FINAL
TECHNICAL MEMORANDUM
SUBAREA HSA-5C
HISTORICAL SITE ASSESSMENT
SANTA SUSANA FIELD LABORATORY SITE
AREA IV RADIOLOGICAL STUDY
VENTURA COUNTY, CALIFORNIA

Prepared for:

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LIST OF ACRONYMS AND ABBREVIATIONS

AEC	U.S. Atomic Energy Commission
AETR	Advanced Epithermal Thorium Reactor
ARRA	American Recovery and Reinvestment Act
AI	Atomics International Division of North American Aviation, Inc.
CAT	Computer Aided Tomography
CDPHE	California Department of Public Health and Environment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
Ci	Curie
COC	Contaminants of Concern
CT	computed axial tomography
D&D	decontamination and decommissioning
DHS	Department of Health Services
DOE	Department of Energy
dpm/100 cm^2	disintegrations per minute per 100 square centimeters
DTSC	Department of Toxic Substances Control
EPA	U.S. Environmental Protection Agency
EPIC	Environmental Photographic Interpretation Center
ETEC	Energy Technology Engineering Center
FCEL	Fast Critical Experiment Laboratory
FOIA	Freedom of Information Act
HGL	HydroGeoLogic, Inc.
HR	House Resolution
HSA	Historical Site Assessment
kW	kilowatt
LLTR	Large Leak Test Rig
LMEC	Liquid Metal Engineering Center
µR/h	microroentgen per hour
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MCP	maximum concentration permissible
MDA	minimum detectable activity
MWd	megawatt days
NASA	National Aeronautics and Space Administration
NBZ	Northern Buffer Zone
NRC	Nuclear Regulatory Commission
ORISE	Oak Ridge Institute for Science and Education
pCi/g	picocuries per gram

RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
S8DR	SNAP 8 Development Reactor
SBZ	Southern Buffer Zone
SGR	sodium graphite reactors
SHEA	Safety Health and Environmental Affairs
SNAP	Systems for Nuclear Auxiliary Power
SPTF	Sodium Pump Test Facility
SSFL	Santa Susana Field Laboratory
TM	technical memorandum
TO	task order
UPS	uninterruptible power supply

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1.0 INTRODUCTION

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

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

Table 1.1
Area IV Study Area
Subarea Designations

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

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

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

1.1 Technical Memoranda and the Radiological Historical Site Assessment

This TM presents information relating solely to sites and buildings located within Subarea HSA-5C. This TM, along with subsequent TMs prepared for the subareas identified in Table 1.1. Each TM has been made available in draft for review and informal comment by SSFL stakeholders and the general public. EPA responded to each comment via draft "Response to Comment" tables, which were also made available to SSFL Stakeholders. Each draft TM was edited as described in the Response to Comment tables, and these edits along with any new information made available to EPA have been compiled into EPA's official Radiological HSA for the Area IV Study Area.

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

1.2 Goals and Methodology of this TM

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

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

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

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

The information provided in this TM together with comments and recommendations provided by SSFL stakeholders and the general public will be used in the EPA's investigation strategy for sampling and analysis for residual radiological contamination in surface and subsurface soil within HSA-5C. In addition to the HSA, information gathered by EPA's Area IV and NBZ gamma scanning program and targeted geophysical investigation will assist EPA in fine-tuning the overall investigation strategy for the Area IV Study Area, and in making the final determination of the appropriate MARSSIM classifications.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

The NBZ is a 175-acre parcel of land that abuts the SSFL property (Figure 1.2). The NBZ is a naturally vegetated area containing drainage channels that transport surface water from the SSFL

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

downslope to surrounding populated areas.[1] The NBZ was purchased by the Rocketdyne Division of Rockwell International (Rockwell) in 1998 from the adjoining Brandeis-Bardin Institute (now known as the American Jewish University) because an environmental contractor found that the NBZ contains radioactive and chemical contamination that had migrated from the SSFL.

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

1.4 Brief Description and History of HSA-5C

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

1.5 Sites in HSA-5C

During the peak of operations, Subarea HSA-5C comprised 23 sites, most of which were buildings. This TM addresses each of these 23 sites within Subarea HSA-5C. Of the 23 sites, one was a reactor (Building 4059), one was a criticality test facility (Building 4100) and others housed operations involving radioactive materials. It is important to note that EPA and HGL continue to obtain and receive information that may alter the findings of this TM. Of the 23 sites in Subarea HSA-5C, only 6 buildings remain today.

1.6 Site Summary Methodology

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

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

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

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

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

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

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

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

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

In preparing the HSA-5C TM, 429 individual documents and photographs were reviewed. The review process was conducted by first screening over 80,000 documents amassed for the project.

This screening effort produced 429 documents relevant to past operations at facilities within HSA-5C and was therefore determined to warrant in-depth evaluation. Each of these 429 relevant documents was thoroughly evaluated for information considered useful for carrying out the goals listed in Section 1.2 of this TM. In addition to screening and evaluating reports and other documents, a comprehensive aerial photograph analysis of Area IV was prepared. This analysis is provided in Appendix A of the HSA.

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

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

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

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

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

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

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

At the discretion of the Interviewee, each interview was conducted either by representatives of the EPA only, representatives of the DOE only or jointly by EPA and DOE representatives. EPA's primary objective of the interview program was to help direct the soil sampling crews to potential source areas of radiological contamination identified during the course of each

interview. All information on potential source areas, corroborated or not, was recorded in EPA's HSA process.

