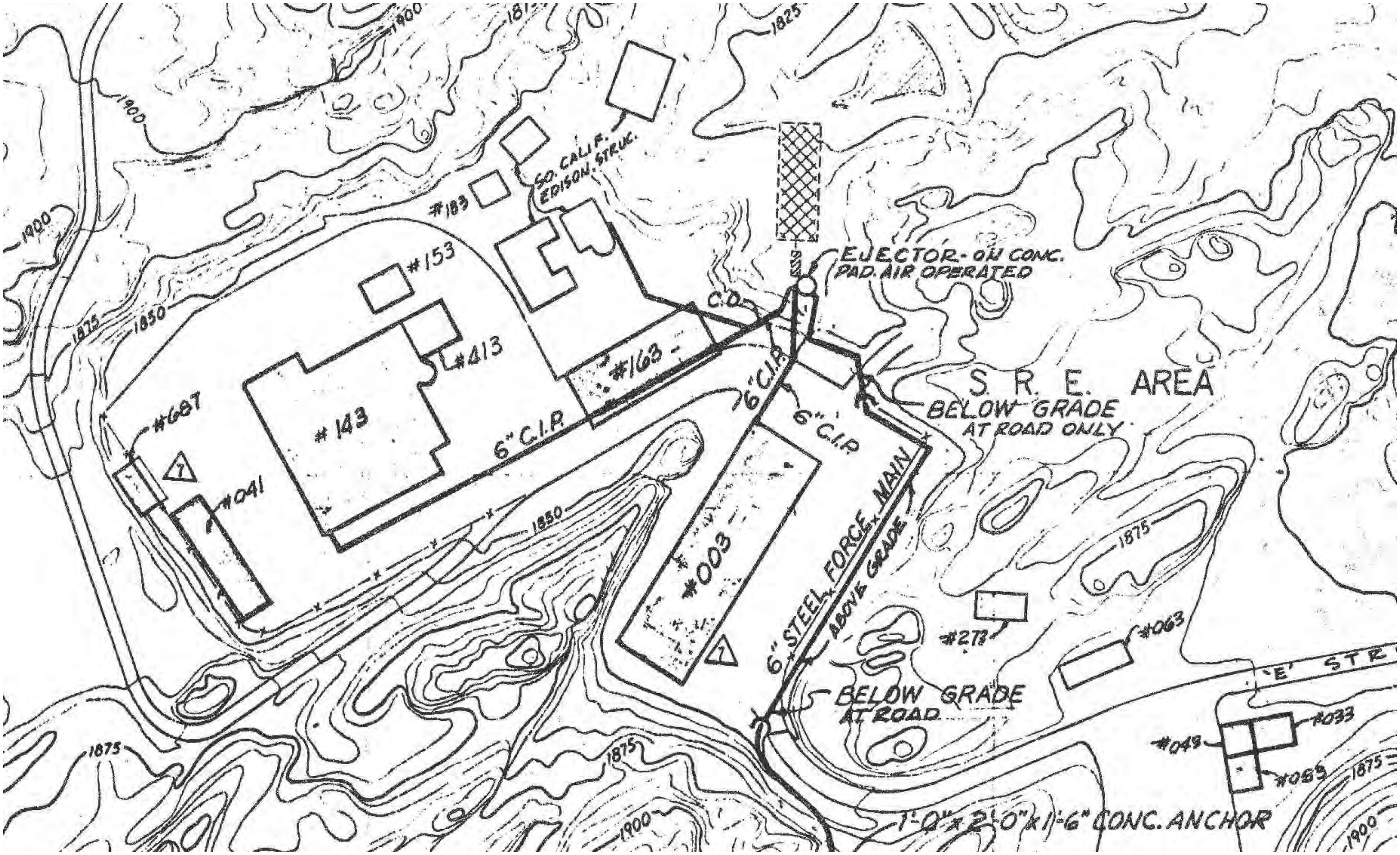

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Figure 2.1.1g
Building 4003
Sewage System

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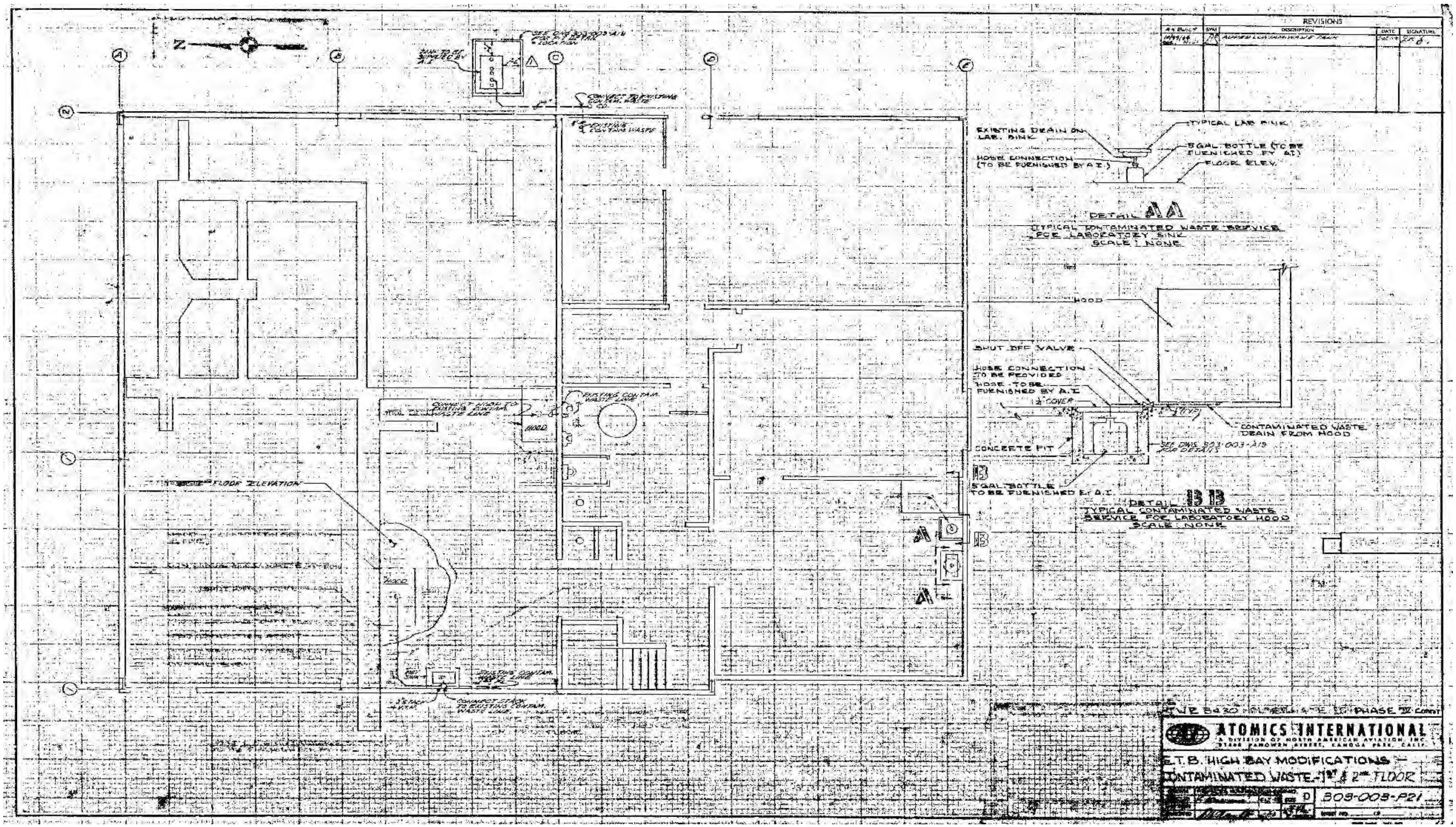

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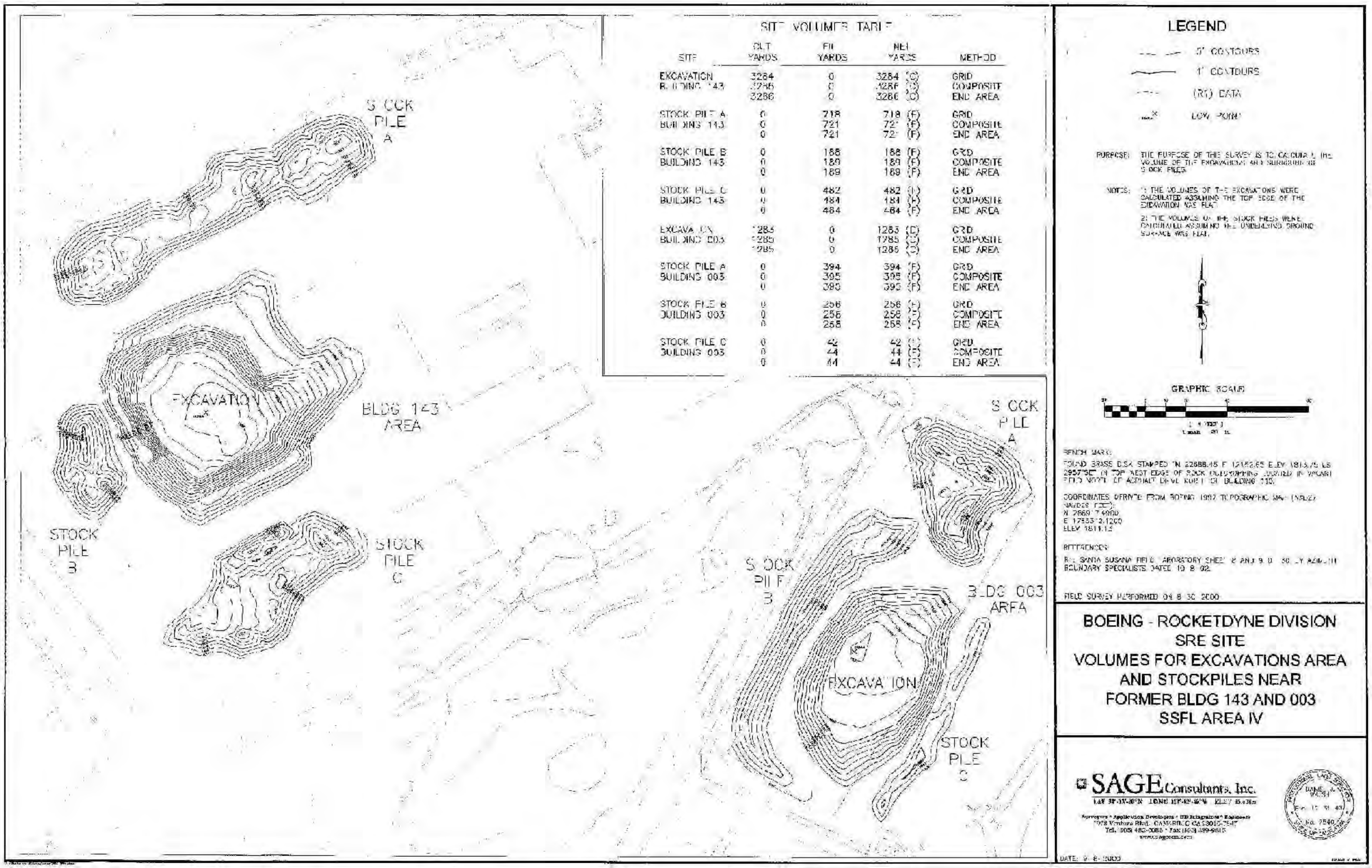
U.S. EPA Region 9

Figure 2.1.1h
Building 4003
Contaminated
Waste Lines



SITE VOLUME TABLE

SITE	CUT YARDS	FILL YARDS	NET YARDS	METHOD
EXCAVATION BUILDING 143	3284	0	3284 (C)	GRID
	3286	0	3286 (C)	COMPOSITE
	3286	0	3286 (C)	END AREA
STOCK PILE A BUILDING 143	0	718	718 (F)	GRID
	0	721	721 (F)	COMPOSITE
	0	721	721 (F)	END AREA
STOCK PILE B BUILDING 143	0	188	188 (F)	GRID
	0	189	189 (F)	COMPOSITE
	0	189	189 (F)	END AREA
STOCK PILE C BUILDING 143	0	482	482 (F)	GRID
	0	484	484 (F)	COMPOSITE
	0	484	484 (F)	END AREA
EXCAVATION BUILDING 003	1283	0	1283 (C)	GRID
	1285	0	1285 (C)	COMPOSITE
	1285	0	1285 (C)	END AREA
STOCK PILE A BUILDING 003	0	394	394 (F)	GRID
	0	395	395 (F)	COMPOSITE
	0	395	395 (F)	END AREA
STOCK PILE B BUILDING 003	0	256	256 (F)	GRID
	0	258	258 (F)	COMPOSITE
	0	258	258 (F)	END AREA
STOCK PILE C BUILDING 003	0	42	42 (F)	GRID
	0	44	44 (F)	COMPOSITE
	0	44	44 (F)	END AREA

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Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.1i
Building 4003
Excavation Area
2000

Redacted

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Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.2a
Building 4041
Site Photograph

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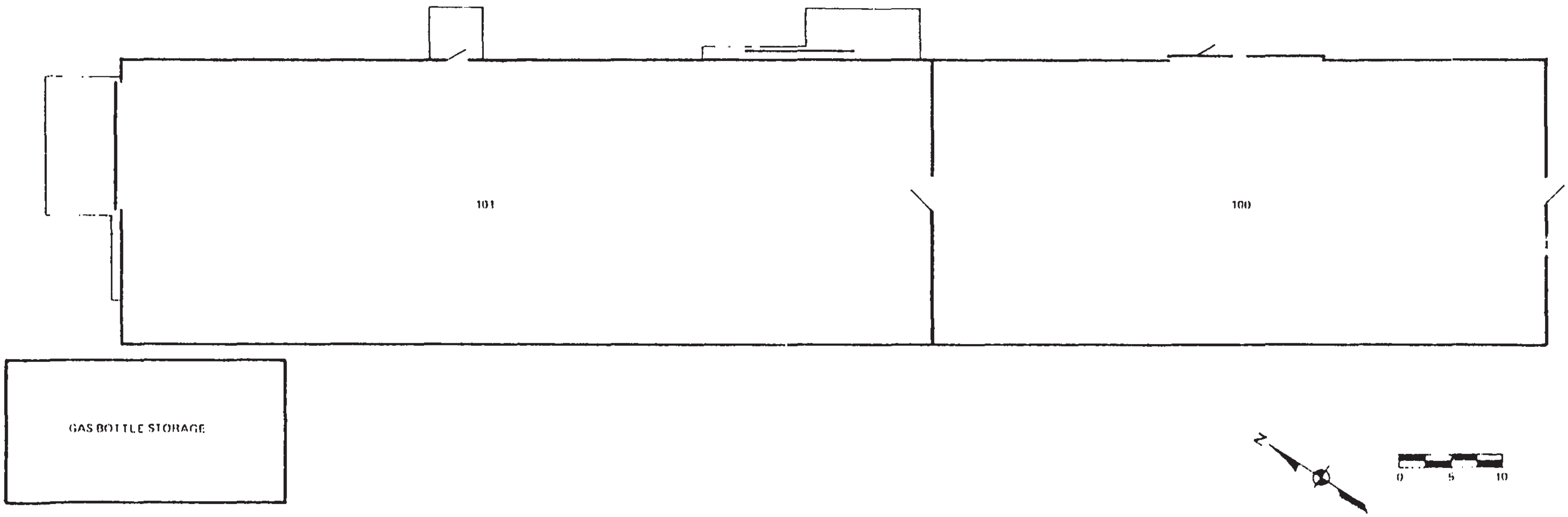

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Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.2b
Building 4041
Floor Plan

Redacted

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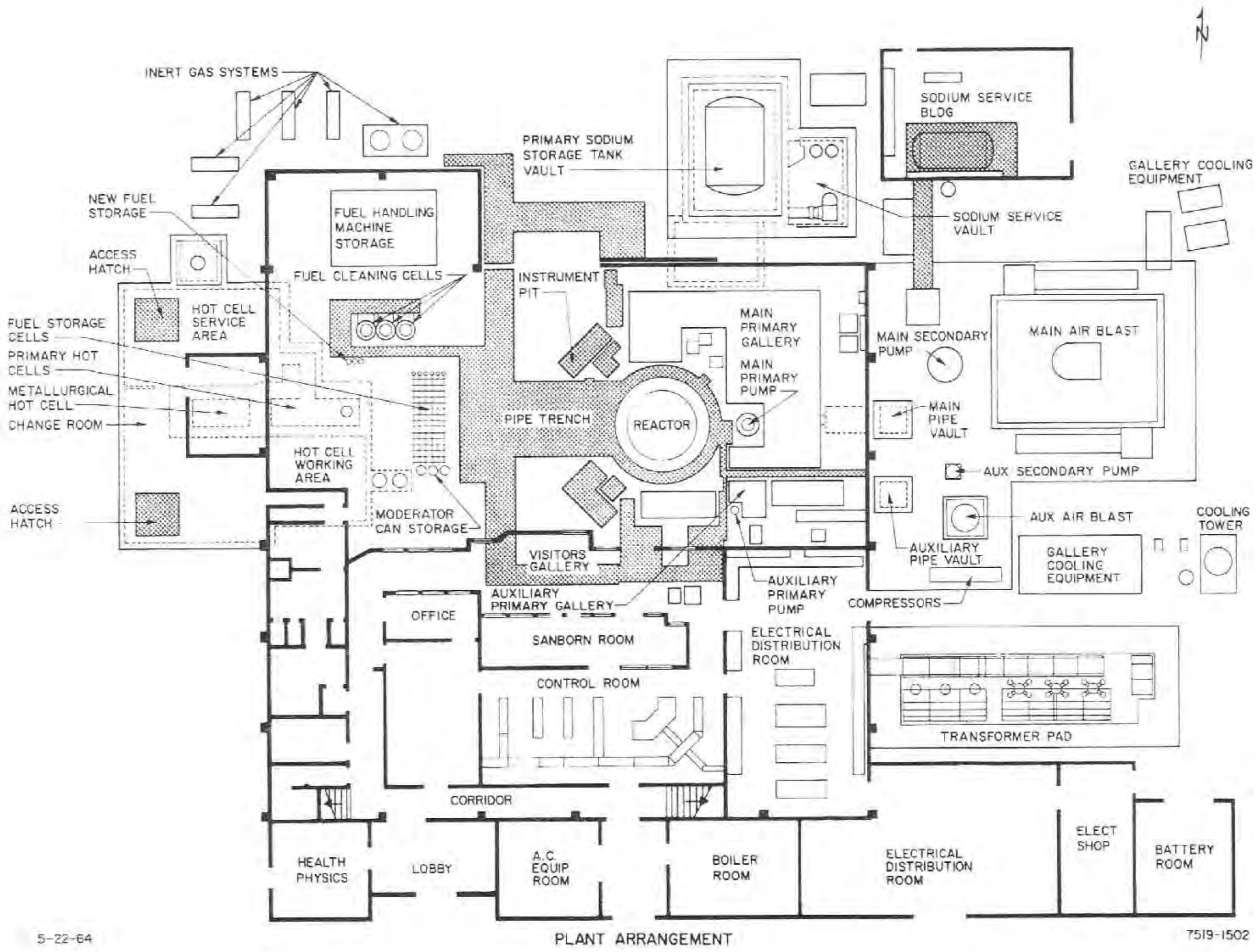
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.3a
Building 4143,
4153, 4695
Site Photograph

Redacted



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Source: Boeing Company, 2008

U.S. EPA Region 9

Sodium Reactor Experiment Building

Figure 2.1.3b
Building 4143
Floor Plan

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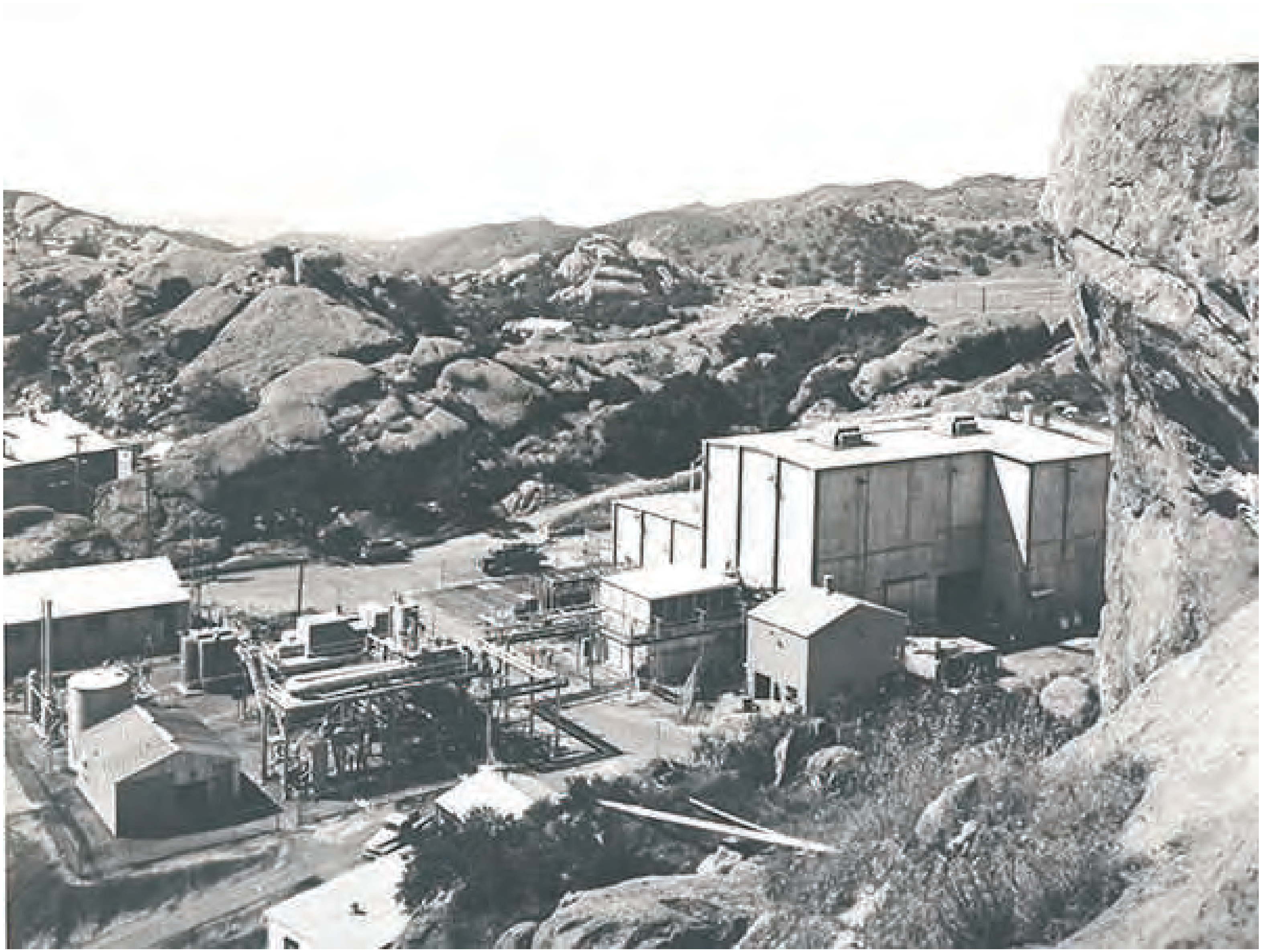

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Source: Boeing Company, 2008

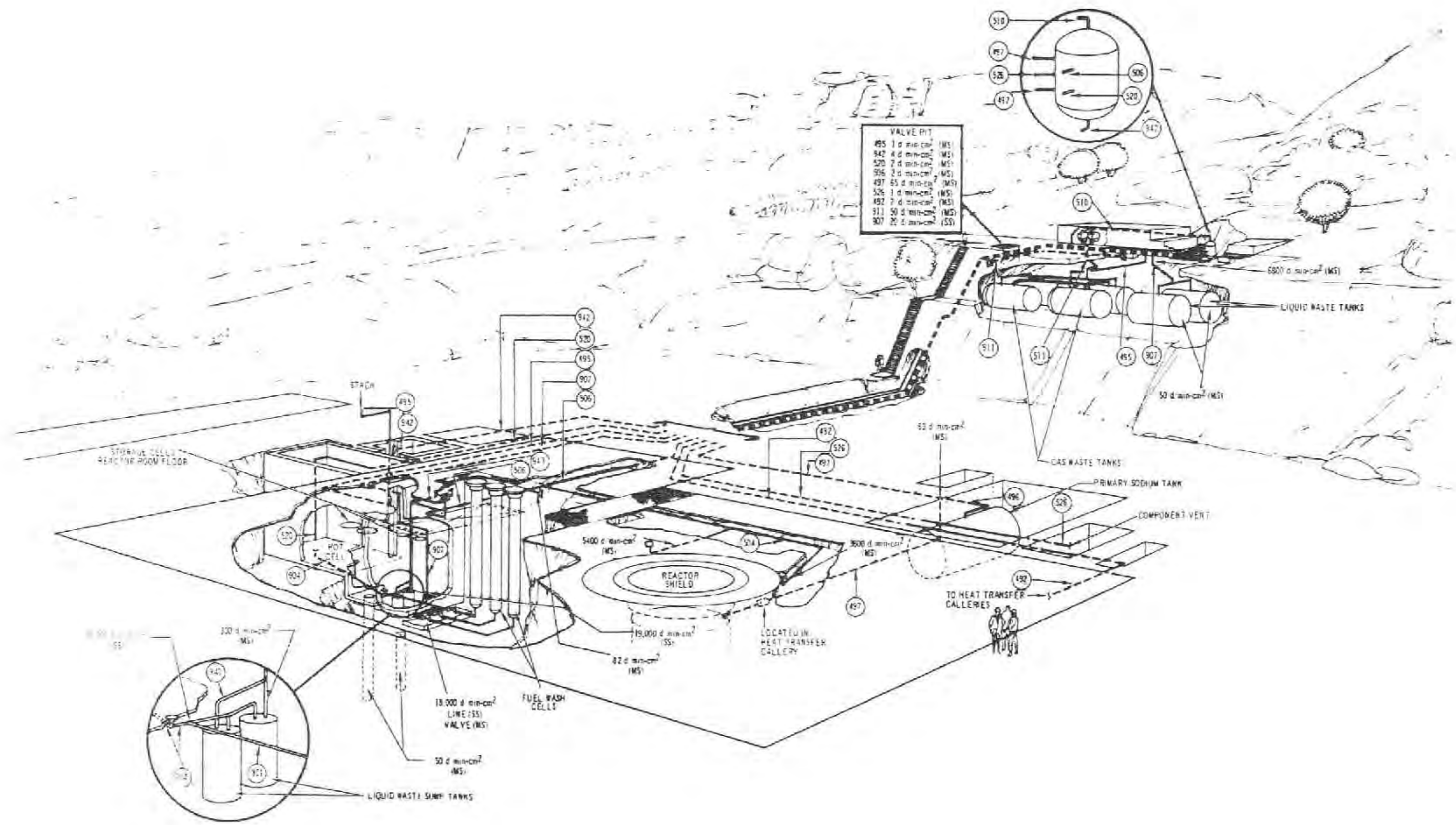
U.S. EPA Region 9

Sodium Reactor Experiment Building

Figure 2.1.3c
Building 4143
Historical Photograph
1962

Redacted

Figure Not to Scale



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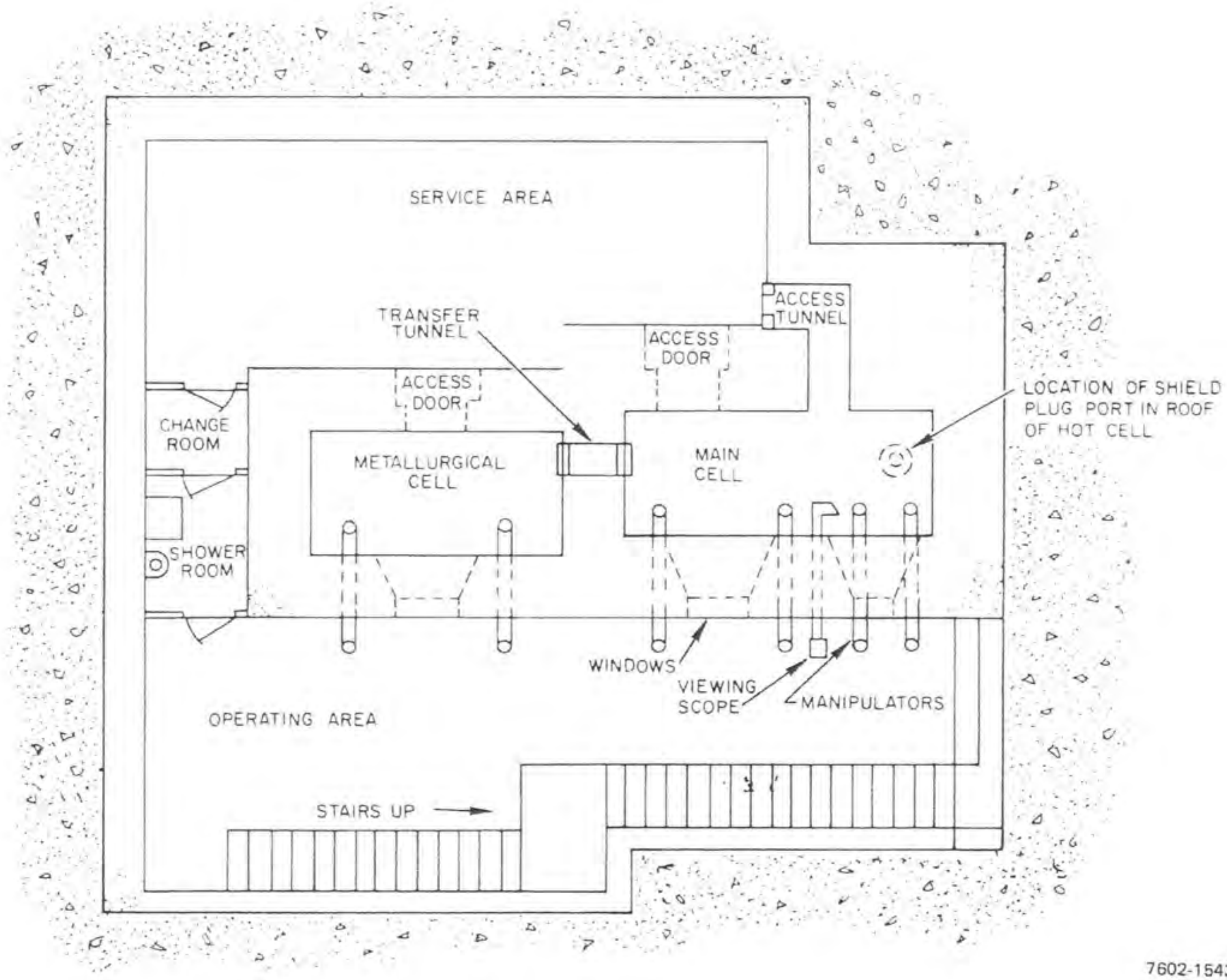
U.S. EPA Region 9

Sodium Reactor Experiment Building

Figure 2.1.3d
Building 4143
Radioactive Liquid
Waste and Vent System

Redacted



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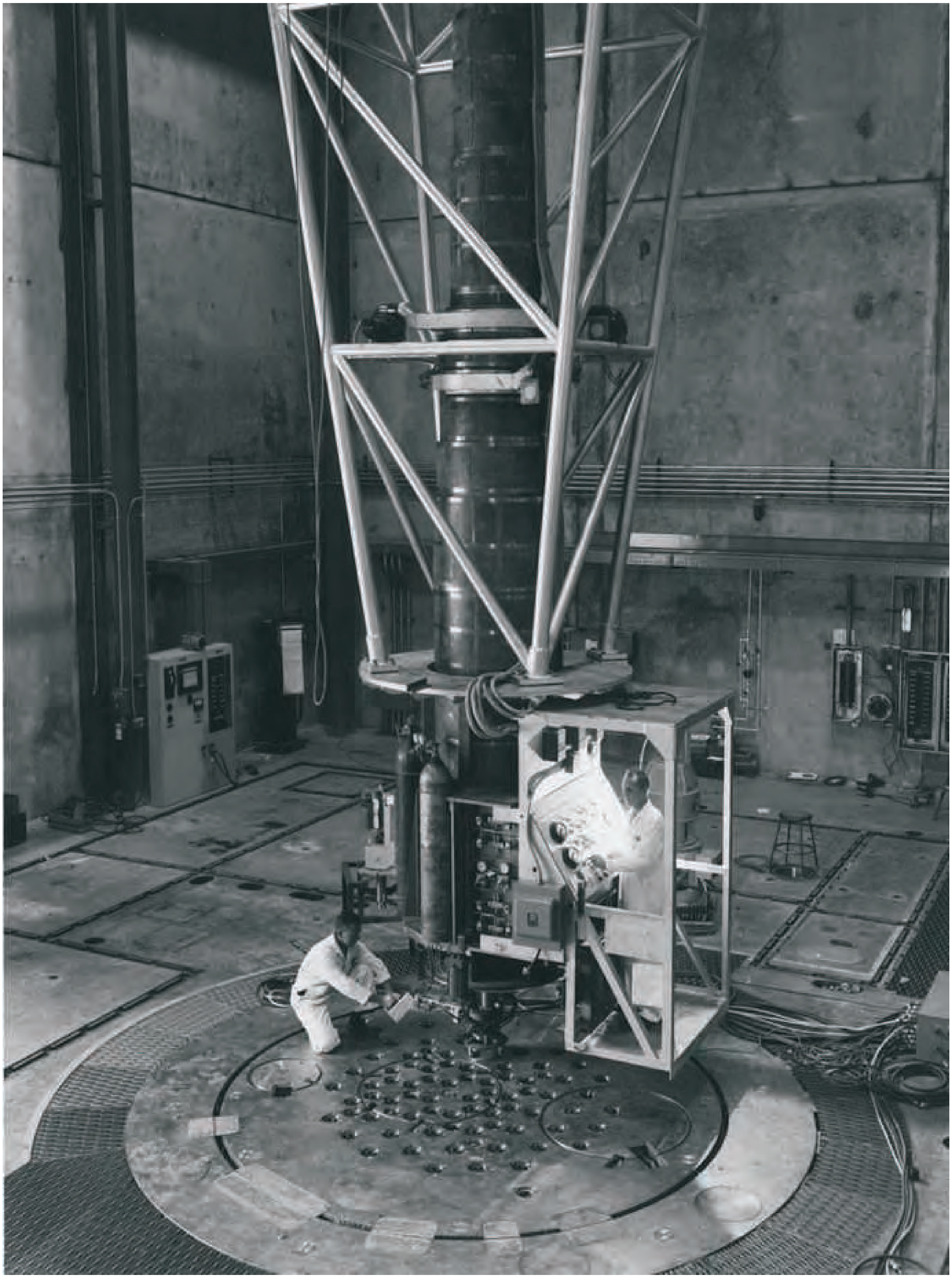
Source: Boeing Company, 2008

U.S. EPA Region 9

Sodium Reactor Experiment Building

Figure 2.1.3e
Building 4143
Hot Cells

Redacted



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Revised: 05/23/11 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Sodium Reactor Experiment Building
High Bay

Figure 2.1.3f
Building 4143
Fuel Rod Removal

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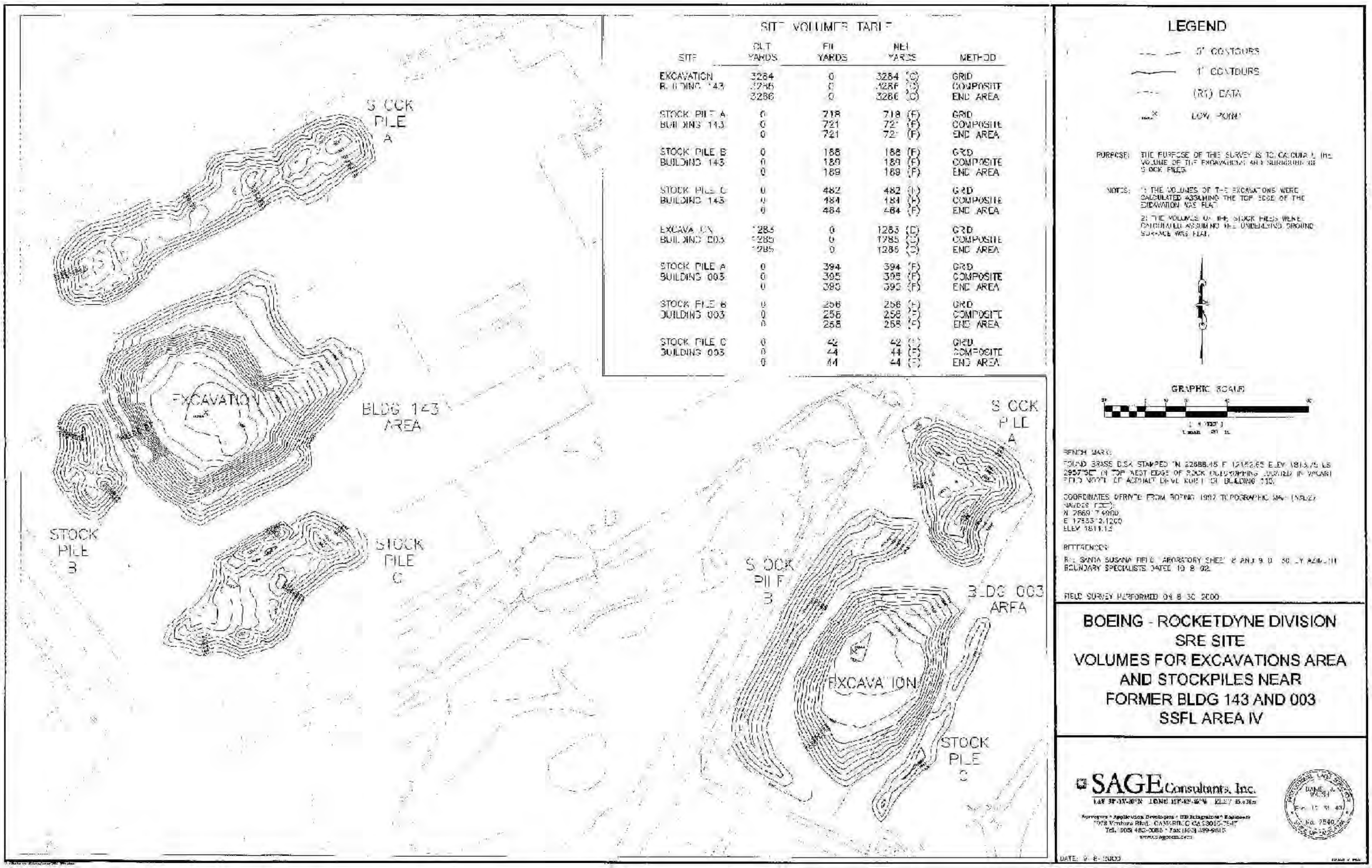
Project:EP9038
Revised: 05/23/2011 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.3g
Building 4143
Reactor Core Removal
1977



SITE VOLUME TABLE

SITE	CUT YARDS	FILL YARDS	NET YARDS	METHOD
EXCAVATION BUILDING 143	3284	0	3284 (C)	GRID
	3286	0	3286 (C)	COMPOSITE
	3286	0	3286 (C)	END AREA
STOCK PILE A BUILDING 143	0	718	718 (F)	GRID
	0	721	721 (F)	COMPOSITE
	0	721	721 (F)	END AREA
STOCK PILE B BUILDING 143	0	188	188 (F)	GRID
	0	189	189 (F)	COMPOSITE
	0	189	189 (F)	END AREA
STOCK PILE C BUILDING 143	0	482	482 (F)	GRID
	0	484	484 (F)	COMPOSITE
	0	484	484 (F)	END AREA
EXCAVATION BUILDING 003	1283	0	1283 (C)	GRID
	1285	0	1285 (C)	COMPOSITE
	1285	0	1285 (C)	END AREA
STOCK PILE A BUILDING 003	0	394	394 (F)	GRID
	0	395	395 (F)	COMPOSITE
	0	395	395 (F)	END AREA
STOCK PILE B BUILDING 003	0	256	256 (F)	GRID
	0	256	256 (F)	COMPOSITE
	0	256	256 (F)	END AREA
STOCK PILE C BUILDING 003	0	42	42 (F)	GRID
	0	44	44 (F)	COMPOSITE
	0	44	44 (F)	END AREA

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Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.3h
Building 4143
Excavation Area
2000

Redacted

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Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.3i
Building 4143
Shielding
Excavation
1979

Redacted

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Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.3j
Building 4143
Fuel Storage Cell
Concrete Excavation
1979