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

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

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

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

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

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

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

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

Aerial Photographs

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

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

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

Radionuclides of Concern

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

Drainage Pathways

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

Radiological Contamination Potential

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

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

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

Recommended Locations for Soil/Sediment Sampling

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

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

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2.0 FINDINGS

This section organizes the building areas within HSA-5C according to six logical "clusters" (a.k.a. groups) based on operational characteristics and geographic locations. Plate 1 depicts the entire HSA-5C subarea and should be referenced while reading Section 2. Each HSA-5C group (discussed in Sections 2.1 through 2.6, below) is depicted in an accompanying group map, which serves as a guide for the text describing the building areas in that group and also as an index for the group's site photograph and building layout drawings.

2.1 Group 1

The Group 1 index map is presented in Figure 2.1. Following Figure 2.1, the site photograph and layout drawings for each building area within HSA-5C Group 1 are presented. HSA-5C Group 1 includes three building areas containing the Building 4059 Systems for Auxiliary Nuclear Power (SNAP) reactor and associated buildings.

2.1.1 Building 4039 Area

Site Description: The Building 4039 area comprises the former Building 4039 and the land around it located on 20th Street. Building 4039 was constructed in approximately 1964 as an office building.[1, 2] Figures 2.1.1a through 2.1.1b provide a current photograph and the best available building-specific drawing(s) that the research team could find. No as-built drawings were located for Building 4039. Buildings 4038, 4057, and 4626, located south of Building 4039 are discussed in this TM. Building 4757, located west of Building 4039, is an electrical substation for Buildings 4038 and 4057. Building 4059, located north of Building 4039, housed the SNAP 8 development reactor. Plate 1 presents a summary of all identified features for this site.

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

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

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

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

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

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

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

Former Radiological Burial or Disposal Locations: None found.

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

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

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

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

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

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

Recommended Locations for Soil/Sediment Sampling:

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

Previous characterization studies for the Building 4039 area were focused on delineating the extent of contamination to standards that were applicable at the time. Therefore, additional characterization is recommended for the Building 4039 area. This includes the following Building 4039 areas and appurtenances:

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

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

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

2.1.2 Building 4059 Area

Site Description: The Building 4059 area comprised Building 4059 and the land surrounding it on 20th Street. Building 4059 was constructed in 1961 and was modified in 1964 to provide a simulated space environment for ground-testing the Systems for Auxiliary Nuclear Power (SNAP) prototype reactor, S8DR. Building 4059 was a 31-foot-tall concrete and Butler-type structure with approximately 10,764 square feet of floor space.[1, 2] Figures 2.1.2a through 2.1.2g provide a current photograph and the best available building-specific drawing(s) that the research team could find. Plate 1 presents a summary of all identified features for this site.

Building Features: Building 4059 contained a below-ground test vault 28 by 39 feet in area and 32 feet deep. The vault walls were of dense borated concrete. Building 4059 also contained a pipe chase room, vacuum equipment room, and a contaminated liquid holdup system. The pipe chase room, located adjacent to the vault, was sand filled and contained the vessel shield cooling pipes and a line from the vacuum chamber to the vacuum equipment room. The vacuum

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

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

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

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

- "There was a SNAP reactor in building 59. In the 1990s, the plan for decommissioning it was to excavate the building down to ground level and fill it in. I worked on the final (at that time) decommissioning report. There were some solvents in the ground at one location. I made a very rough estimate about how much would be there and my calculations predicted that there might have been as much as one bottle! Eventually, the decision was made to excavate everything and then backfill."[4] This former employee worked at the SSFL between 1959 and 1981.
- "One of my concerns is with Building 4059, which was a reactor building. I know they took sand that was discovered to be contaminated out of the pit. I don't know what else they have done since then. I heard the building was torn down. Building 4059 was the last reactor that went in and the reason I know that is because I was the inspector when the fuel rods were placed in the vessel. That reactor ran about a year and then they took everything out… As I mentioned earlier, they took the reactor out of Building 4059 years ago and then they set that building up for other tests at that time. Even though Health & Safety said Building 4059 was a safe building to be in, I went in with my own equipment, including a Geiger counter, and walked that whole building to make sure it was safe. I did my own checking to verify that Health & Safety was right. When we were working in Building 4059, we wore rubber gloves, and in some cases booties and coveralls. When

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

you come out of the work area you removed clothing or anything else that had become contaminated and put it into a separate container for disposal as radioactive material. So they took pretty good care up there. Anything radiological was shipped off the site to a burial ground in either Idaho or Nevada. I am not aware of anything being buried on site… I am still concerned about Building 4059. It might be a good idea to put in some wells around it and close to it and make sure there is no contaminated groundwater around that building because the reactor was in the basement and they had a 5-foot diameter tube that went from the reactor vessel to a huge diffusion pump packed in dry sand. The pump was used to prevent water from filling the cavity. The pump went bad and the cavity filled up with water. The water may have become radioactive at that time. It wasn't what I called dirty radiation, but the water and/or cavity probably became radioactive. That's the place I'm concerned with. If it's been cleaned up and a report has been written on it then fine. You would have to go down at least 40 feet to see if there was any groundwater contamination because the basement was 32 foot deep and this was below that. The Building 4059 radioactive water could have possibly drained down into Simi Valley and could be the reason people are saying there is some contamination down as far as Royal Street in Simi Valley. It might be worth looking into."[1] This former employee worked at the SSFL between 1967 and 1985.

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

Building 4059 Incident Report Summary

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

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

Building 4059 Incident Report Summary (continued)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

[1] Vitkus, T. J., *Verification Survey of the Building 059 Excavation, Santa Susana Field Laboratory, The Boeing Company, Ventura County, California*, Final Report, Oak Ridge Institute for Science and Education, March 2005, p. 8.
[2] Graves, A. W., *Decontamination and Disposition Facilities Program Plan*, Atomics International Report No. PP-704-990-002, January 23, 1975, p. 11.
[3] Sturtevant, W.C. et al., *Building 059 Remediation Program, Phase II Reactor Test Cell Remediation*, EID-04422, June 25, 1999, pp. 24-25.
[4] Rockwell International, *Radiological Survey Results – Interim Status, Building 059, Santa Susana Field Laboratory*, N704TI990043, November 28, 1978.
[5] Dempsey, Gregg, *Report on Environmental Samples Collected at the Rocketdyne Santa Susana Field Laboratory*, Environmental Protection Agency, Office of Radiation Programs, Las Vegas Facility, July 1989, pgs. 5-6.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Radionuclides of Concern: The SNAP 8 reactor contained 211 fuel/moderator elements of zirconium-uranium hydride ($(Zr\text{-}U)H_x$) with beryllium reflector segments.[3] Some parts of this facility, such as steel and concrete, became activated by neutrons produced by the reactors. Tritium was produced and was detected in groundwater pumped from a French drain around the western end of the basement.[2] Potential radioactive contaminants include U-238, U-234, U-235, Pu-238, Pu-239, Pu-240, Pu-241, Am-241, Cs-137, Sr-90, H-3, Fe-55, Co-58, Co-60, Ni-63, Ba-133, Eu-152, Eu-154, Eu-155, Pm-147, and Ta-182.[3] All radionuclides of concern listed with the exception of Co-58 and Ta-182, are included in the August 2010 Final Field Sampling Plan for soil sampling in Area IV. Co-58 and Ta-182 both have half-lives of less than 1 year and thus do not meet the criteria for analysis. Table 3.3 presents a summary of contaminants of concern.

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

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

Recommended Locations for Soil/Sediment Sampling:

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

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

- The area at the north end of the site where possible open storage was identified in the 1965 aerial photograph. Radionuclides originating from Building 4059 may have migrated to this area via surface water flow or airborne releases.

- The storm drains located on the northwest and southern sides of the site. If radiological materials were released from Building 4059, they may have migrated to the storm drain network during precipitation events.

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

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

2.1.3 Building 4459 Area

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

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

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

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: Building 4459 was demolished in 2003. Based on available information, the dimensions of the excavation made during building demolition are unknown.

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

Radiological Use Authorizations: None found.

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

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

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

Radionuclides of Concern: The research team did not find evidence that radioactive materials were used or stored in Building 4459. However, the building is located approximately 35 feet northwest of Building 4059; consequently, there is some potential that radionuclides associated with Building 4059 may have migrated to the area surrounding former Building 4459. The S8DR Reactor Building 4059, located adjacent to the site, contained 211 fuel/moderator elements of (Zr-U)H_x with beryllium reflector segments.[2] Potential radioactive contaminants include U-238, U-234, U-235, Pu-238, Pu-239, Pu-240, Pu-241, Am-241, Cs-137, Sr-90, H-3, Fe-55, Co-58, Co-60, Ni-63, Ba-133, Eu-152, Eu-154, Eu-155, Pm-147, and Ta-182.[3] All radionuclides of concern listed with the exception of Co-58 and Ta-182, are included in the August 2010 Final Field Sampling Plan for soil sampling in Area IV. Co-58 and Ta-182 both have half-lives of less than 1 year and thus do not meet the criteria for analysis. Table 3.3 presents a summary of contaminants of concern.

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

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

Recommended Locations for Soil/Sediment Sampling:

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

Previous characterization studies for the Building 4459 area were focused on delineating the extent of contamination to standards that were applicable at the time. Therefore, additional characterization is recommended for the Building 4459 area. This includes the following Building 4459 areas and appurtenances:

- The area to the northeast of the site where possible open storage was identified in the 1965 aerial photograph. Radionuclides originating from Building 4059 may have migrated to this area via surface water flow or airborne releases.

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

- The storm drain located on the west side of the site. If radiological materials were released from Building 4059, they may have migrated to the storm drain network during precipitation events.

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

2.2 Group 2

The Group 2 index map is presented in Figure 2.2. Following Figure 2.2, the site photograph and layout drawings for each building area within HSA-5C Group 2 are presented. HSA-5C Group 2 includes six building areas containing office and support buildings, two sodium test rigs, a Systems for Auxiliary Nuclear Power (SNAP) vacuum test facility, instrument calibration facilities, and associated buildings.

2.2.1 Building 4038 Area

Site Description: The Building 4038 area comprises Building 4038 and the land surrounding it on 20th Street. Building 4038 was constructed between 1963 and 1965 as an office building. It is 15,297 square feet in area and is constructed with a steel frame, roof and siding anchored to a concrete floor.[1, 2] Figures 2.2.1a through 2.2.1b provide a current photograph and the best available building-specific drawing(s) that the research team could find. Floor plans depicting other building configurations were not located. Plate 1 presents a summary of all identified features for this site.

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

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

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

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

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

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

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

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Locations: None found.