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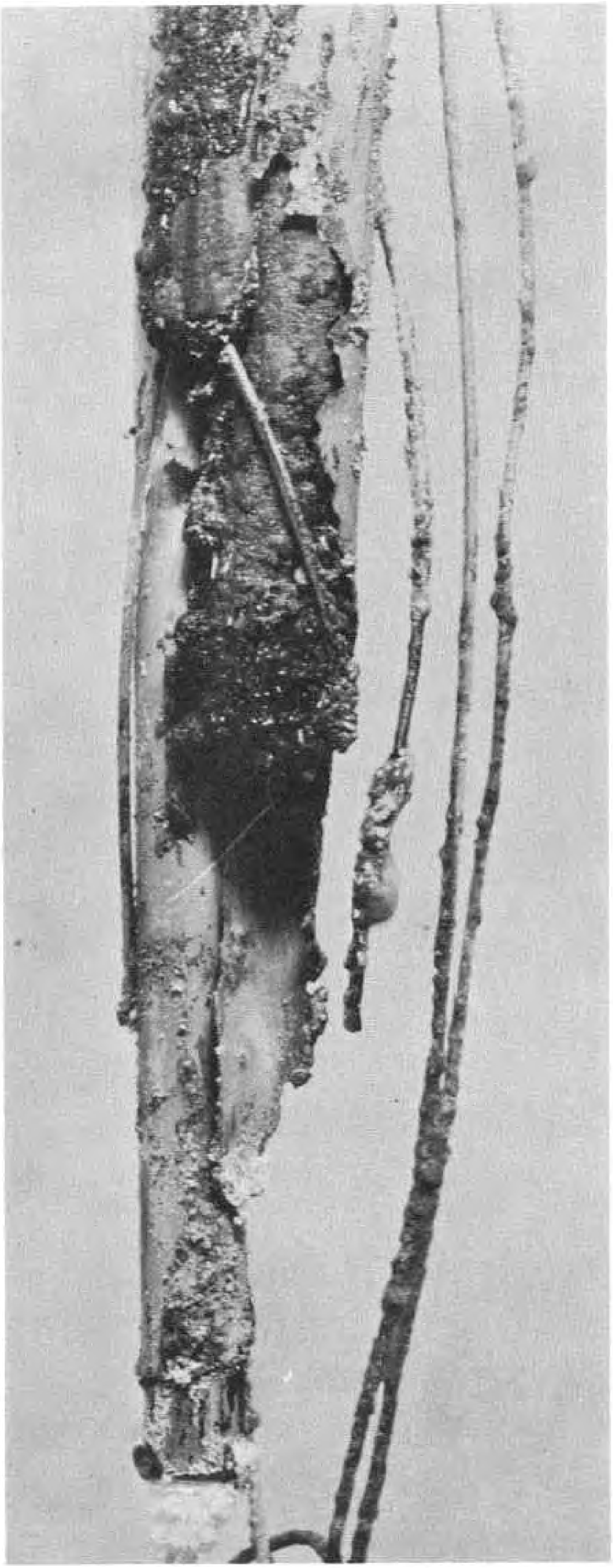
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.3k
Building 4143
Below-ground
Excavation
1979

Redacted



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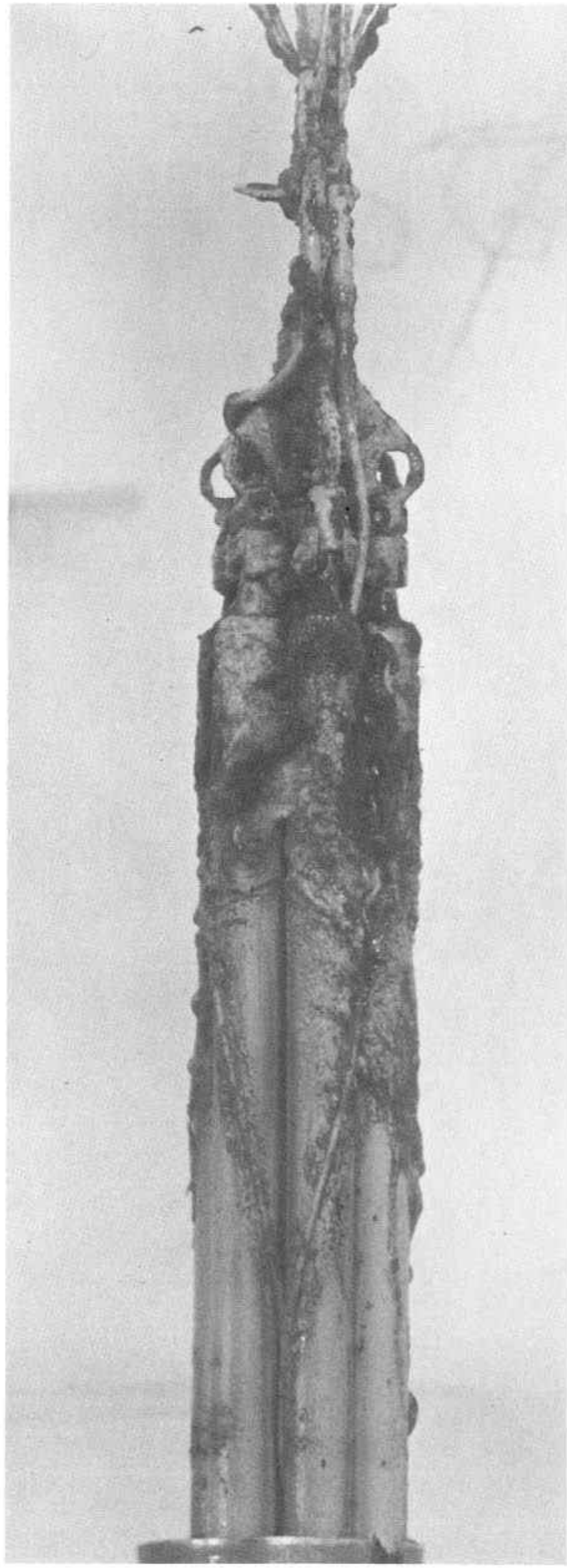
U.S. EPA Region 9

**Figure 2.1.3l
Building 4143
Drainage to Bottom
Midsection of Fuel
Element in Channel 55**



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Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.3m
Building 4143
Damage to Top of Fuel Element in Channel 55

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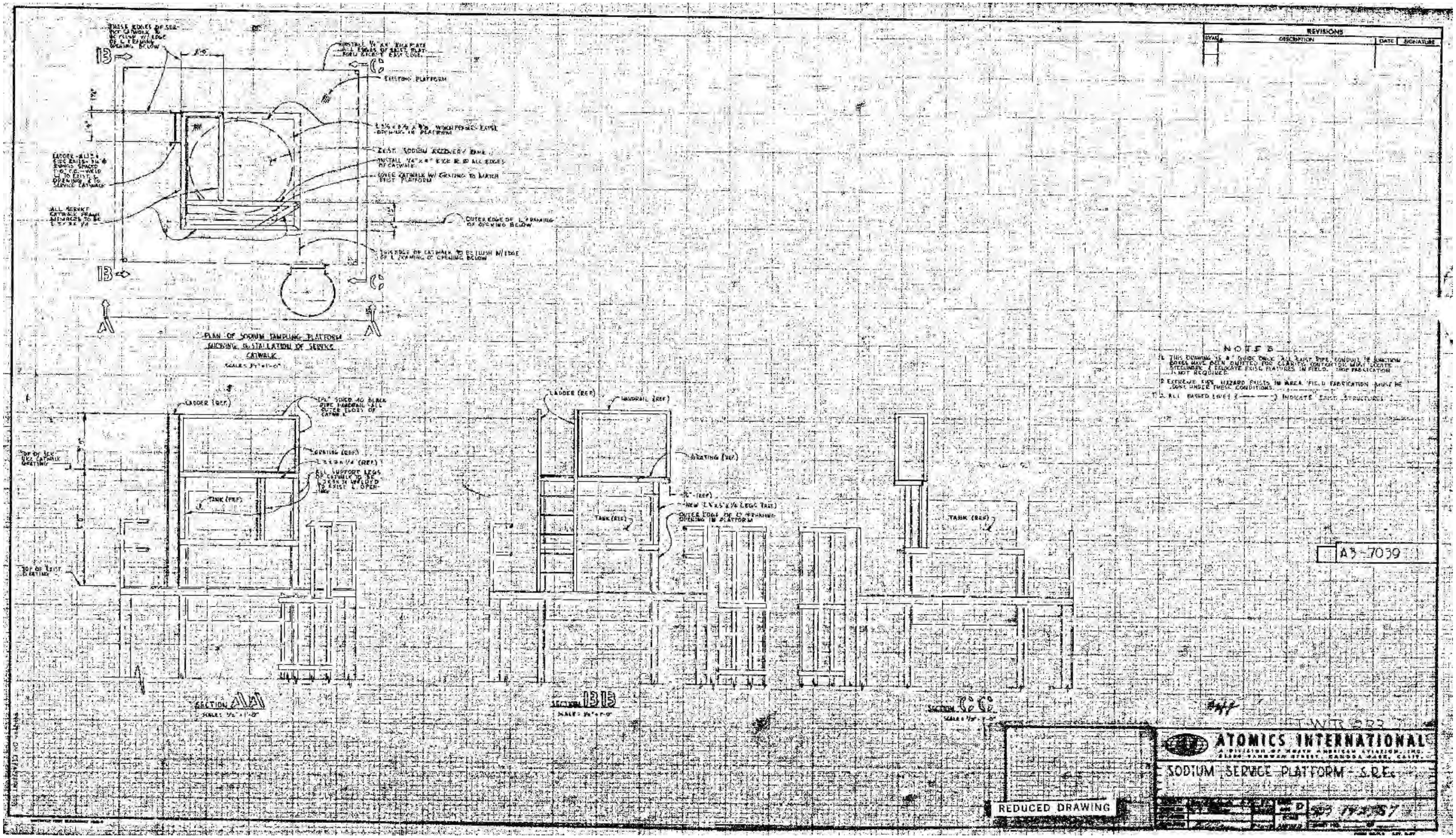
Revised: 10/20/2010 TJ
Source: Boeing Company, 2008*

U.S. EPA Region 9

**Figure 2.1.4a
Building 4143,
4153, 4695
Site Photograph**

Redacted



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Revised: 04/25/2011 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.4b
Building 4153
Site Layout

Redacted

Y:/Santa_Susana/EP9038/TM/HSA_6
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Project:EP9038
Revised: 04/25/2011 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.4c
Building 4153
Above-ground
Demolition

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Project:EP9038
Revised: 04/25/2011 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.4d
Building 4153
Below-ground
Demolition

Redacted

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Revised: 04/25/2011 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.4e
Building 4153
Site After
Demolition

Redacted

Y:/Santa_Susana/EP9038/TM/HSA_6
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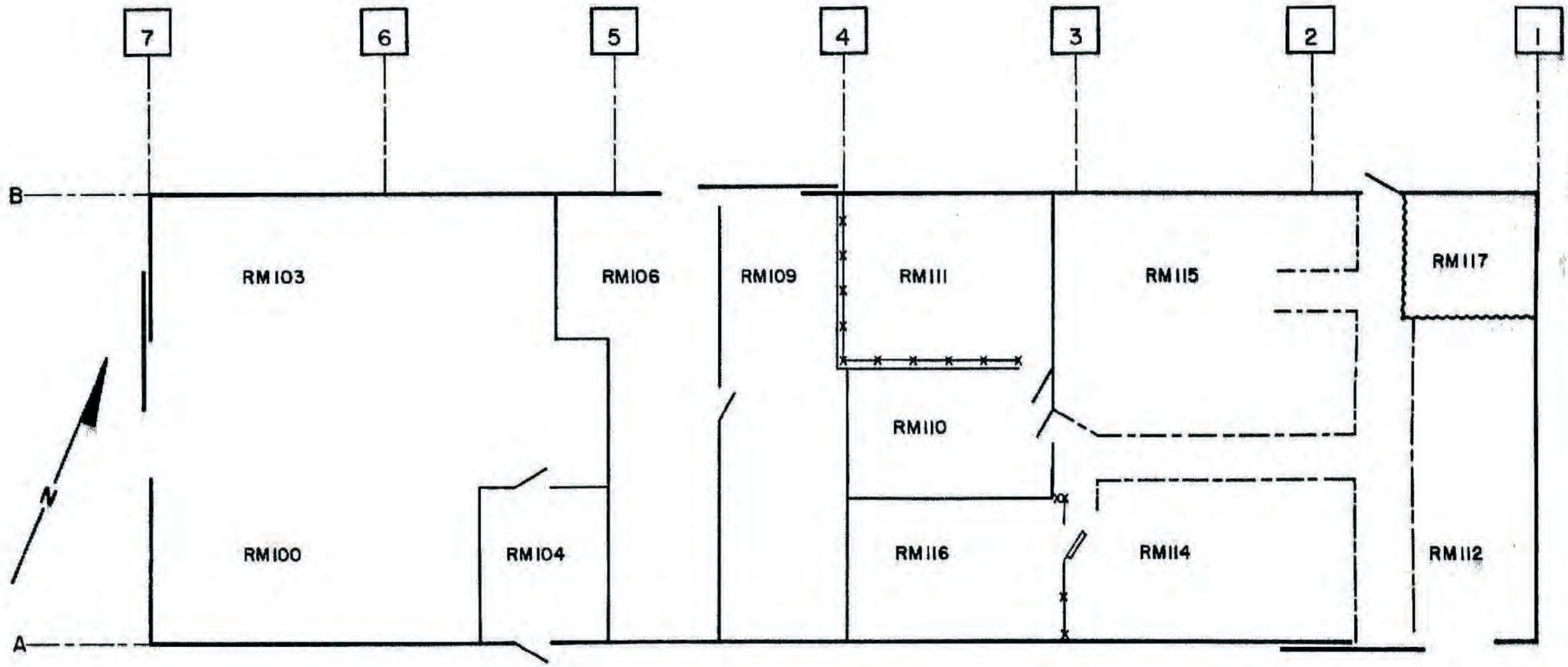
Project:EP9038
Revised: 10/20/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.5a
Building 4163, 4183,
4184, 4185, 4684
Site Photograph

Redacted

Figure Not to Scale



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Project:EP9038
Revised: 09/02/10 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Component Equipment Repair Facility (CERF)

Figure 2.1.5b
Building 4163
Floor Plan

Redacted

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Project:EP9038
Revised: 04/08/2011 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.5c
Building 4163
Aerial Photograph
1977

Redacted

Y:/Santa_Susana/EP9038/TM/HSA_6
(2-1-6a)bldg4163AP.cdr
Project:EP9038
Revised: 10/20/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.6a
Building 4163, 4183, 4184, 4185, 4684
Site Photograph

Redacted

Y:/Santa_Susana/EP9038/TM/HSA_6
(2-1-6b)bldg4183AP.cdr
Project:EP9038
Revised: 09/02/10 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Fire Pump Building

Figure 2.1.6b
Building 4183
Historical Photograph
1975

Y:/Santa_Susana/EP9038/TM/HSA_6
(2-1-7a)bldg4163AP.cdr
Project:EP9038
Revised: 10/20/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.7a
Building 4163, 4183, 4184, 4185, 4684
Site Photograph

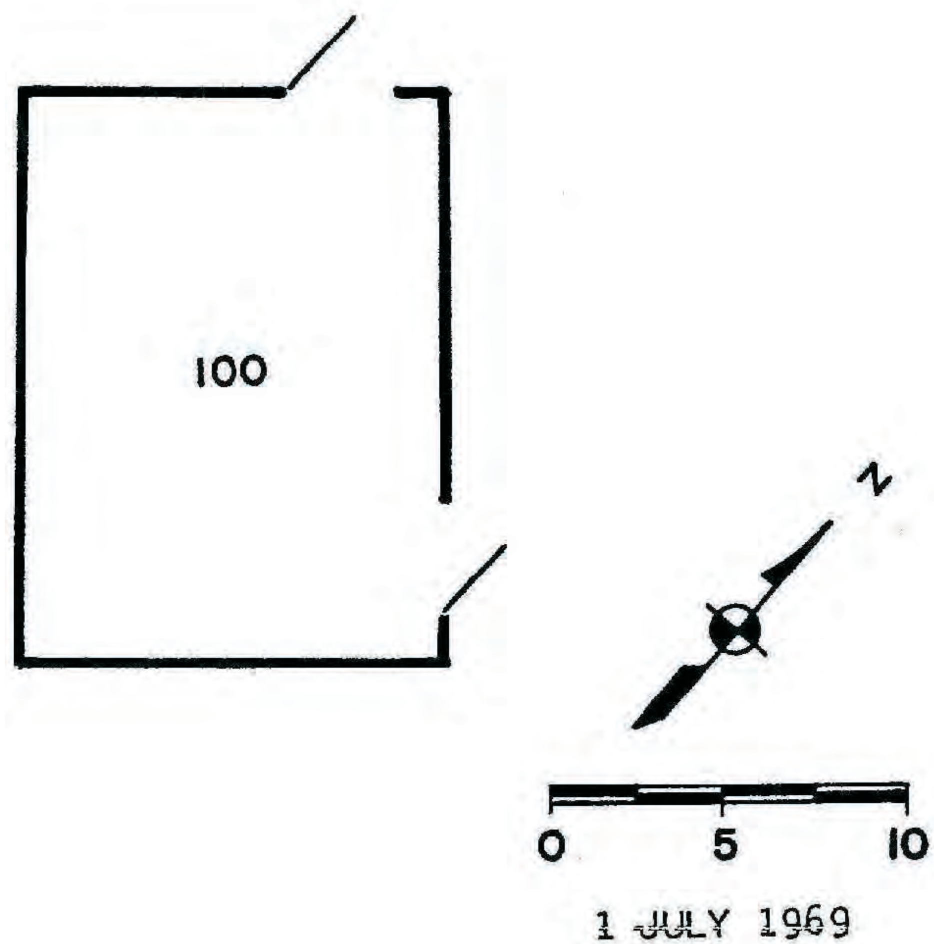
Y:/Santa_Susana/EP9038/TM/HSA_6
(2-1-8a)bldg4163AP.cdr
Project:EP9038
Revised: 04/08/2011 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.8a
Building 4163, 4183, 4184, 4185, 4684
Site Photograph

Redacted

Figure Not to Scale



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Revised: 09/02/10 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Steam Generator Control Building

Figure 2.1.8b
Building 4185
Floor Plan

Y:/Santa_Susana/EP9038/TM/HSA_6
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Project:EP9038
Revised: 10/20/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.9a
Building 4505,
Site 4714
Site Photograph

Redacted

Y:/Santa_Susana/EP9038/TM/HSA_6
(2-1-10a)Bldg4653AP.cdr
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Revised: 10/27/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.10a
Building 4653
Site Photograph

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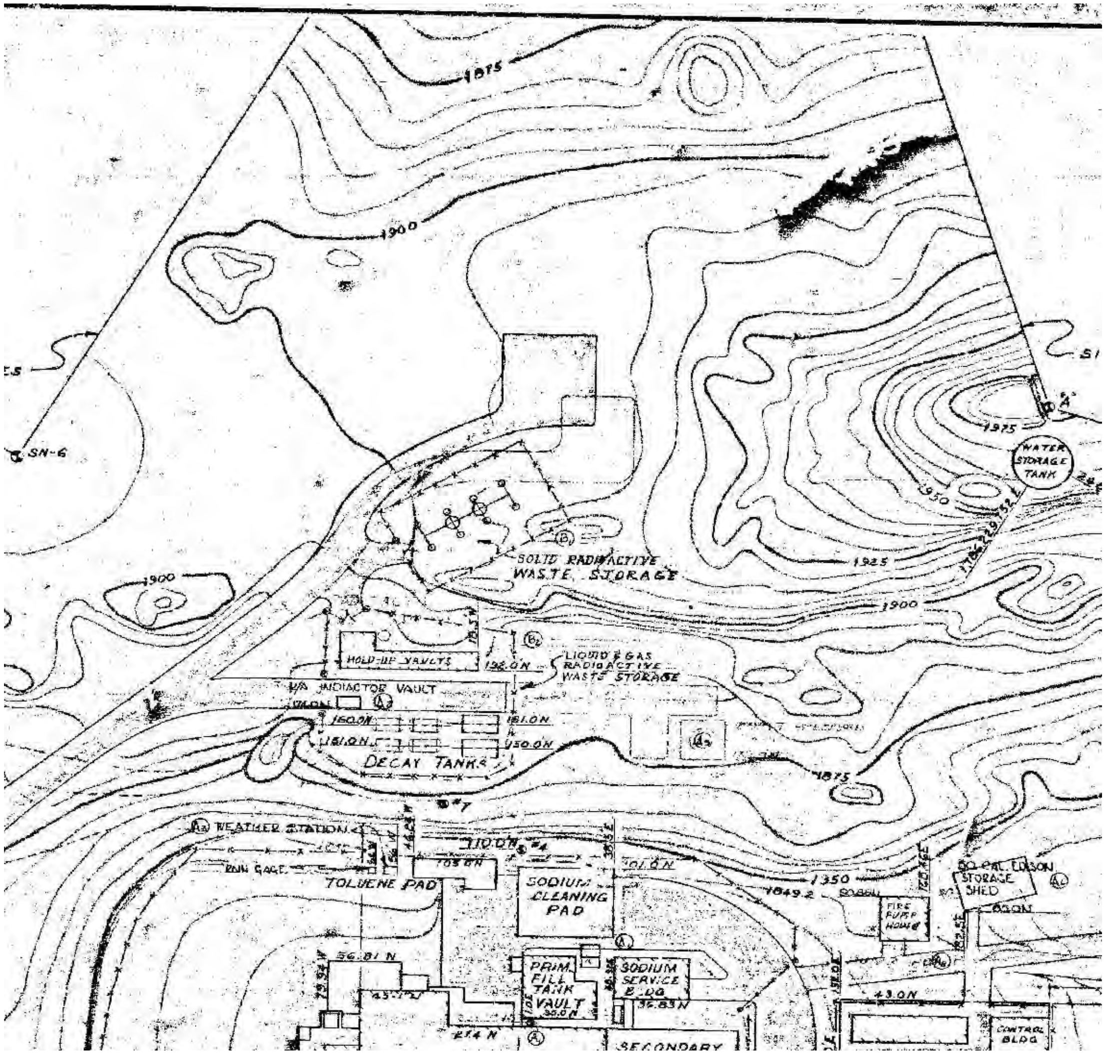