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

Radionuclides of Concern: The research team did not find evidence that radioactive materials were used or stored within Building 4038. However, in 1978, a storage yard located at the northwest end of the Building 4038 site held barrels of activated sand from the vacuum duct room of the SNAP 8 Development Reactor Building 4059. The barrels contained activation products of europium (primarily Eu-152) and Co-60.[3] Building 4038 area is located approximately 420 feet south of Building 4059; consequently, there is some potential that other radionuclides associated with Building 4059 may have migrated to the area surrounding Building 4038. Radionuclides associated with the operations of SNAP reactor Building 4059 include U-238, U-234, U-235, Pu-238, Pu-239, Pu-240, Pu-241, Am-241, Cs-137, Sr-90, H-3, Fe-55, Co-58, Co-60, Ni-63, Ba-133, Eu-152, Eu-154, Eu-155, Pm-147, Ta-182.[4] All radionuclides of concern listed, with the exception of Co-58 and Ta-182, are included in the August 2010 Final Field Sampling Plan for soil sampling in Area IV. Co-58 and Ta-182 both have half-lives of less than 1 year and thus do not meet the criteria for analysis. Table 3.3 presents a summary of contaminants of concern.

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

[1] Sapere, Consulting, Inc., *Historical Site Assessment of Area IV Santa Susana Field Laboratory, Ventura County, California*, Volume 2 – Area IV Site Summaries, May 2005, p. V-1.
[2] U.S. EPA, Environmental Photographic Interpretation Center Draft Report, March 2010.
[3] Chapman, J. A., *Radiological Survey of Buildings T019 and T013; an Area Northwest of T059, T019, T013, and T012; and a Storage Yard West of Buildings T626 and T038*, GEN-ZR-0010, 1988, pp. 25, 85, 91-92.
[4] Vitkus, T. J. and Morton, J. R., *Radiological Survey of the Building 059 Reactor Vault, Santa Susana Field Laboratory, Rockwell International, Ventura County, California*, Final Report, Oak Ridge Institute for Science and Education ORISE 95/G-18, June 1995, pp. 1-2, 8-9.

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

Recommended Locations for Soil/Sediment Sampling:

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

Previous characterization studies for the Building 4038 area were focused on delineating the extent of contamination to standards that were applicable at the time. Therefore, additional characterization is recommended for the Building 4038 area. This includes the following Building 4038 areas and appurtenances:

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

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

2.2.2 Building 4057 Area

Site Description: The Building 4057 area comprises Building 4057, Substation 4757, and the land surrounding these two buildings located on 20th Street. Building 4057 was constructed in approximately 1963 to house two sodium test rigs. It was constructed with a steel frame, siding and roof anchored to a concrete slab. The roof height is at two levels: 44 feet 7 inches and 20 feet 6 inches.[1, 2] Figures 2.2.2a through 2.2.2d provide a current photograph and the best available building-specific drawing(s) that the research team could find. Plate 1 presents a summary of all identified features for this site.

Building Features: Building 4057 contained a 5-ton and a 20-ton crane. In 1975, Building 4057 also contained two identical sodium test rigs that were used during research and development for the Space Station power generation system. The rigs comprised vessels and piping mounted on steel skids. The test vessels were 2 feet in diameter and 4 feet deep. Positive argon cover gas pressure was maintained to limit cover gas contamination. A sodium vapor trap prevented sodium aerosol from escaping to the atmosphere. A cooling water system was provided to protect the test vessel O-ring seals from excessive temperature.[3] The floor plan for Building 4057 is presented in Figure 2.2.2b. A dry well of unknown purpose and function was located on the south side of Building 4057. This is shown in Figures 2.2.2c and 2.2.2d.

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

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

Information from Interviewees: None to date.

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

Building 4057 Incident Report Summary

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

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

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

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

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Locations: None identified.

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

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

Radionuclides of Concern: The research team did not find evidence that radioactive materials were used or stored within Building 4057. However, the building was used as a research laboratory, so there is a possibility that radioactive materials may have been used. In addition, Building 4057 area is located approximately 130 feet south of Building 4059; consequently, there is some potential that other radionuclides associated with Building 4059 may have migrated to the area surrounding Building 4057. Radionuclides associated with the operations of nearby SNAP reactor Building 4059 include U-238, U-234, U-235, Pu-238, Pu-239, Pu-240, Pu-241, Am-241, Cs-137, Sr-90, H-3, Fe-55, Co-58, Co-60, Ni-63, Ba-133, Eu-152, Eu-154, Eu-155, Pm-147, Ta-182.[1] All radionuclides of concern listed with the exception of Co-58 and Ta-182, are included in the August 2010 Final Field Sampling Plan for soil sampling in Area IV. Co-58 and Ta-182 both have half-lives of less than 1 year and thus do not meet the criteria for analysis. Table 3.3 presents a summary of contaminants of concern.

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

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

Recommended Locations for Soil/Sediment Sampling:

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

Previous characterization studies for the Building 4057 area were focused on delineating the extent of contamination to standards that were applicable at the time. Therefore, additional characterization is recommended for the Building 4057 area. This includes the following Building 4057 areas and appurtenances:

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

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

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

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

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

2.2.3 Building 4062 Area

Site Description: The Building 4062 area comprises Building 4062 and the land surrounding it located on 20th Street. Building 4062 was constructed in 1963 as a non-nuclear support building for the Energy Technology Engineering Center (ETEC) program. Building 4062 was constructed with steel beams, corrugated steel siding, and a corrugated steel roof.[1, 2] Figures 2.2.3a through 2.2.3b provide a current photograph and the best available building-specific drawing(s) that the research team could find. No as-built drawings were located for Building 4062. Plate 1 presents a summary of all identified features for this site.

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

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

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

I**nformation from Interviewees:** None to date.

Radiological Incident Reports: None found.

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

Radiological Use Authorizations: None found.