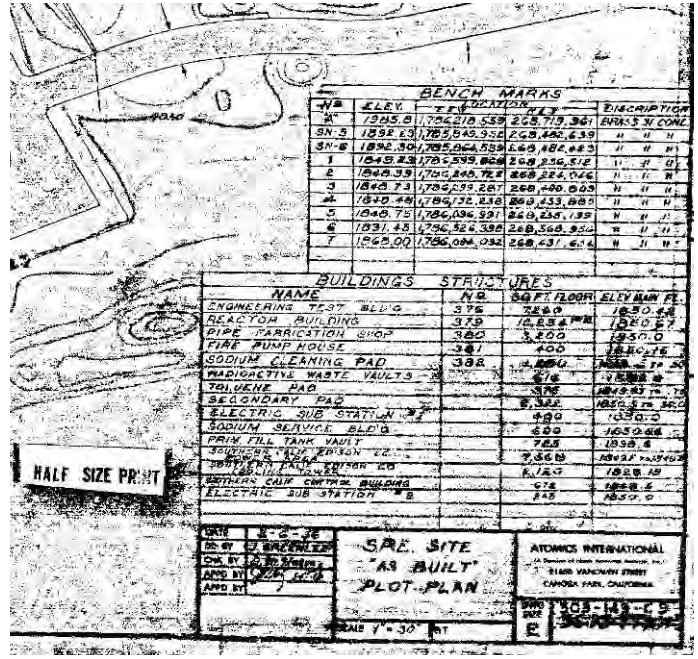

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U.S. EPA Region 9

Figure 2.1.10b
Building 4653
Plot Plan

Redacted

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Revised: 05/23/11 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.10c
Building 4653
Tank Removal
1977

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Revised: 04/08/2011 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.11a
Building 4163, 4183, 4184, 4185, 4684
Site Photograph

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Revised: 10/27/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.12a
Site 4686
Site Photograph

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Revised: 10/27/2010 TJ
Source: Boeing Company, 2008*

U.S. EPA Region 9

**Figure 2.1.13a
Building 4689
Site Photograph**

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Y:/Santa_Susana/EP9038/TM/HSA_6
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Project:EP9038
Revised: 04/08/2011 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.14a
Building 4143, 4153, 4695
Site Photograph

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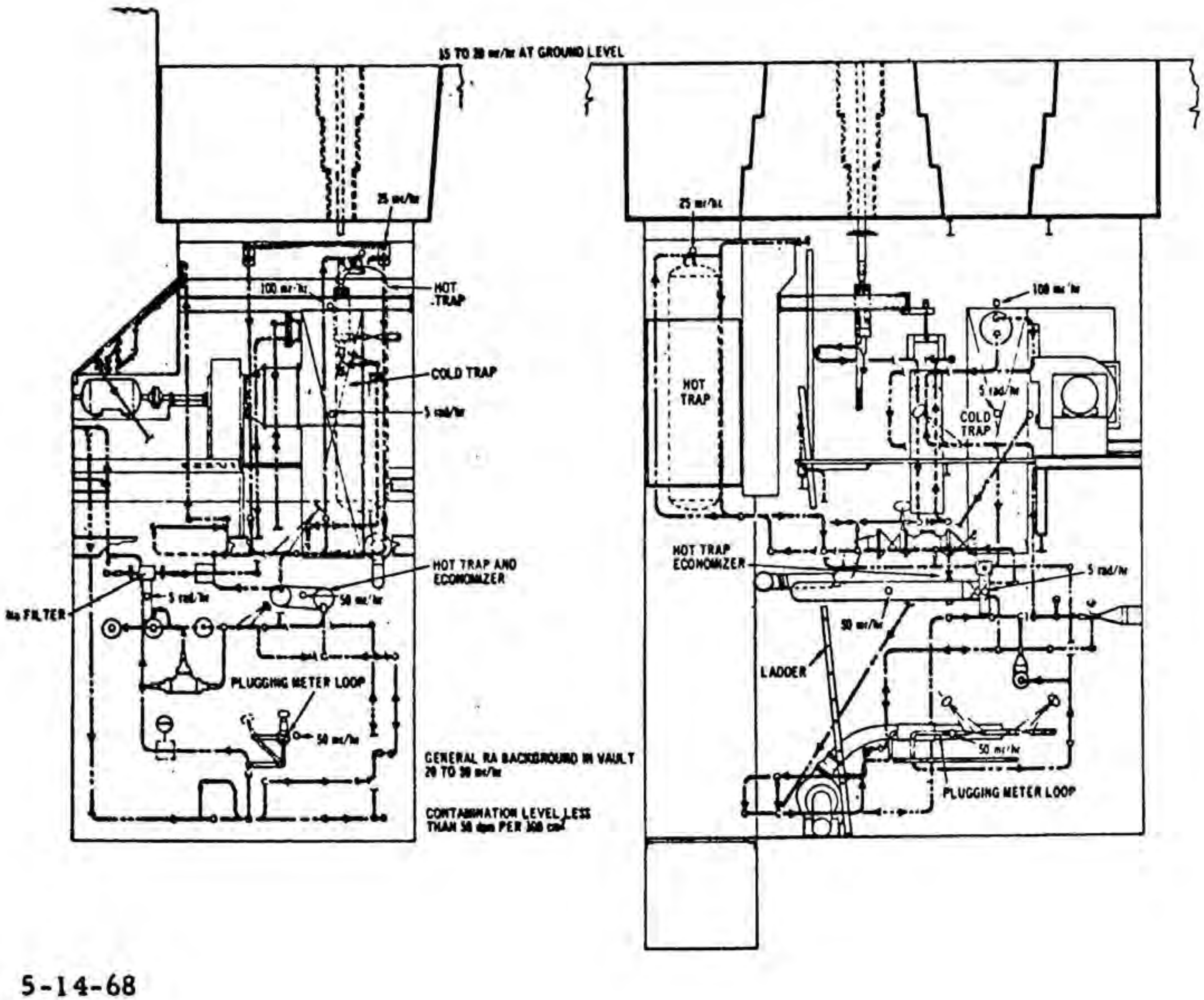

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U.S. EPA Region 9

Cold Trap Vault

Figure 2.1.14b
Building 4695
Elevation Views

Y:/Santa_Susana/EP9038/TM/HSA_6
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Revised: 05/11/11 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.14c
Building 4695
Below-ground
Demolition
1978

Redacted

Y:/Santa_Susana/EP9038/TM/HSA_6
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Revised: 10/27/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.15a
Site 4703
Site Photograph

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Revised: 04/08/2011 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.16a
Building 4505,
Site 4714
Site Photograph

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Revised: 10/27/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.17a
Site 4723
Site Photograph

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Revised: 10/27/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.18a
Building 4724
Site Photograph

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Revised: 10/20/2010 TJ
Source: Boeing Company, 2008*

U.S. EPA Region 9

**Figure 2.1.19a
Site 4733, 4743
Site Photograph**

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Project:EP9038
Revised: 04/08/2011 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.20a
Site 4733, 4743
Site Photograph

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Revised: 10/27/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.21a
Building 4753
Site Photograph

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Project:EP9038
Revised: 10/20/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Sodium Reactor Experiment Pond

Figure 2.1.22a
Site 4773
Site Photograph

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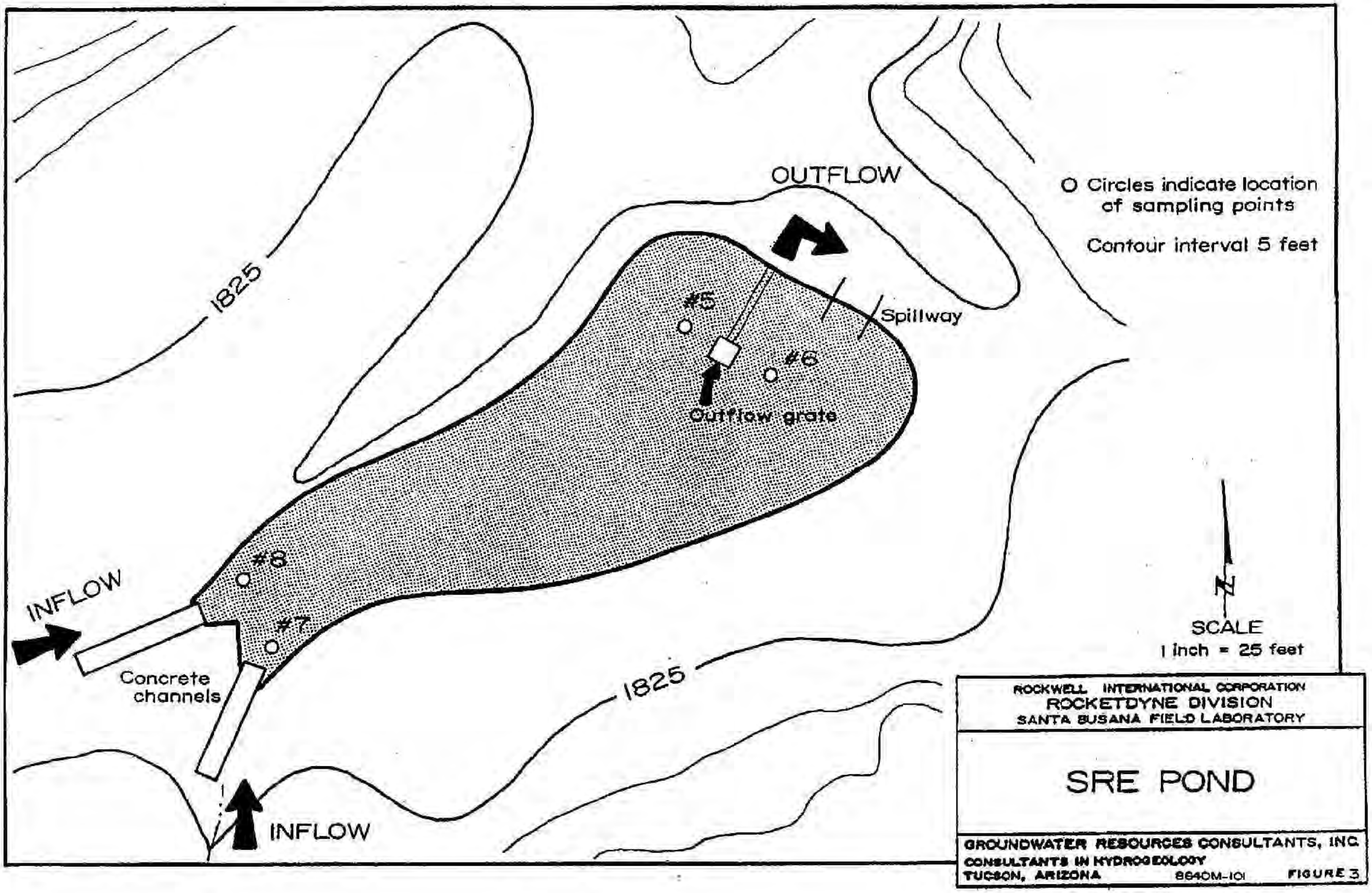

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Revised: 09/02/10 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Sodium Reactor Experiment Pond

Figure 2.1.22b
Site 4773
Pond

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Revised: 05/11/11 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.1.22c
Site 4773
1979 Photograph

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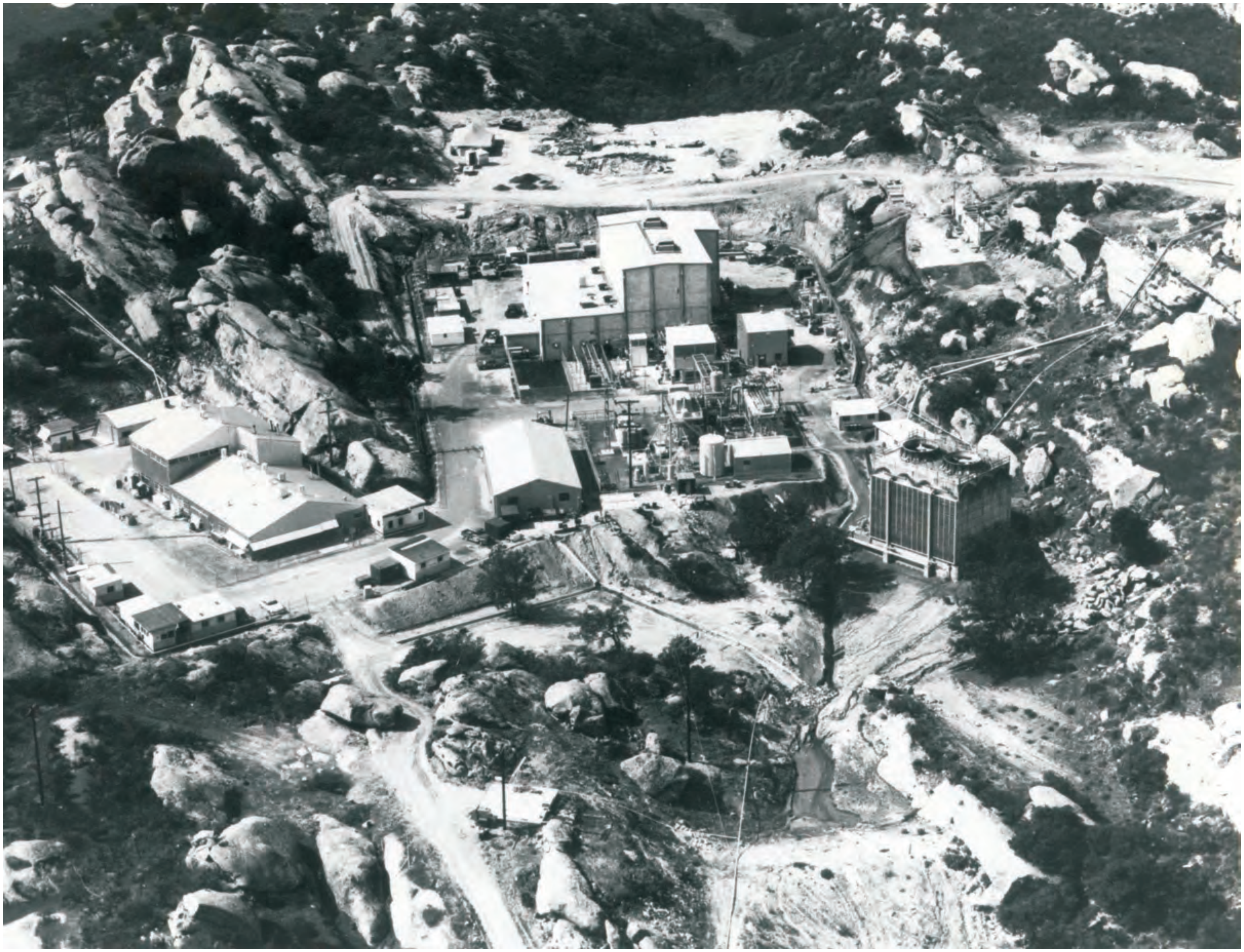

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Revised: 05/11/11 TJ
Source: Boeing Company, 2008

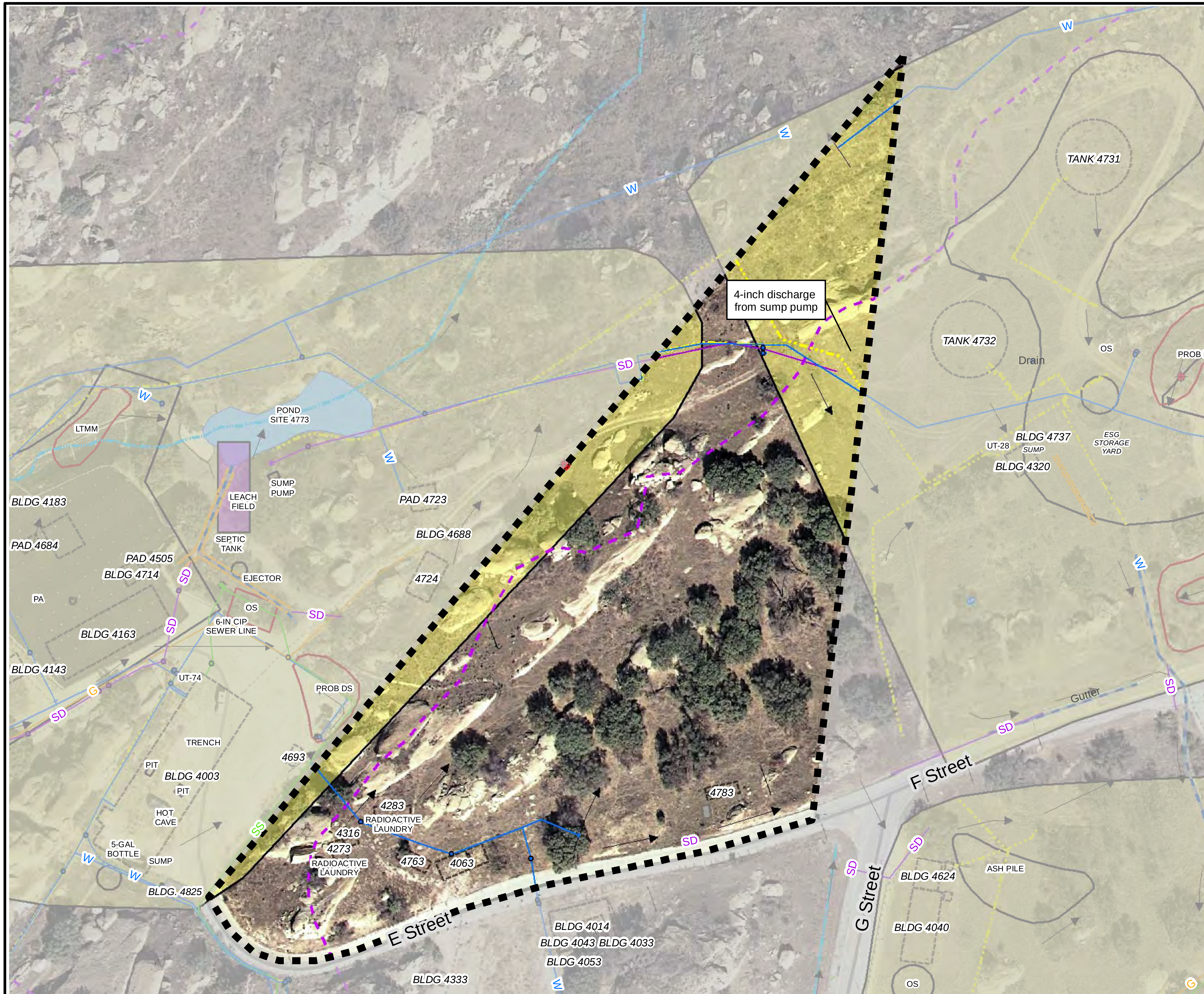
U.S. EPA Region 9

Figure 2.1.22d
Site 4773
Pond in Foreground

Historical Site Assessment
Final Technical Memorandum - HSA-6

Figure 2.2
Area IV Subarea 6-2
Santa Susana Field Laboratory

U.S. EPA Region 9



Legend

- Subarea 6-1 Boundary
- Primary Roads
- Secondary Roads
- Tertiary Roads
- Underground Storage Tank
- Unknown Tank Type
- French Drain Holding Tank
- Sump
- Dry Well
- Tank Footprint
- Above ground Storage Tank
- Demolished Bldg.
- Existing Bldg.
- Parking Lots
- Drainage
- Drainage Ditch
- Interview Line
- Offsite Seeps and Springs
- Onsite Seeps and Springs
- Drain
- Well

B	Building
CA	Cleared Area
CONT	Container
CR	Crates
DB	Debris
DG	Disturbed Ground
DTM	Dark Tone Material
EX	Excavation
FA	Fill Area
GR	Graded
GS	Ground Scar
HT	Horizontal Tank
IM	Impoundment
LTMM	Light Toned Mounded Material
MTMM	Medium Toned Mounded Material
OS	Open Storage
PA	Processing Area
PL	Pipeline
POSS	Possible
PROB	Probable
SS	Smoke Stack
ST	Stain
S-T	Storage Tank
UO	Unidentified Object
UT	Underground Tank
VT	Vertical Tank
WDA	Waste Disposal Area

Aerial Photography Data

- Aerial Photography Features
- Septic Tank
- Leach Field
- Parking Lots

Surface Water

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

Utilities

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

Surface Water Flow (From Boeing Database, 2008)

0 25 50 100
Scale In Feet

N

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HGL HydroGeoLogic, Inc.