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

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

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

Radionuclides of Concern: The research team did not find evidence that radioactive materials were used or stored within Building 4062. However, the building is located approximately 500 feet south of Building 4059; consequently, there is some potential that other radionuclides associated with Building 4059 may have migrated to the area surrounding Building 4062. Radionuclides associated with the operations of nearby SNAP reactor Building 4059 include U-238, U-234, U-235, Pu-238, Pu-239, Pu-240, Pu-241, Am-241, Cs-137, Sr-90, H-3, Fe-55, Co-58, Co-60, Ni-63, Ba-133, Eu-152, Eu-154, Eu-155, Pm-147, Ta-182.[2] All radionuclides of concern listed with the exception of Co-58 and Ta-182, are included in the August 2010 Final Field Sampling Plan for soil sampling in Area IV. Co-58 and Ta-182 both have half-lives of less than 1 year and thus do not meet the criteria for analysis. Table 3.3 presents a summary of contaminants of concern.

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

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

Recommended Locations for Soil/Sediment Sampling:

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

Previous characterization studies for the Building 4062 area were focused on delineating the extent of contamination to standards that were applicable at the time. Therefore, additional characterization is recommended for the Building 4062 area. This includes the following Building 4062 areas and appurtenances:

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

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

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

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

2.2.4 Building 4065 Area

Site Description: The Building 4065 area comprises Building 4065 and the land surrounding it located on F Street. Building 4065 was constructed in 1963 as a vacuum test facility for SNAP reactors. It was a 6,300-square-foot single-story building with galvanized steel walls and roof anchored to a concrete slab floor.[1, 2] Figures 2.2.4a through 2.2.4b provide a current photograph and the best available building-specific drawing(s) that the research team could find. No as-built drawings were located for Building 4065. Plate 1 presents a summary of all identified features for this site.

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

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

Information from Interviewees: None to date.

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

Building 4065 Incident Report Summary

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

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

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

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

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

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

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

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

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

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

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

associated with Building 4059 include U-238, U-234, U-235, Pu-238, Pu-239, Pu-240, Pu-241, Am-241, Cs-137, Sr-90, H-3, Fe-55, Co-58, Co-60, Ni-63, Ba-133, Eu-152, Eu-154, Eu-155, Pm-147, Ta-182.[1] All radionuclides of concern listed with the exception of Co-58 and Ta-182, are included in the August 2010 Final Field Sampling Plan for soil sampling in Area IV. Co-58 and Ta-182 both have half-lives of less than 1 year and thus do not meet the criteria for analysis. Table 3.3 presents a summary of contaminants of concern.

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

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

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

Recommended Locations for Soil/Sediment Sampling:

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

Previous characterization studies for the Building 4065 area were focused on delineating the extent of contamination to standards that were applicable at the time. Therefore, additional characterization is recommended for the Building 4065 area. This includes the following Building 4065 areas and appurtenances:

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

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

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

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

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

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

2.2.5 Building 4066 Area

Site Description: The Building 4066 area comprised Building 4066, time clock Building 4806, and the land surrounding these two buildings located on 20th Street. Building 4066 was constructed in 1963 for use in calibrating and testing non-radiological equipment. Building 4066 was a 4,800-square-foot steel building with concrete foundations and floor, corrugated steel siding and roof, housing a 3,524-square-foot laboratory.[1, 2] Figures 2.2.5a through 2.2.5b provide a current photograph and the best available building-specific drawing(s) that the research team could find. No as-built drawings were located for Building 4066. Plate 1 presents a summary of all identified features for this site.

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

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

Information from Interviewees: None to date.

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

Building 4066 Incident Report Summary

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

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

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

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

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

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

Radiological Use Authorizations: None found.

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

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

Radionuclides of Concern: Possible uranium release from accidental introduction of black powder to Building 4066 (see below). In addition, Building 4066 is located approximately 600 feet south of Building 4059; consequently, there is some potential that other radionuclides associated with Building 4059 may have migrated to the area surrounding Building 4066. Potential radioactive contaminants associated with the SNAP reactor Building 4059 include U-238, U-234, U-235, Pu-238, Pu-239, Pu-240, Pu-241, Am-241, Cs-137, Sr-90, H-3, Fe-55, Co-58, Co-60, Ni-63, Ba-133, Eu-152, Eu-154, Eu-155, Pm-147, Ta-182.[4] All radionuclides of concern listed with the exception of Co-58 and Ta-182, are included in the August 2010 Final Field Sampling Plan for soil sampling in Area IV. Co-58 and Ta-182 both have half-lives of less than 1 year and thus do not meet the criteria for analysis. Table 3.3 presents a summary of contaminants of concern.

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

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

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

Recommended Locations for Soil/Sediment Sampling:

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

Previous characterization studies for the Building 4066 area were focused on delineating the extent of contamination to standards that were applicable at the time. Therefore, additional characterization is recommended for the Building 4066 area. This includes the following Building 4066 areas and appurtenances:

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

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

2.2.6 Building 4626 Area

Site Description: The Building 4626 area comprised Building 4626 and the land surrounding it located behind Building 4057 on 20th Street. Building 4626 was constructed in approximately 1963 for equipment storage. It had a steel frame, siding, and roof anchored to a concrete slab. The roof height ranged between 15 and 25 feet.[1, 2] Figures 2.2.6a through 2.2.6b provide a current photograph and the best available building-specific drawing(s) that the research team could find. Plate 1 presents a summary of all identified features for this site.

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

[1] Energy Research and Development Administration, *Site Development Plan: 1977-1981*, LR-03026, Part 1, June 1975.
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[3] Chapman, J. A., *Radiological Survey of Buildings T019 and T013; and Area Northwest of T059, T019, T013, and T012; and a Storage Yard West of Buildings T626 and T038*, GEN-ZR-0010, 1988, pp. 25, 85, 92.