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U.S. EPA Region 9

Figure 2.2.1a
Building 4063
Site Photograph

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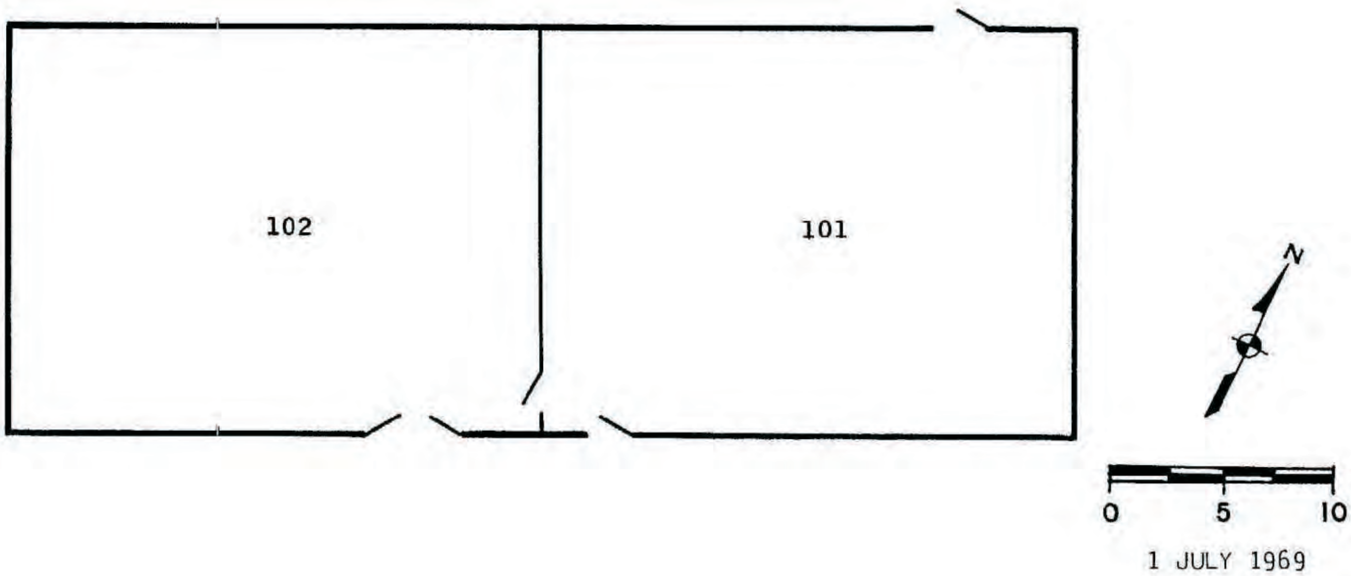

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Source: Boeing Company, 2008

U.S. EPA Region 9

Maintenance Service Building

Figure 2.2.1b
Building 4063
Floor Plan

Y:/Santa_Susana/EP9038/TM/HSA_6 (2-2-1c)Bldg4063PP.cdr Project:EP9038 Revised: 04/08/2011 TJ Source: Boeing Company, 2008 U.S. EPA Region 9		**Figure 2.2.1c Building 4063 Plot Plan**

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Revised: 10/27/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.2.2a
Building 4273
Site Photograph

Redacted

*Y:/Santa_Susana/EP9038/TM/HSA_6
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Project:EP9038
Revised: 10/27/2010 TJ
Source: Boeing Company, 2008*

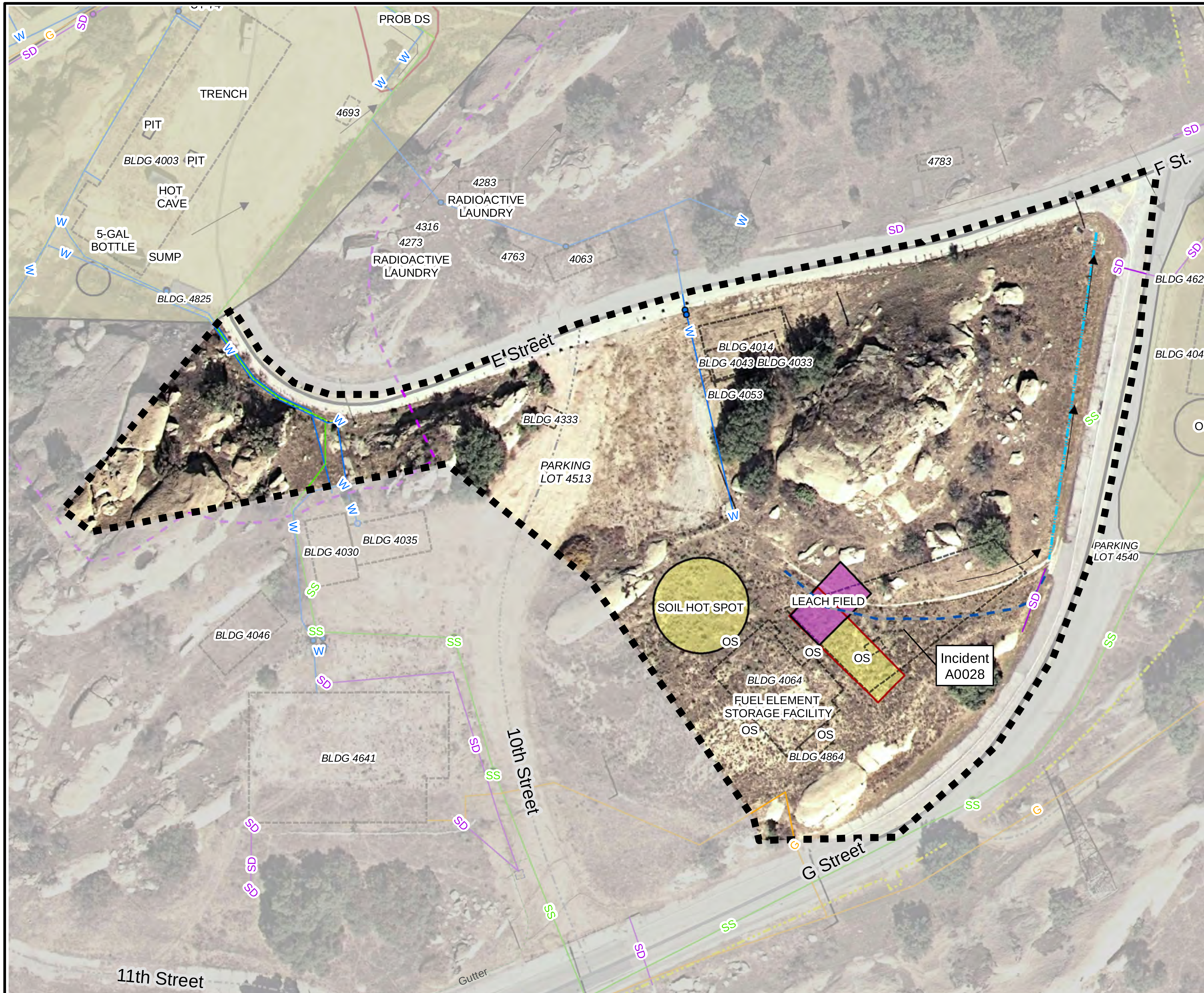
U.S. EPA Region 9

**Figure 2.2.3a
Building 4283
Site Photograph**

Historical Site Assessment
Final Technical Memorandum - HSA-6

Figure 2.3
Area IV Subarea 6-3
Santa Susana Field Laboratory

U.S. EPA Region 9



Legend

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S-T	Storage Tank
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- Gutter
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- Tank
- Vault
- Well
- Water (Removed)
- Water (Removed)
- Pipes (Unknown Type)
- Pipes (Unknown Type)
- Gas
- Storm Drain
- Sanitary Sewer
- Water

Surface Water Flow (From Boeing Database, 2008)

N

0 25 50 100
Scale In Feet

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HGL HydroGeoLogic, Inc.

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Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.3.1a
Building 4014, 4053
Site Photograph

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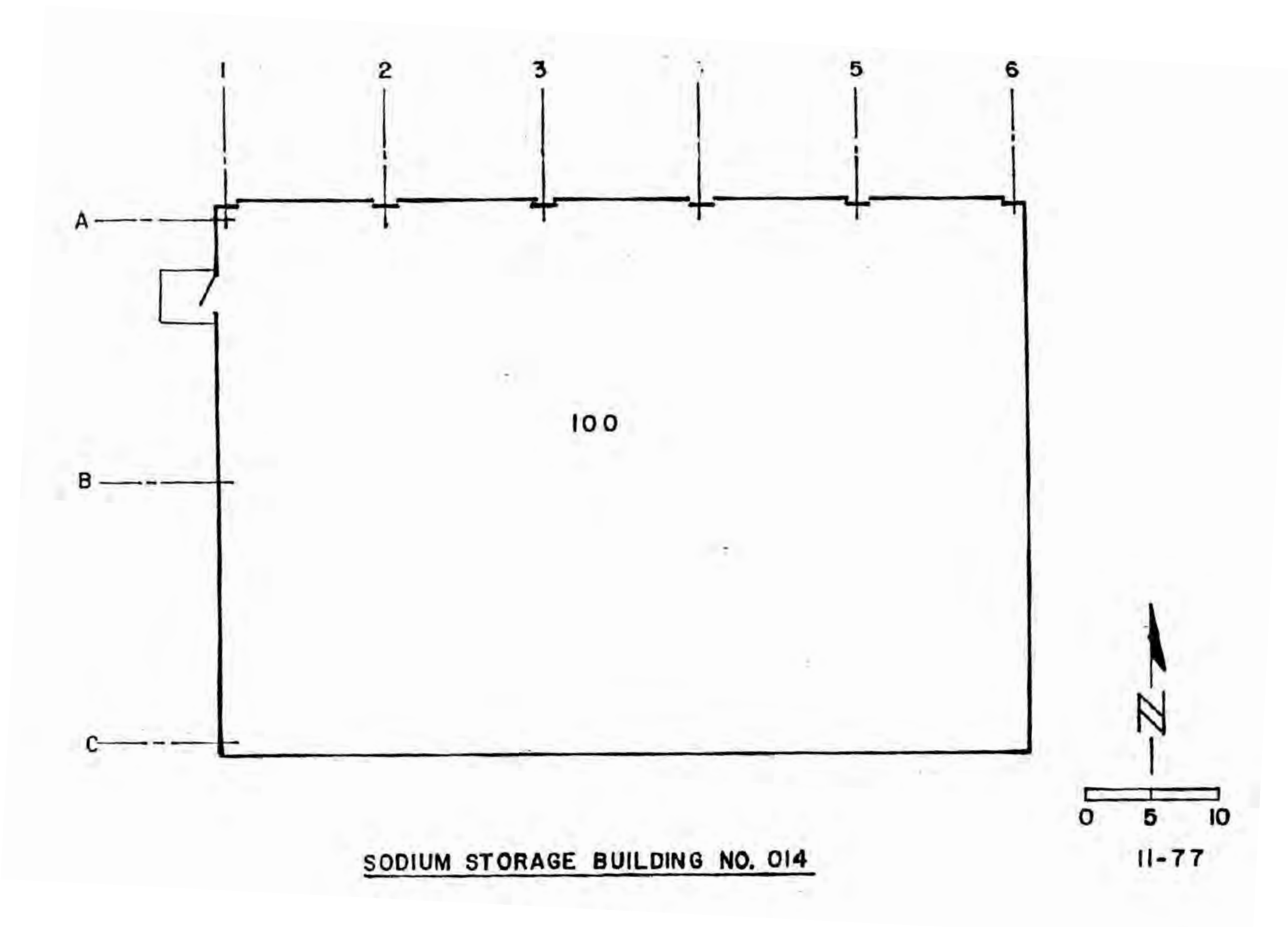

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Source: Boeing Company, 2008

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Figure 2.3.1b
Building 4014
Floor Plan

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U.S. EPA Region 9

**Figure 2.3.2a
Building 4014, 4053
Site Photograph**

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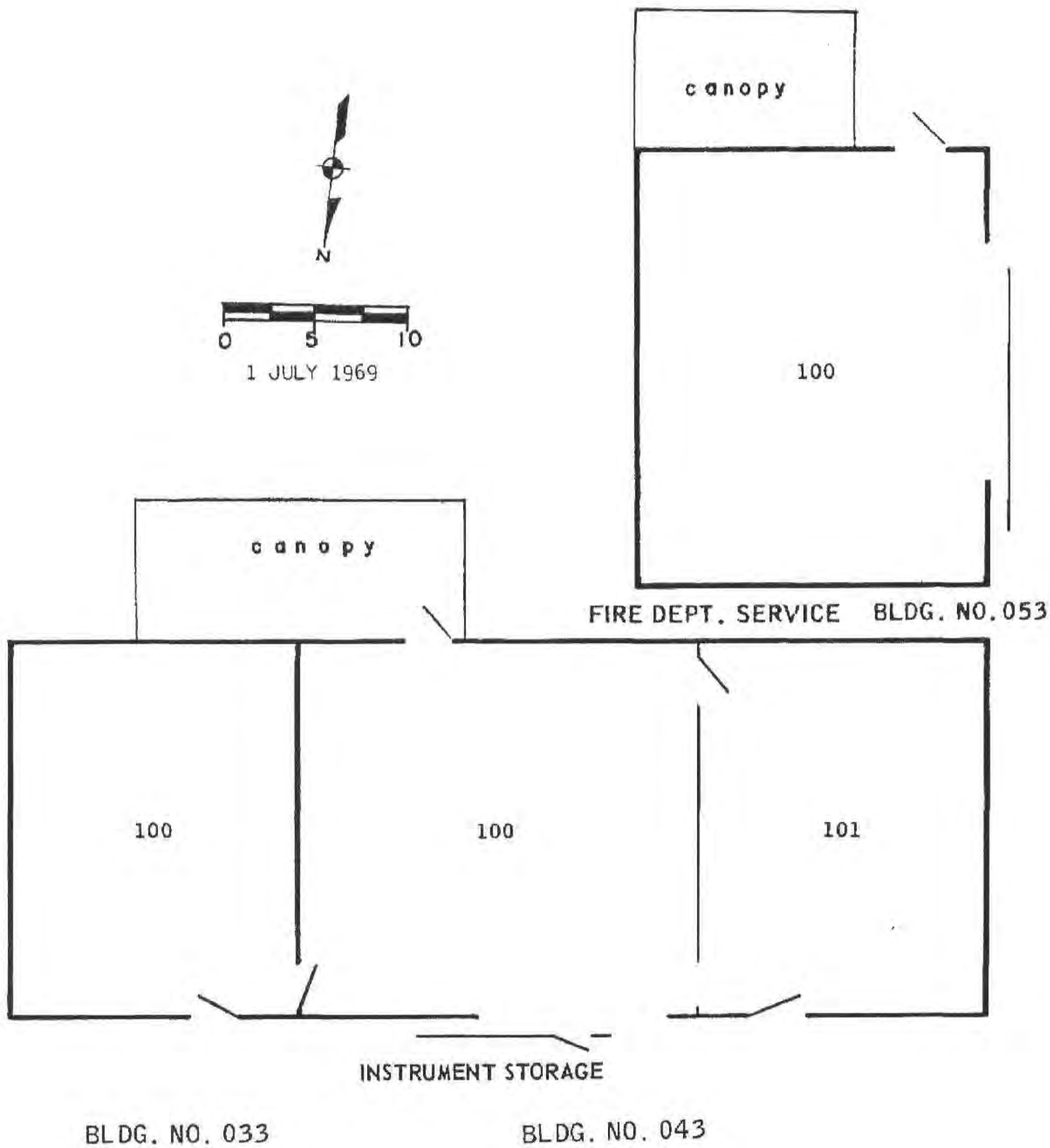

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Revised: 09/01/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Fire Department and Instrument Storage Buildings

Figure 2.3.2b
Building 4053
Floor Plan

Y:/Santa_Susana/EP9038/TM/HSA_6 (2-3-3a)Bldg4064AP.cdr
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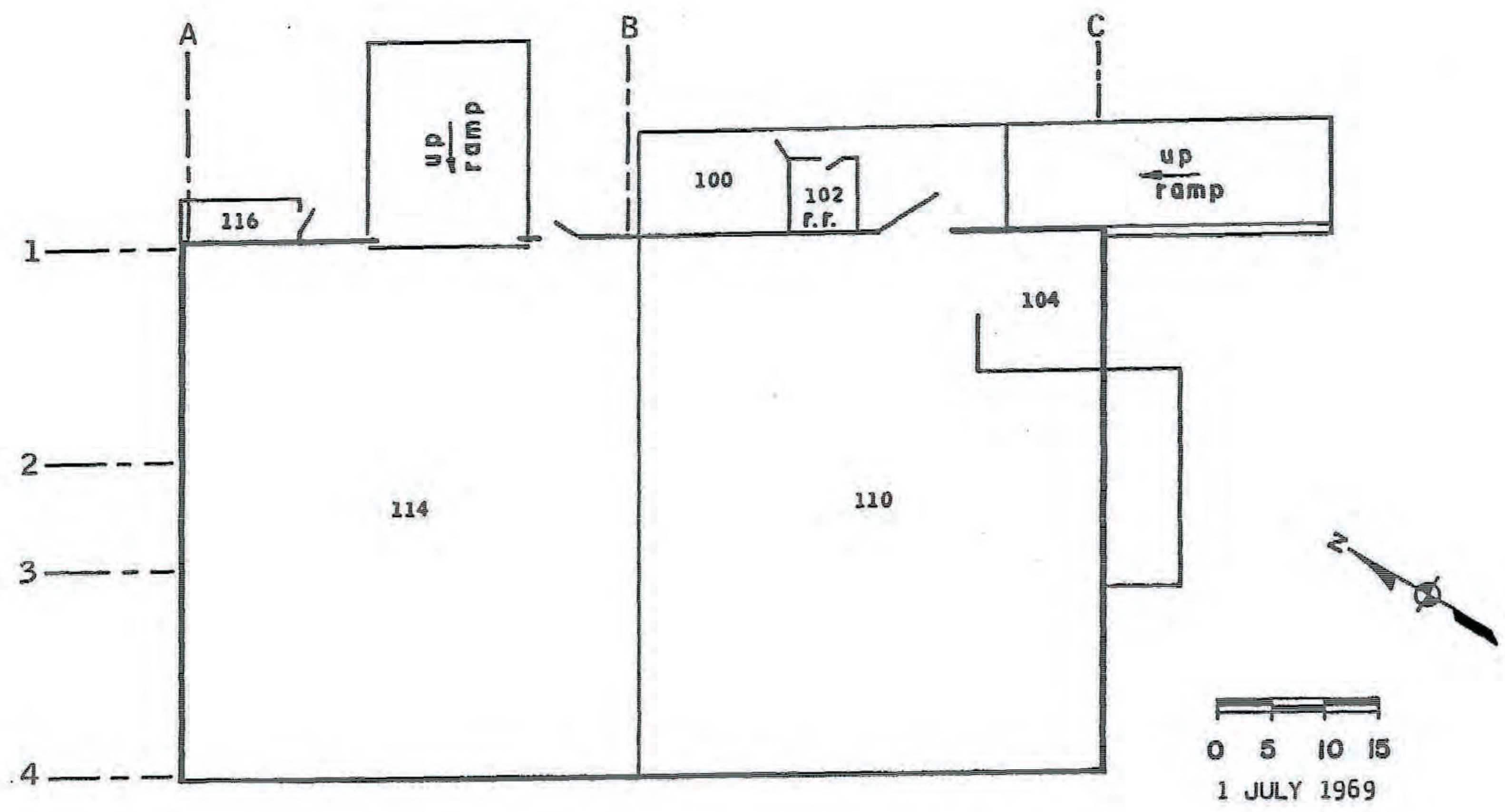
Revised: 10/20/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.3.3a
Building 4064
Site Photograph



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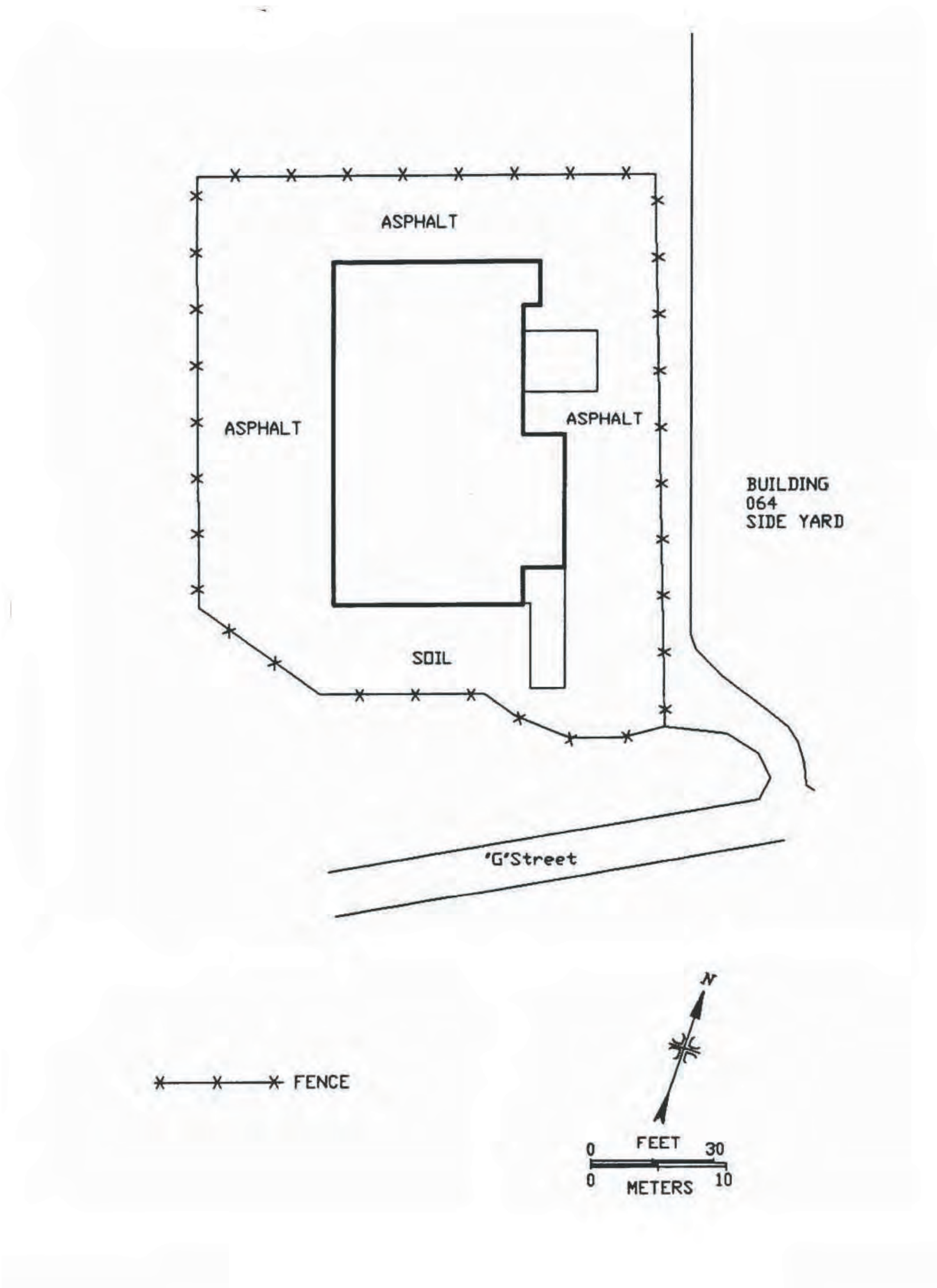
U.S. EPA Region 9

Fuel Element Storage Facility

Figure 2.3.3b
Building 4064
Floor Plan



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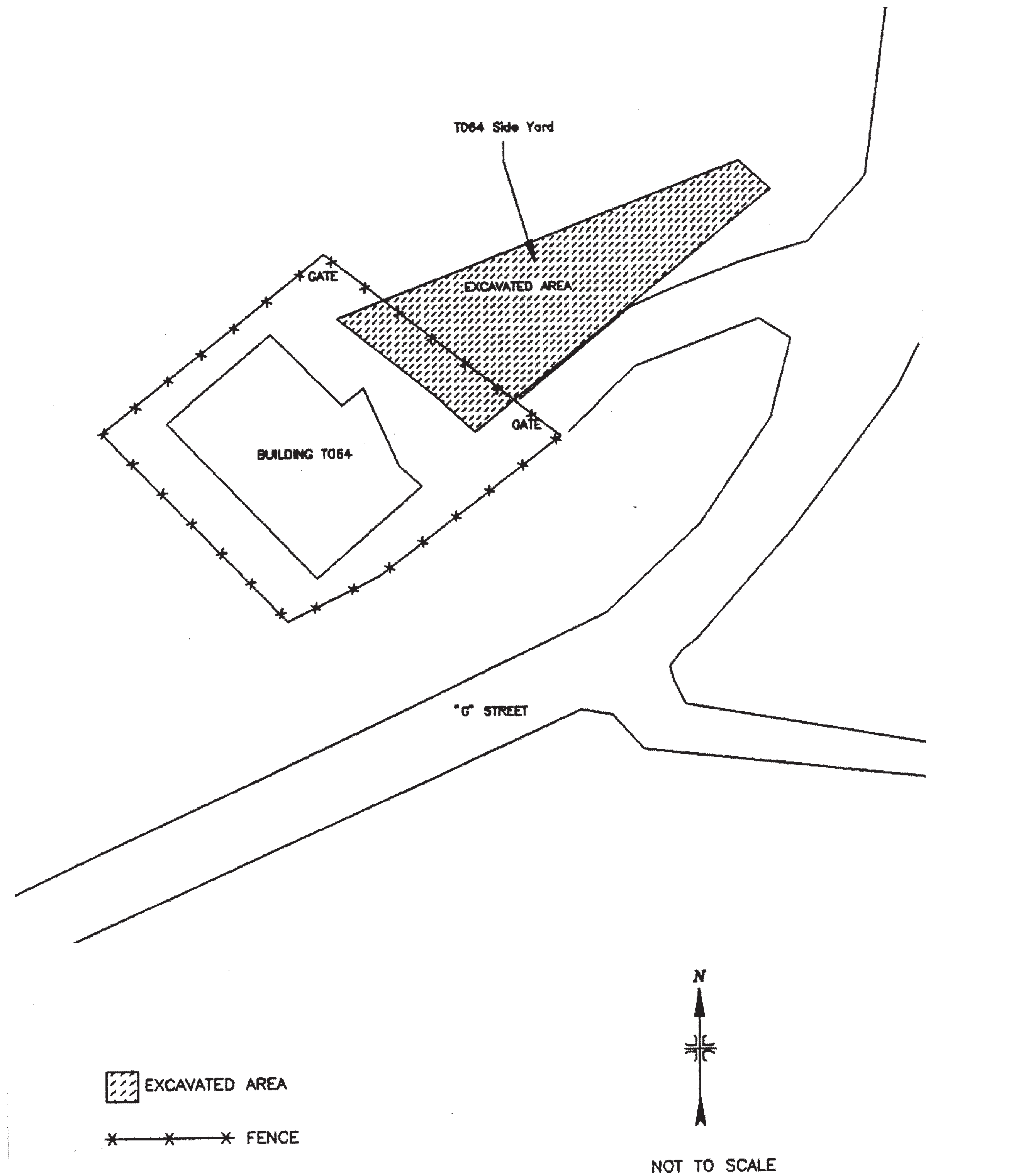
U.S. EPA Region 9

Fuel Element Storage Facility

Figure 2.3.3c
Building 4064
Fenced Area



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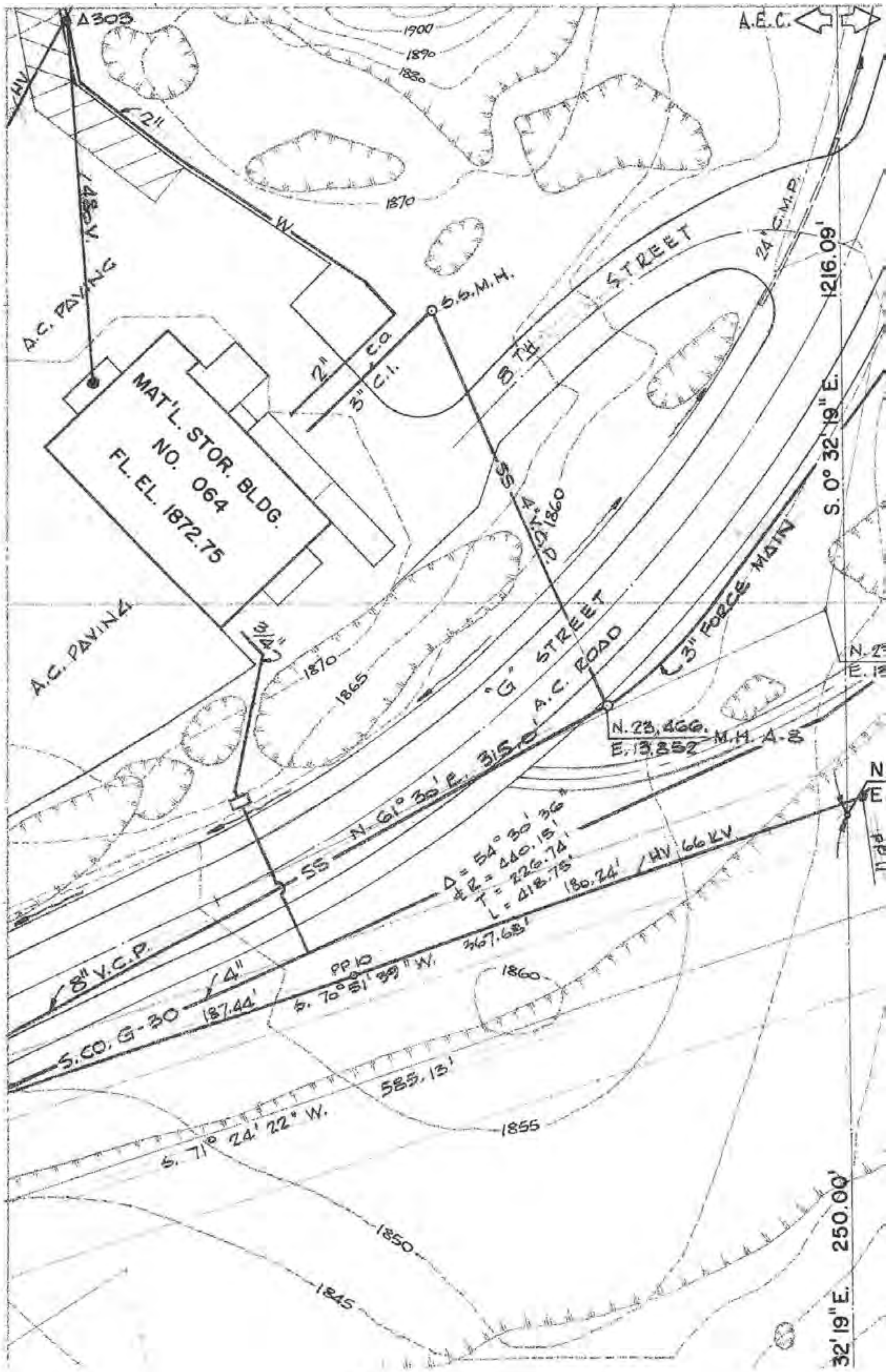
U.S. EPA Region 9

Fuel Element Storage Facility

Figure 2.3.3d
Building 4064
Side Yard



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Revised: 04/08/2011 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.3.3e
Building 4064
Plot Plan

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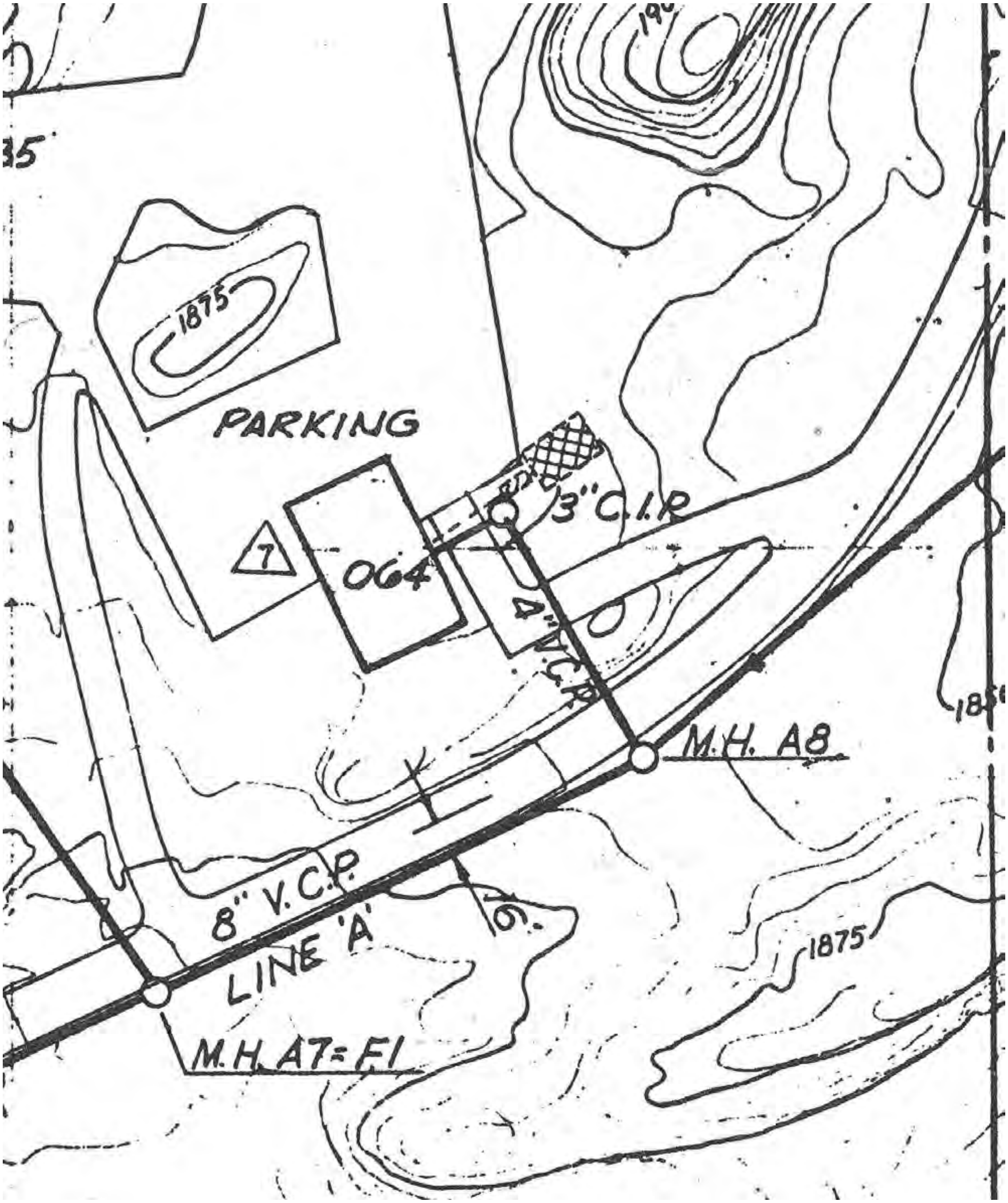

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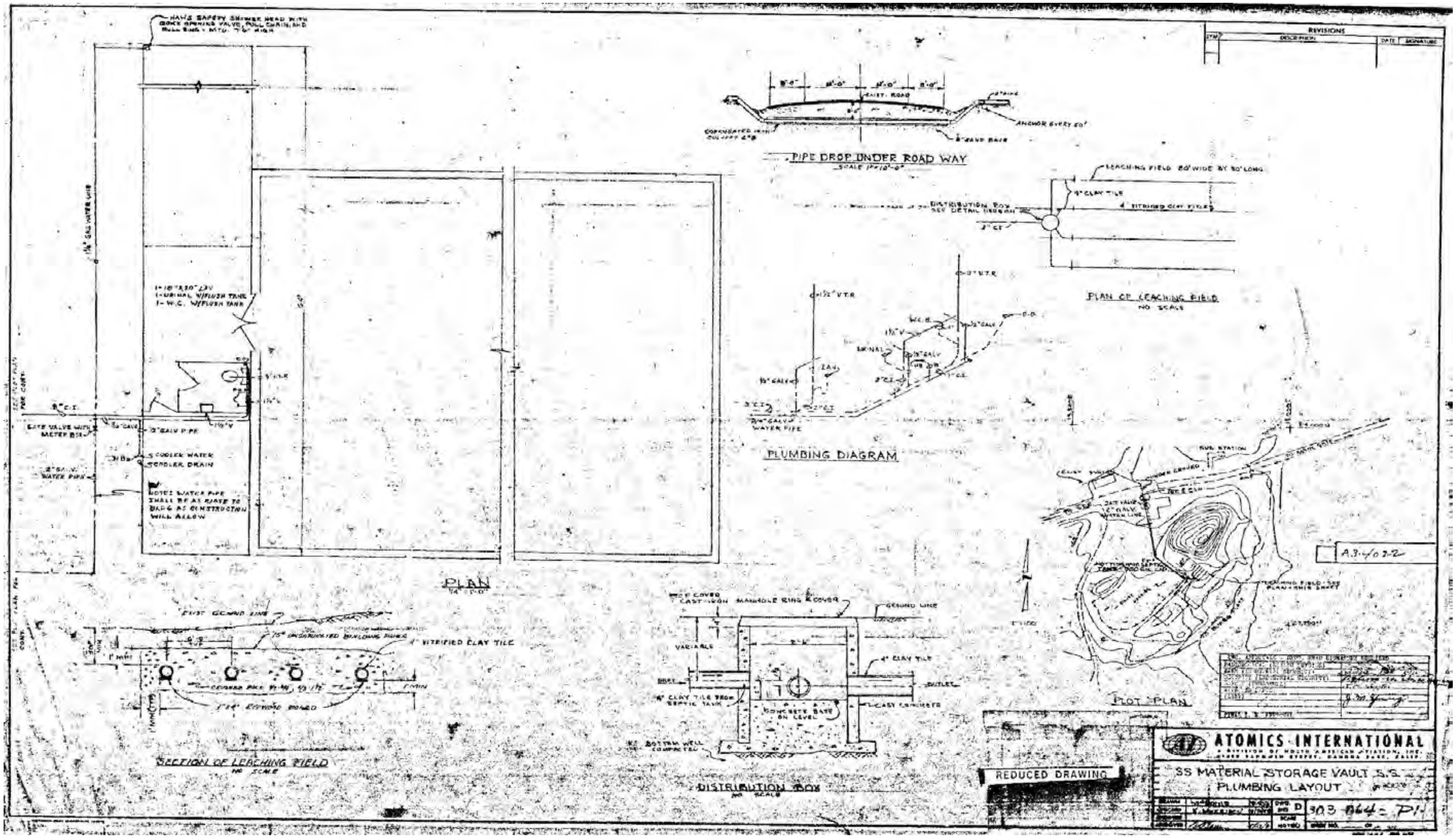
Revised: 04/08/2011 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.3.3f
Building 4064
Sewage System



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Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.3.3g
Building 4064
Plumbing Layout

Redacted

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Project:EP9038
Revised: 10/27/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.3.4a
Parking Lot 4513
Site Photograph

Redacted

Historical Site Assessment
Final Technical Memorandum - HSA-6

Figure 2.4
Area IV Subarea 6-4
Santa Susana Field Laboratory

U.S. EPA Region 9

Legend

- Subarea 6-1 Boundary
- Primary Roads
- Secondary Roads
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S-T	Storage Tank
UO	Unidentified Object
UT	Underground Tank
VT	Vertical Tank
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- Tank
- Tank
- Vault
- Well
- Water (Removed)
- Water (Removed)
- Pipes (Unknown Type)
- Pipes (Unknown Type)
- Gas
- Storm Drain
- Sanitary Sewer
- Water