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

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

Radiological Incident Reports: None found.

Current Use: Building 4626 was demolished in 2004. Based on available information, the dimensions of the excavation made during building demolition are unknown.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): Rockwell conducted a radiological survey of the storage yard west of Building 4626 because it had been used to store radioactive materials. Survey results were below acceptable limits in 1988.[1]

Radiological Use Authorizations: None found.

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

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

Radionuclides of Concern: The research team did not find evidence that radioactive materials were used or stored within Building 4626. However, the building was used, in part to store equipment associated with the SNAP reactor program, so there is a possibility that radioactive materials may have been used. In addition, Building 4626 area is located approximately 150 feet south of Building 4059; consequently, there is some potential that other radionuclides associated with Building 4059 may have migrated to the area surrounding Building 4057. Radionuclides associated with the operations of adjacent SNAP reactor Building 4059 include U-238, U-234, U-235, Pu-238, Pu-239, Pu-240, Pu-241, Am-241, Cs-137, Sr-90, H-3, Fe-55, Co-58, Co-60, Ni-63, Ba-133, Eu-152, Eu-154, Eu-155, Pm-147, Ta-182.[3] All radionuclides of concern listed with the exception of Co-58 and Ta-182, are included in the August 2010 Final Field Sampling Plan for soil sampling in Area IV. Co-58 and Ta-182 both have half-lives of less than 1 year and thus do not meet the criteria for analysis. Table 3.3 presents a summary of contaminants of concern.

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

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

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

Recommended Locations for Soil/Sediment Sampling:

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

Previous characterization studies for the Building 4626 area were focused on delineating the extent of contamination to standards that were applicable at the time. Therefore, additional characterization is recommended for the Building 4626 area. This includes the following Building 4626 areas and appurtenances:

- The area between Building 4626 and Building 4059. Radionuclides originating from Building 4059 may have migrated to this area via surface water flow or airborne releases.

- The general areas on the east, south and west sides of Building 4626 as there is evidence of open storage surrounding Building 4626.

- The storm drains located on the northern and eastern side of Building 4626 (near Buildings 4039 and 4057). If radiological materials were released from Building 4626, they may have migrated to the storm drain network during precipitation events.

- The sanitary sewer lines located on the northern and eastern side of Building 4626 (near Buildings 4039 and 4057). If radioactive materials were released into the sanitary sewer system, residual contamination may exist in the materials surrounding the sewer lines.

2.3 Group 3

The Group 3 index map is presented in Figure 2.3. Following Figure 2.3, the site photograph and layout drawings for the building area within HSA-5C Group 3 are presented. HSA-5C Group 3 includes one building area containing criticality test facilities as well as adjacent disposal areas including trenches.

2.3.1 Building 4100 Area

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

wide.[1, 2] Figures 2.3.1a through 2.3.1b provide a current photograph and the best available building-specific drawing(s) that the research team could find. Plate 1 presents a summary of all identified features for this site.

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

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

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

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

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

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

Building 4100 Incident Report Summary

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Recommended Locations for Soil/Sediment Sampling:

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

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

- The drainage channel surrounding the site may provide a pathway for the migration of radionuclides originating from Building 4100.

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

- The septic tank area and associated leach field may contain residual radioactive contamination.

- The Building 4100 storage yard/debris field between Building 4100 and 24th Street has no documented remediation. If radioactive materials were released here, residual contamination may exist in this area.

- The Building 4100 trench may contain residual radioactive contamination because the depth of remediation and backfilling are not documented.

- The areas of the exterior waste storage tank for Building 4100 may contain residual radioactive contamination.

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

2.4 Group 4

The Group 4 index map is presented in Figure 2.4. Following Figure 2.4, the site photograph and layout drawings for the building areas within HSA-5C Group 4 are presented. HSA-5C Group 4 includes four building areas containing the Sodium Pump Test Facility, the Sodium Cleaning and Handling facility, and associated buildings.

2.4.1 Building 4461 Area

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

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

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

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

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

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

Radiological Use Authorizations: None found.

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

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

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

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

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

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

Recommended Locations for Soil/Sediment Sampling:

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

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

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

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

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

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

- Open storage area that was observed in aerial photos.

2.4.2 Building 4462 Area

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

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

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

Information from Interviewees: None to date.

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

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

Building 4462 Incident Report Summary

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

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

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

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

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

Radiological Use Authorizations: None found.

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

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

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

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

Radionuclides of Concern: The research team did not find evidence that radioactive materials were used or stored with the Building 4462 area. However, given its location within the ETEC, the presence of radioactive contamination cannot be ruled out. The Building 4462 area is located relatively close to radiological test Buildings 4009, 4020, and 4100; consequently, there is some potential that radionuclides associated with these buildings may have migrated to the Building 4462 area. Radionuclides used and generated in Buildings 4009, 4020, and 4100 include U-233, U-234, U-235, U-236, U-238, Th-232, Np-237, Pu-238, Pu-239, Pu-240, and Pu-241, and decay products including Th-228, Ra-228, Th-230, Ra-226, Pb-210, Pa-231, and Ac-227. All radionuclides of concern listed are included in the August 2010 Final Field Sampling Plan for soil sampling in Area IV.[2] Table 3.3 presents a summary of contaminants of concern.