Surface Water Flow
(From Boeing Database, 2008)

0 25 50 100
Scale In Feet

N

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Project: EP9038
Created: TJansen
Revised: 04/28/2011 TJ
Sorce: Boeing Company, 2008
CIRGIS, 2007

HGL HydroGeoLogic, Inc

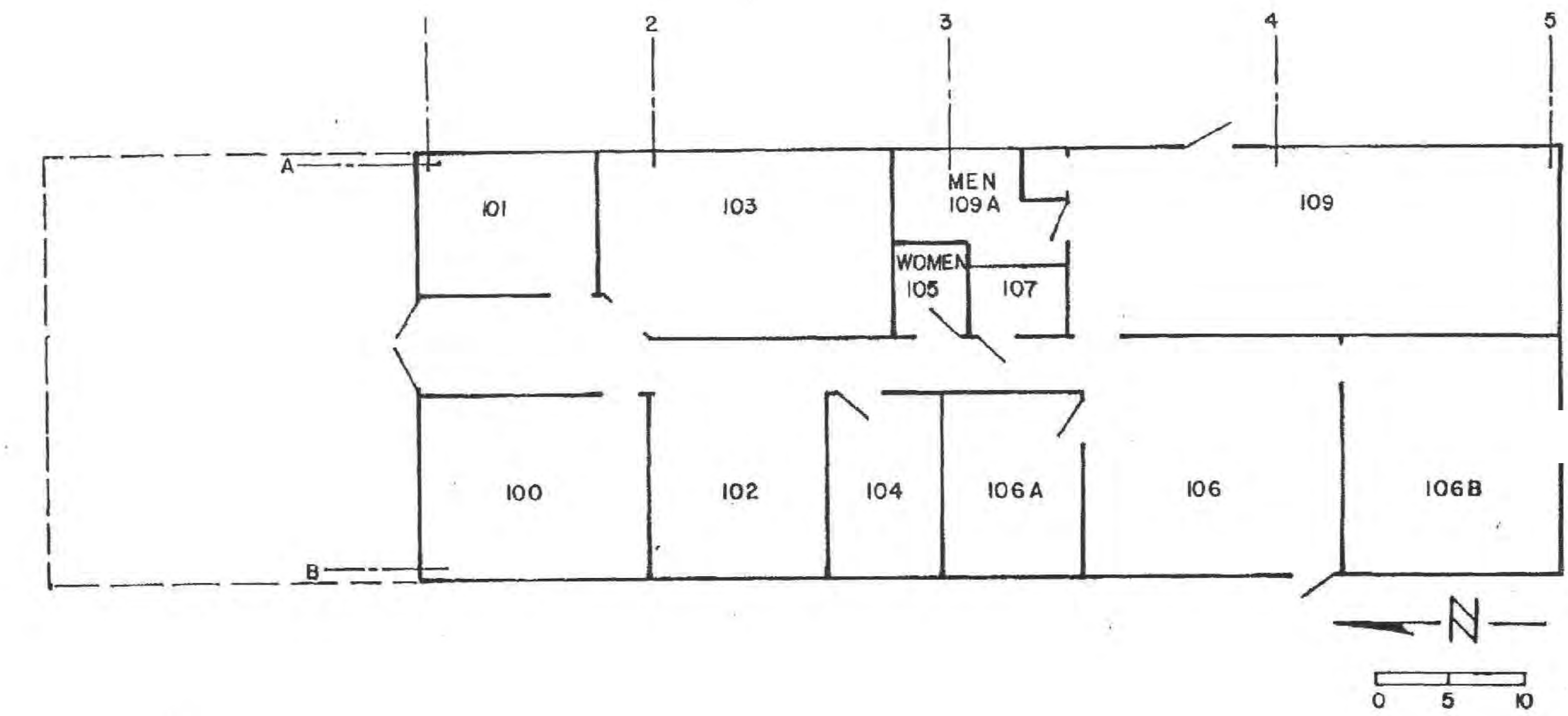
Redacted

Y:/Santa_Susana/EP9038/TM/HSA_6
(2-4-1a)Bldg4040AP.cdr
Project:EP9038
Revised: 10/20/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.4.1a
Building 4040
Site Photograph

Redacted



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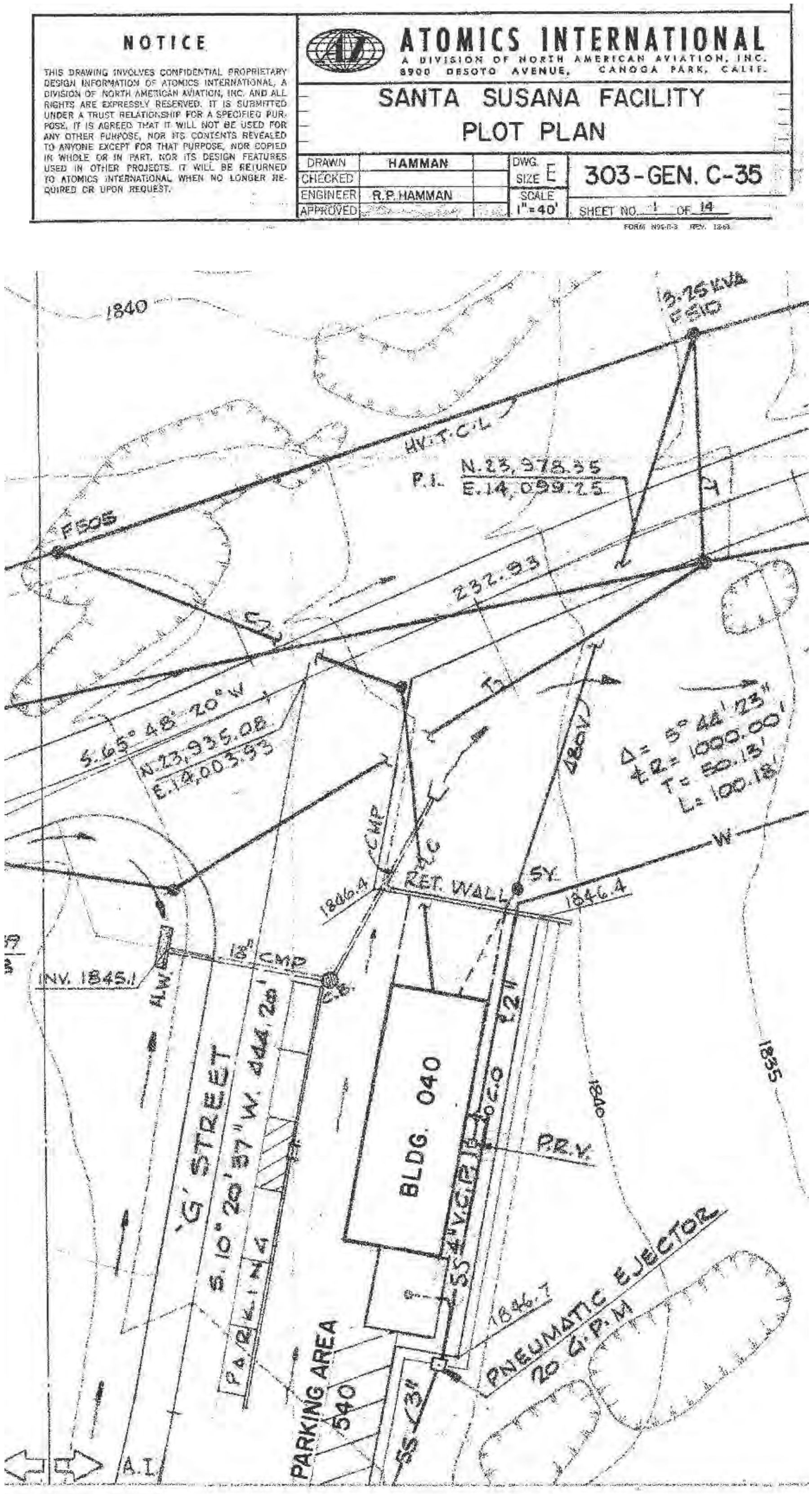
Project:EP9038
Revised: 09/02/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Contaminated Medical/Storage Facility

Figure 2.4.1b
Building 4040
Floor Plan

Redacted



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Revised: 04/08/2011 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.4.1c
Building 4040
Plot Plan

Redacted

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Project:EP9038
Revised: 10/20/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.4.2a
Building 4114
Site Photograph

Redacted

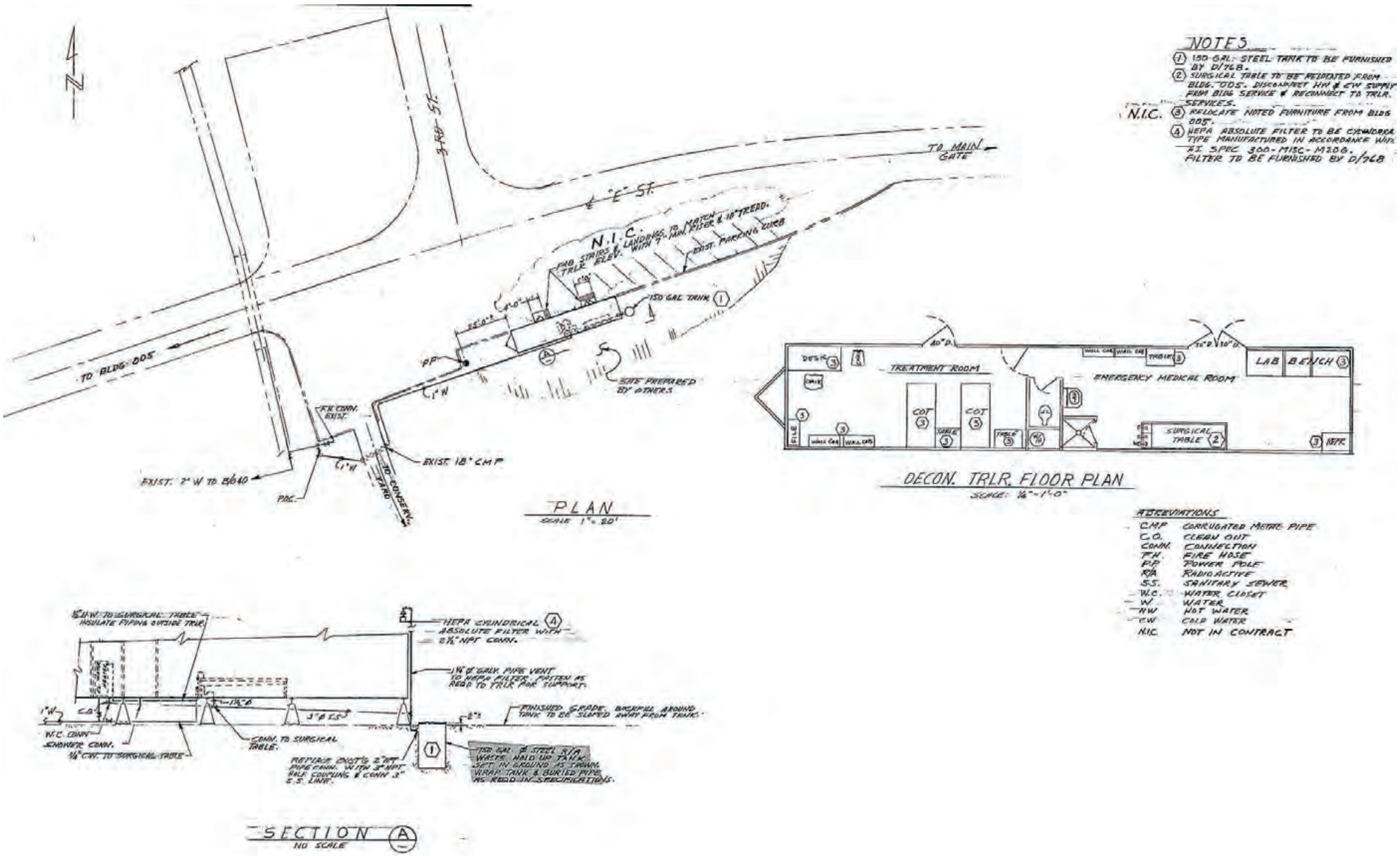

Figure Not to Scale

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Project:EP9038
Revised: 09/02/2010 TJ
Source: Rockwell International
Drawing No. 303-114-Pl March 3rd, 1977

U.S. EPA Region 9

Decontamination Trailer

Figure 2.4.2b
Building 4114
Floor Plan

Redacted

Y:/Santa_Susana/EP9038/TM/HSA_6
(2-4-3a)Site4511AP.cdr
Project:EP9038
Revised: 10/27/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.4.3a
Parking Lot 4511
Site Photograph

Redacted

Y:/Santa_Susana/EP9038/TM/HSA_6
(2-4-4a)Site4540AP.cdr
Project:EP9038
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Source: Boeing Company, 2008

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Figure 2.4.4a
Parking Lot 4540
Site Photograph

Redacted

*Y:/Santa_Susana/EP9038/TM/HSA_6
(2-4-5a)Site4583AP.cdr
Project:EP9038
Revised: 10/27/2010 TJ
Source: Boeing Company, 2008*

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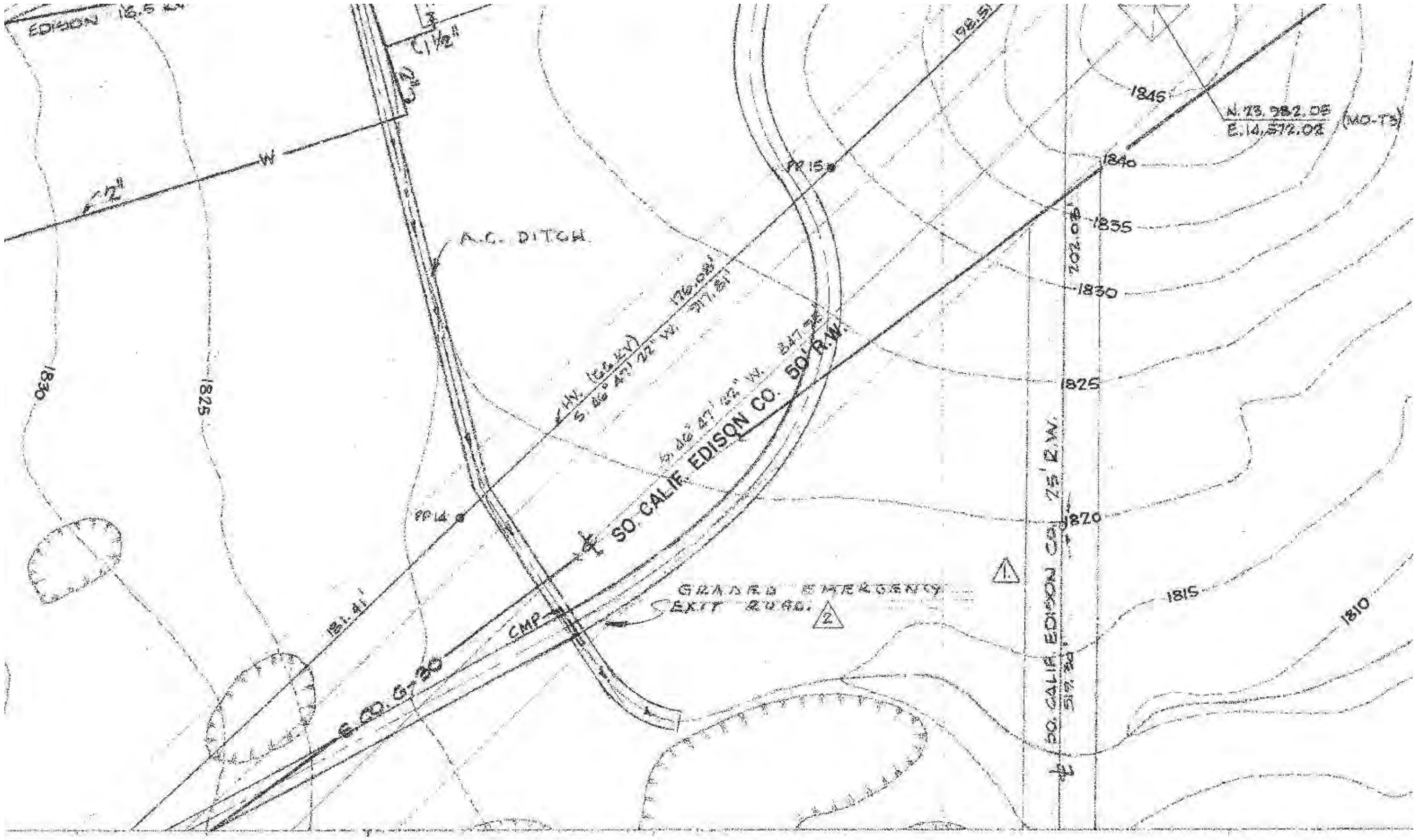
**Figure 2.4.5a
Site 4583-New
Site Photograph**

Redacted



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SANTA SUSANA FACILITY
PLOT PLAN

DRAWN	HAMMAN	DWG. SIZE E	303-GEN. C-35
CHECKED			
ENGINEER	R.P. HAMMAN	SCALE 1" = 40'	SHEET NO. 1 OF 14
APPROVED			

Y:/Santa_Susana/EP9038/TM/HSA_6 (2-4-5b)BldgSite4583PP.cdr
Project:EP9038
Revised: 04/08/2011 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.4.5b
Site 4583-New
Plot Plan

Redacted

Historical Site Assessment
Final Technical Memorandum - HSA-6

Figure 2.5
Area IV Subarea 6-5
Santa Susana Field Laboratory

U.S. EPA Region 9

Legend

- Subarea 6-1 Boundary
- Primary Roads
- Secondary Roads
- Tertiary Roads
- Underground Storage Tank
- Unknown Tank Type
- French Drain Holding Tank
- Sump
- Dry Well
- Tank Footprint
- Above ground Storage Tank
- Demolished Bldg.
- Existing Bldg.
- Parking Lots
- Drainage
- Drainage Ditch
- Interview Line
- Offsite Seeps and Springs
- Onsite Seeps and Springs
- Drain
- Well

B	Building
CA	Cleared Area
CONT	Container
CR	Crates
DB	Debris
DG	Disturbed Ground
DTM	Dark Tone Material
EX	Excavation
FA	Fill Area
GR	Graded
GS	Ground Scar
HT	Horizontal Tank
IM	Impoundment
LTMM	Light Toned Mounded Material
MTMM	Medium Toned Mounded Material
OS	Open Storage
PA	Processing Area
PL	Pipeline
POSS	Possible
PROB	Probable
SS	Smoke Stack
ST	Stain
S-T	Storage Tank
UO	Unidentified Object
UT	Underground Tank
VT	Vertical Tank
WDA	Waste Disposal Area

Aerial Photography Data
- Aerial Photography Features
- Septic Tank
- Leach Field
- Parking Lots

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

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

Surface Water Flow (From Boeing Database, 2008)

0 25 50 100
Scale In Feet

N

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Sorce: Boeing Company, 2008
CIRGIS, 2007

HGL HydroGeoLogic, Inc

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(2-5-1a)Bldg4320AP.cdr
Project:EP9038
Revised: 10/20/2010 TJ
Source: Boeing Company, 2008

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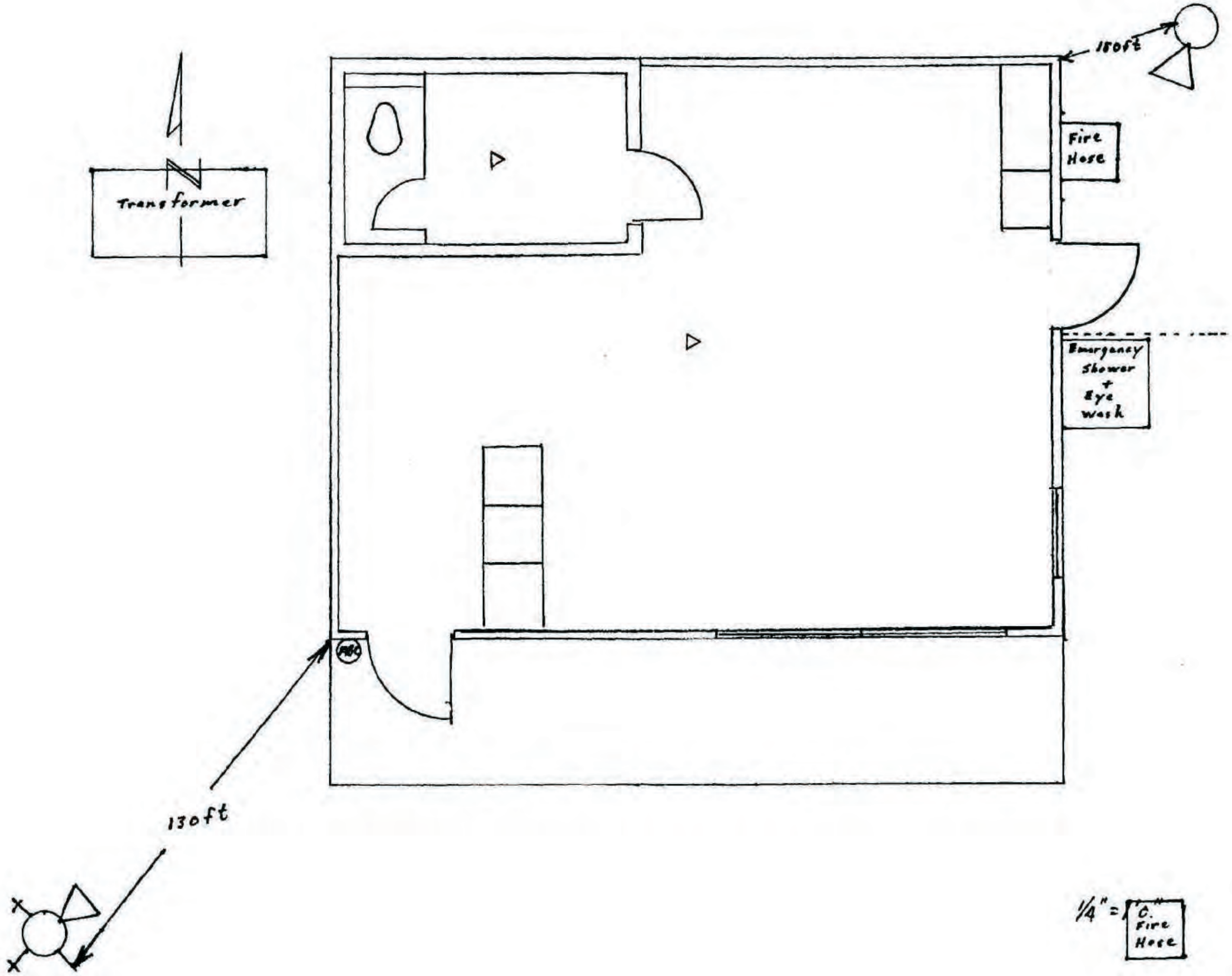
Figure 2.5.1a
Building 4320
Site Photograph

Redacted

Figure Not to Scale



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Fuel Oil Control/Pump Building

Figure 2.5.1b
Building 4320
Floor Plan

Redacted

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(2-5-2a)Site4583AP.cdr
Project:EP9038
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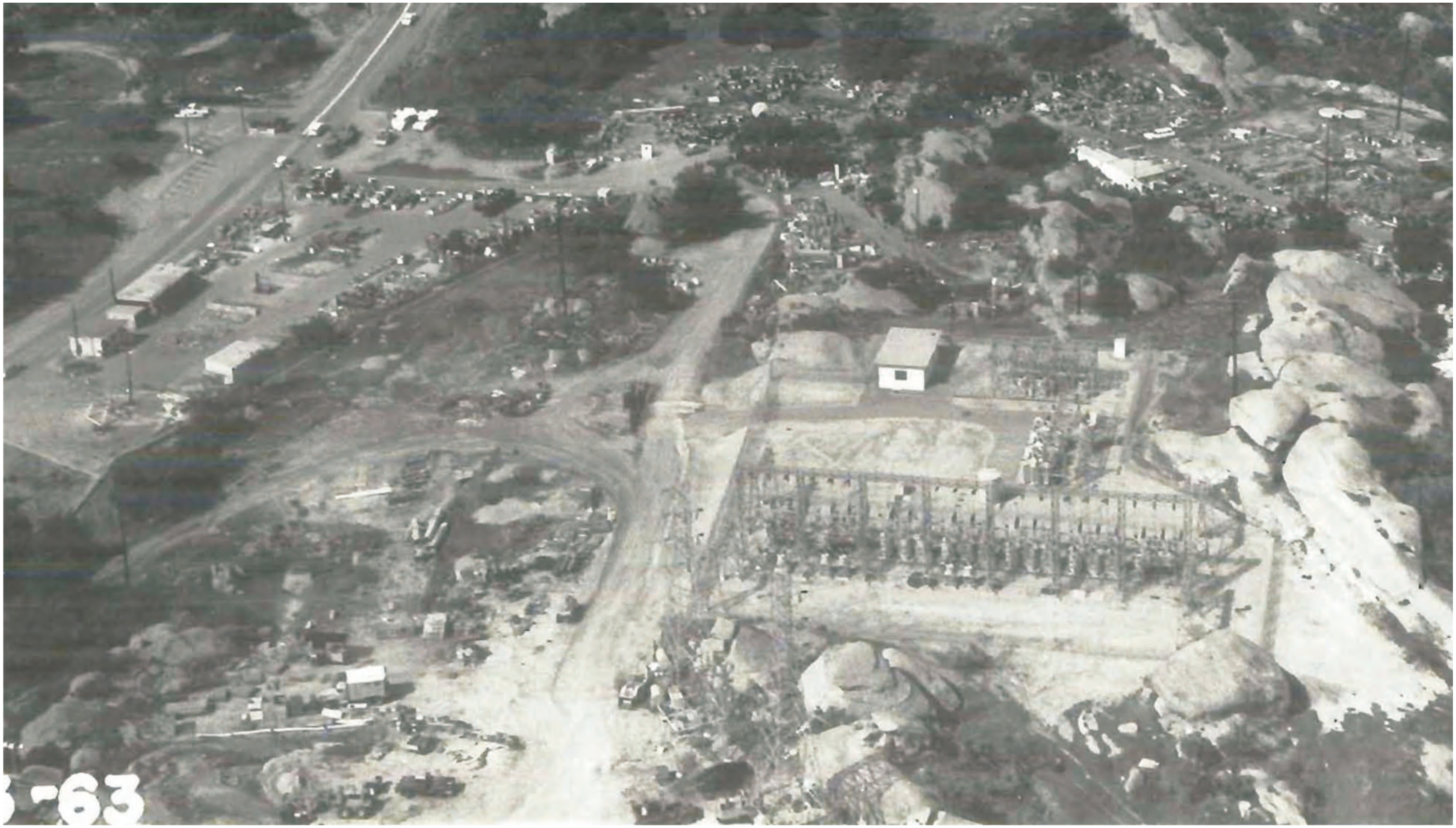
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.5.2a
Site 4583-Old
Site Photograph

Redacted



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Revised: 0530/2011 TJ
Source: Boeing Company, 2008

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Figure 2.5.2b
Site 4583-Old
Historical Photograph
1963

Redacted

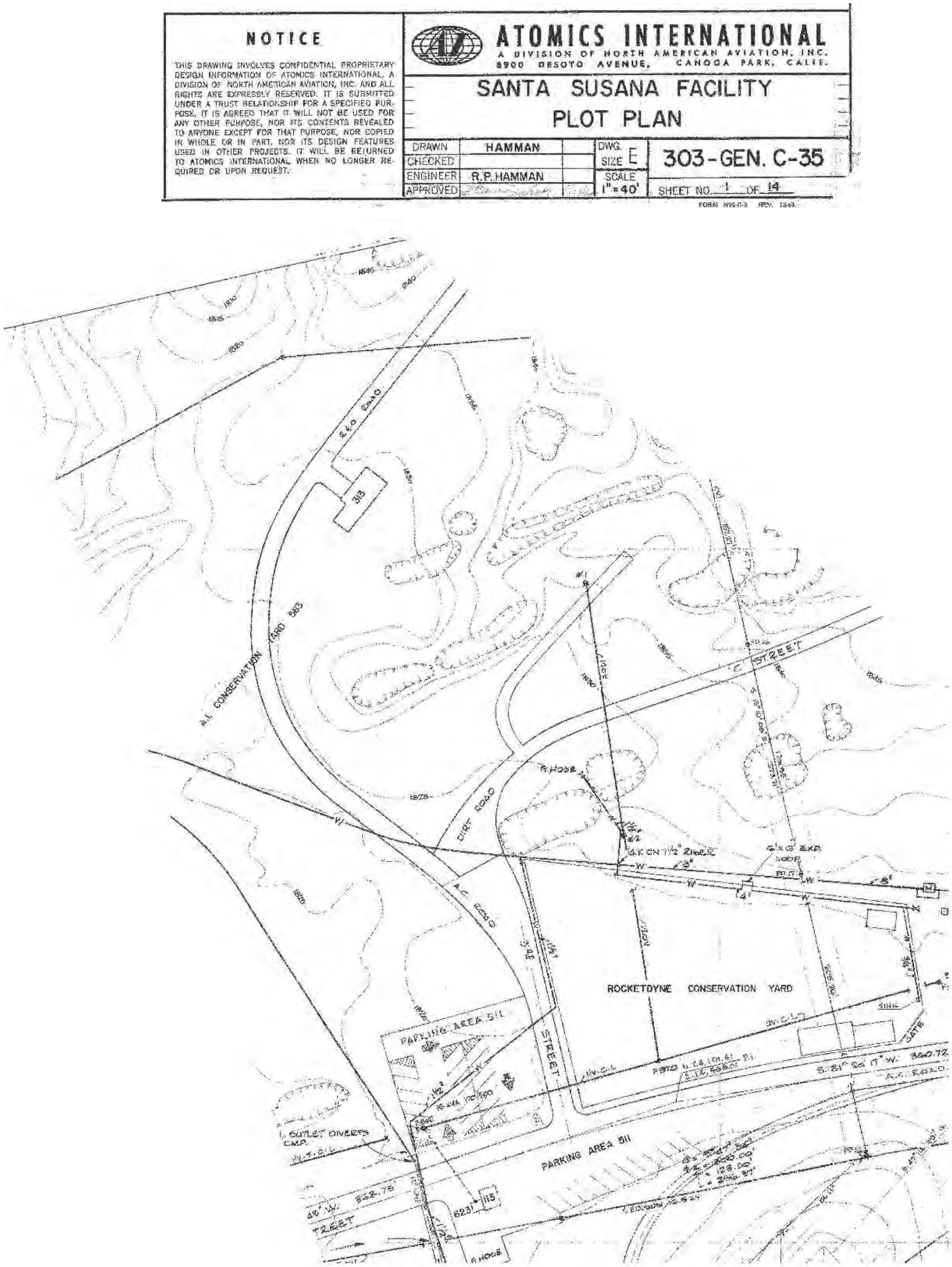

Figure 2.5.2c
Site 4583-Old
Plot Plan

Redacted

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(2-5-3a)Site4731AP.cdr
Project:EP9038
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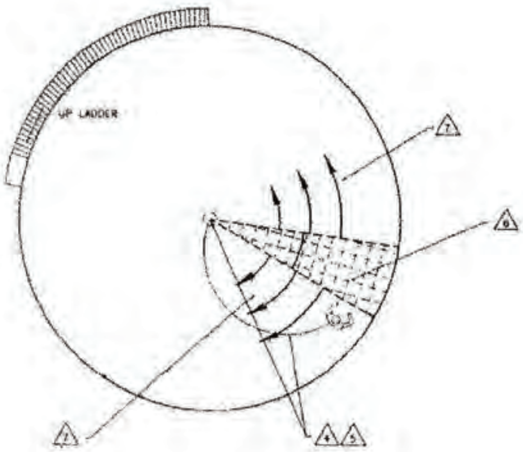
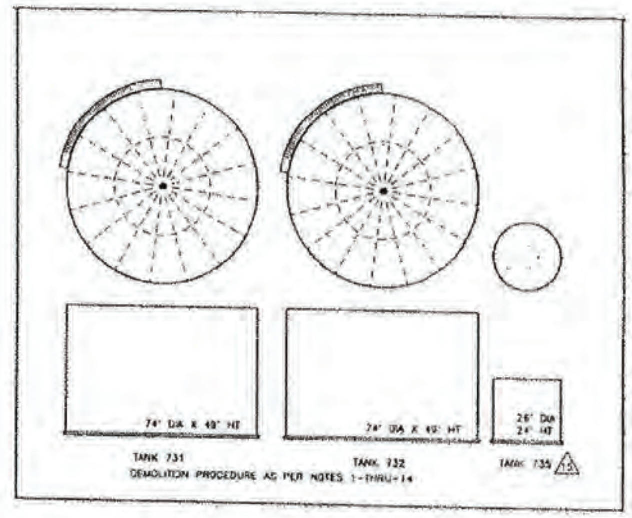
Source: Boeing Company, 2008

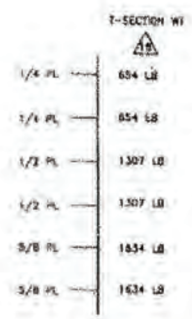
U.S. EPA Region 9

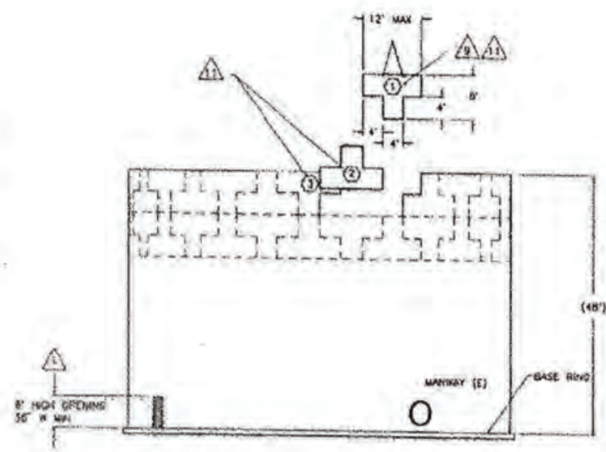
Figure 2.5.3a
Site 4731
Site Photograph

Figure Not to Scale









16 PLATE THICKNESS ESTIMATED AND DENOTE TYPICAL TANK PLATE THICKNESSES.
15 TANK 135 DEMOLITION: CUT INTO LARGE PIECES AT DISCRETION OF CONTRACTOR
14 STEP #10 LIFT TANK BOTTOM AND INSPECT FOR PRESENCE OF HARMFUL AND/OR DANGEROUS VAPORS BEFORE CUTTING.
13 STEP #9 REMOVE ALL SCRAP AND DEBRIS FROM TANK BOTTOM.
12 STEP #8: FABRICATE LIFT BRACKETS ALONG EDGE OF TANK BOTTOM.
11 NUMBER INDICATES SEQUENCED PLATE REMOVAL FOR DRAWING PURPOSES ONLY
10 REPEAT FOR NEXT LEVEL, THEN FOR NEXT.
9 REMOVE T-SHAPED SECTIONS AS SHOWN CLOCKWISE STARTING AT UPPERMOST TANK RING
8 STEP #7 REMOVE VERTICAL BULKHEAD PLATES AS PER DETAIL
7 CONTINUE TANK ROOF DEMOLITION, REMOVING 30° SECTORS IN ALTERNATE SEQUENCE FROM FIRST CUT ALL ROOF WORK SHALL PROCEED FROM POINTS FURTHEST FROM LADDER TOWARD LADDER.
6 STEP #6 REMOVE TANK ROOF AREA, APPROX. 30° SECTOR, IN 3-FT SECTIONS, STARTING AT ROOF EDGE, WORKING TOWARD CENTER
5 STEP #5 SECURE OPERATOR(S) TO SHACKLE
4 STEP #4: ATTACH 1-1/2" SHACKLE FROM WHICH TO SECURE MINIMUM 5/8" NYLON ROPE OR "SAFETY LINE".
3 STEP #3 INSURE TANK BOTTOM IS CLEAR FOR TANK EGRESS.
2 STEP #2 POST FIRE WATCH AT BOTH OPENINGS AS REQD FOR FLAME CUTTING OPERATIONS
1 STEP #1 REMOVE TWO (2 EA) BOTTOM SECTIONS AS FOLLOWS:
90-DEGREES TO TANK MANWAY
180-DEGREES APART

DEMOLITION NOTES: UNLESS OTHERWISE SPECIFIED

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Project:EP9038
Revised: 09/02/10 TJ
Source: Boeing Company, 2008

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Fuel Oil Storage Tank

Figure 2.5.3b
Site 4731
Demolition Details

Redacted

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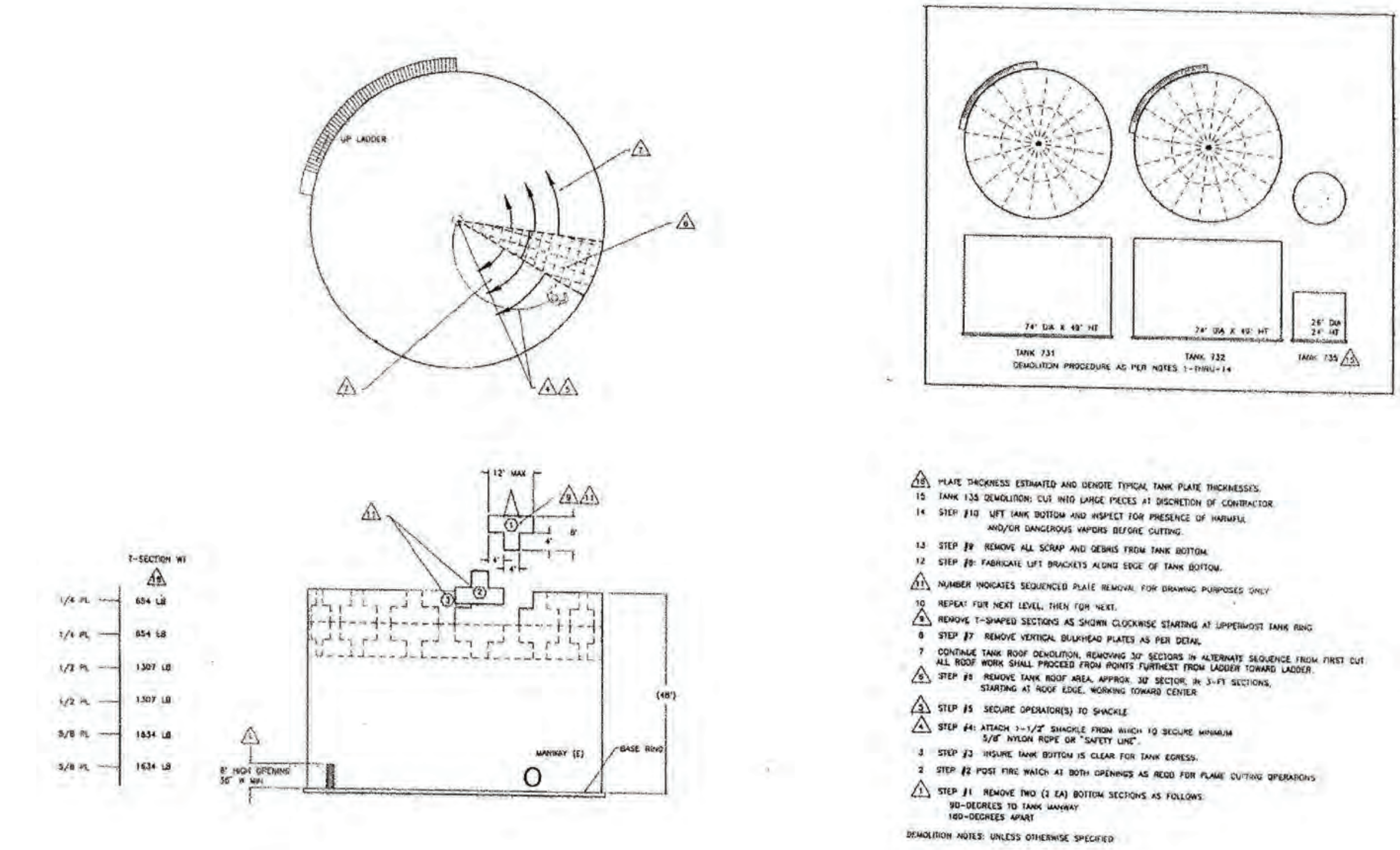
(2-5-4a)Site4732AP.cdr
Project:EP9038
Revised: 10/27/2010 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Figure 2.5.4a
Site 4732
Site Photograph

Figure Not to Scale



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Project:EP9038
Revised: 04/08/2011 TJ
Source: Boeing Company, 2008

U.S. EPA Region 9

Fuel Oil Storage Tank

Figure 2.5.4b
Building 4732
Demolition Details

Redacted