Drainage Pathways: Based on general site topography, surface water from the site likely flows east to a storm drain that connects to an intermittent stream that flows southeast through Area III to a pond in Area II. Storm drains are located northeast and west of Building 4462. The storm drain along south of the site receives storm water from Buildings 4009, 4020, and 4100 where radioactive materials were used and radionuclides were generated.[3] Sanitary sewer lines are located on the north side of the site.

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

Recommended Locations for Soil/Sediment Sampling:

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

Previous characterization studies for the Building 4462 area were focused on delineating the extent of contamination to standards that were applicable at the time. Therefore, additional characterization is recommended for the Building 4462 area. This includes the following Building 4462 areas and appurtenances:

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

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

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

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

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

2.4.3 Building 4463 Area

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

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

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

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

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

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

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

Radiological Use Authorizations: None found.

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

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

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

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

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

Recommended Locations for Soil/Sediment Sampling:

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

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

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

2.4.4 Site 4662 Area

Site Description: The Site 4662 area comprises Site 4662 and the land surrounding it on 23rd Street. Site 4662 was constructed in approximately 1978 as a concrete pad with a roof.[1] Figures 2.4.4a through 2.4.4c provide a current photograph and the best available building-specific drawing(s) that the research team could find. Plate 1 presents a summary of all identified features for this site.

Building Features: Concrete Pad 4662 was 36 feet long by 12 feet wide. It had a 13-foot high roof covering 21 feet of length and concrete sloped ramps at each end. Figure 2.4.4b presents a foundation plan, and Figure 2.4.4c presents an elevation view.

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

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

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

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

Radiological Use Authorizations: None found.

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

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

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

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

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

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

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

Recommended Locations for Soil/Sediment Sampling:

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

Previous characterization studies for the Building 4662 area were focused on delineating the extent of contamination to standards that were applicable at the time. Therefore, additional characterization is recommended for the Building 4662 area. This includes the following Building 4662 areas and appurtenances:

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

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

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

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

2.5 Group 5

The Group 5 index map is presented in Figure 2.5. Following Figure 2.5, the site photograph and layout drawings for the building areas within HSA-5C Group 5 are presented. HSA-5C Group 5 includes eight building areas containing a Sodium Instrumentation building and numerous office buildings and trailers.

2.5.1 Building 4383 Area

Site Description: The Building 4383 area comprises Building 4383, Tower 4393, and the land surrounding these two buildings located on G Street. Building 4383 was constructed in approximately 1957, as a sodium instrumentation building. It was 3,691 square feet in area and 10 feet in height, constructed on a concrete pad and had a steel frame, siding and roof.[1, 2] Figures 2.5.1a through 2.5.1b provide a current photograph and the best available building-specific drawing(s) that the research team could find. Plate 1 presents a summary of all identified features for this site.

Building Features: Building 4383 contained laboratories, and a sodium tower. It also had a septic tank and a leach field.[3]. A floor plan of Building 4383 is presented in Figure 2.5.1b.

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

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: Building 4383 was demolished in approximately 1980. Based on available information, the dimensions of the excavation made during building demolition are unknown.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): Rockwell included the Building 4383 area in the 1994-1995 Area IV Radiological Characterization Survey. Radionuclide levels were below 1995 acceptable limits of less than 5 µR/h above background. Background was set at 15.6 µR/h.[4]

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

Radiological Use Authorizations: None found.

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

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

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

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

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

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

Recommended Locations for Soil/Sediment Sampling:

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

Previous characterization studies for the Building 4383 area were focused on delineating the extent of contamination to standards that were applicable at the time. Therefore, additional characterization is recommended for the Building 4383 area. This includes the following Building 4383 areas and appurtenances:

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

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

2.5.2 Building 4482 Area

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

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

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

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

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

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

[1] Energy Research and Development Administration, *Site Development Plan: 1977-1981, L*R-03026, Part 1, June 1975.
[2] Santa Susana Area IV, Atomics International/Energy Systems Group Planning Maps, March 1962–November 1992.
[3] Montgomery Watson Harza, *DOE Leach Fields (Area IV AOC) RCRA Facility Investigation Report, Santa Susana Field Laboratory, Ventura County, California*, Draft, October 2003, p. 2-5.

Radiological Use Authorizations: None found.

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

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

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

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

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

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

Recommended Locations for Soil/Sediment Sampling:

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

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

2.5.3 Building 4483 Area

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

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

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

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

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

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

Radiological Use Authorizations: None found.

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

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

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

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

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

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

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

Recommended Locations for Soil/Sediment Sampling:

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

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

2.5.4 Building 4484 Area

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

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

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

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

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

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

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

Radiological Use Authorizations: None found.

Former Radiological Burial or Disposal Locations: None found.

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

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

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

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

Recommended Locations for Soil/Sediment Sampling:

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

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

2.5.5 Building 4485 Area

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

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

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

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

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

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

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

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

Radiological Use Authorizations: None found.

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

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

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

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

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

Recommended Locations for Soil/Sediment Sampling:

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

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

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

2.5.6 Building 4486 Area

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

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

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

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

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

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

Radiological Use Authorizations: None found.

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

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

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

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

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

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

Recommended Locations for Soil/Sediment Sampling:

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

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

2.5.7 Building 4487 Area

Site Description: The Building 4487 area comprised Building 4487 and the land surrounding it located on 22nd Street. Building 4487 was constructed in 1981 as an office building. It was a prefabricated building with a wooden frame and stucco siding.[1, 2] Figures 2.5.7a through 2.5.7b provide a current photograph and the best available building-specific drawing(s) that the research team could find. Plate 1 presents a summary of all identified features for this site.

Building Features: Building 4487 contained air-conditioned offices, rest rooms, and a computer terminal room. It had a septic tank that was later excavated and removed. The floor plan for Building 4487 is presented in Figure 2.5.7b.

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

Information from Interviewees: None to date.

Radiological Incident Reports: None found

Current Use: Building 4487 was demolished in 2004. Based on available information, the dimensions of the excavation made during building demolition are unknown.

Previous Radiological Investigation(s) and Decontamination/Cleanup of Release(s): Boeing conducted periodic radiation surveys between December 2002 and 2004. No radiological contamination was detected above 2002, 2003, and 2004 designated background concentrations on those occasions.

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

Radiological Use Authorizations: None found.

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

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

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

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

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

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

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

Recommended Locations for Soil/Sediment Sampling:

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

Previous characterization studies for the Building 4487 area were focused on delineating the extent of contamination to standards that were applicable at the time. Therefore, additional characterization is recommended for the Building 4487 area. This includes the following Building 4487 areas and appurtenances:

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

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

2.5.8 Site 4538 Area

Site Description: The Site 4538 area comprised Parking Lot 4538 and the land surrounding it at the northwest corner of the intersection of 20th and G Streets.[1, 2] It was constructed in approximately 1966. Figures 2.5.8a through 2.5.8b provide a current photograph and the best available building-specific drawing(s) that the research team could find. Plate 1 presents a summary of all identified features for this site.

Building Features: Site 4538 was a paved parking lot. A site layout map is presented in Figure 2.5.8b.

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

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

Current Use: Site 4538 is undeveloped land.

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

Radiological Use Authorizations: None found.

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

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

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

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

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

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

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

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

2.6 Group 6

The Group 6 index map is presented in Figure 2.6. Following Figure 2.6, the site photograph and layout drawings for the building areas within HSA-5C Group 6 are presented. HSA-5C Group 6 includes one building area containing a warehouse building constructed over a former parking lot.

2.6.1 Building 4015 Area

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

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

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

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

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

Information from Interviewees: None to date.

Radiological Incident Reports: None found.

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

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

Radiological Use Authorizations: None found.

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

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

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

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

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

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

Recommended Locations for Soil/Sediment Sampling:

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

Previous characterization studies for the Building 4015 area were focused on delineating the extent of contamination to standards that were applicable at the time. Therefore, additional characterization is recommended for the Building 4015 area. This includes the following Building 4015 areas and appurtenances:

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

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

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

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

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

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

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

3.0 RADIONUCLIDE LIST

3.1 U.S. Atomic Energy Commission Special Nuclear Material License

The first license issued by the U.S. Atomic Energy Commission (AEC) for the SSFL site was Special Nuclear Material License No. SNM-21. It was initially issued on April 6, 1956, for use at the Canoga Park site. License No. SNM-21 authorized AI to receive and possess 50 grams of uranium enriched in uranium-235 (U-235) for use in fission counter tubes. License No. SNM-21 was amended 79 times in its 40-year history to increase the number and type of nuclear materials that could be handled at the Canoga Park and SSFL sites. This license was terminated on September 27, 1996. In February 1975, the AEC became known as NRC and License No. SNM-21 became an NRC license. License No. SNM-21 applies to company owned, not federally owned facilities. This license does not apply to the HSA-5C area.

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

On October 3, 1960, the AEC authorized AI, under License No. CX-17, to possess and operate a separable-half type critical experiments facility at power levels not exceeding 200 watts (thermal) in Building 100 (now known as Building 4100). AI conducted this research under contract to the Southwest Atomic Energy Associates of Shreveport, Louisiana. The license permitted the possession "and use of special nuclear materials as follows:

- 25 kilograms of U-233 and 110 kilograms of U-235 as fuel for the reactor;
- 135 grams of U-233, 1,135 grams of U-235, and 135 grams of Pu-239 in foils and capsules for use in connection with operation of the reactor;
- 0.5 gram each of U-233, U-235, and Pu-239 in fission counters for use in connection with operation of the reactor; and
- 32 grams of Pu in encapsulated neutron sources for use in connection with operation of the reactor."

License No. CX-17 also permitted the possession "and use of source materials as follows:

- 656 kilograms of Th-232 for use in the core and buffer regions of the reactor;
- 700 grams of natural uranium in foils and capsules for use in connection with operation of the reactor; and
- 0.5 gram each of U-234, U-236, and U-238 in fission counters for use in connection with operation of the reactor."

License No. CX-17 also permitted the possession "and use of 0.5 gram of Np-237 in fission counters for use in connection with operation of the reactor and to possess, but not to separate such byproduct materials as may be produced by operation of the reactor."

License No. CX-17 was amended ten times before it was terminated on October 6, 1980.

3.3 California Department of Public Health Radioactive Material License

On September 11, 1963, the State of California, Department of Public Health issued Radioactive Material License No. 0015-59 to Atomics International. This license authorized the possession and use of a wide range of radioactive materials at the De Soto Avenue, Canoga Park, and SSFL sites as listed in Table 3.1, below.

Table 3.1
Radioactive Materials Covered by License No. 0015-59

Radioactive Material (element and mass number)	Chemical and/or Physical Form	Maximum Quantity that Licensee may Possess
Any byproduct material between atomic number 3 and 83	Any	7 curies of each byproduct material between atomic number 3 and 83
Antimony-124	Any	50 curies
Iridium-192	Any	70 curies
Cobalt-60	Sealed sources	10 sources not to exceed 400 curies each
Hydrogen-3	Any	550 curies
Polonium-210	Any	150 curies
Any byproduct material	Separated from irradiated thorium and uranium samples	250 microcuries total
Hydrogen-3	Titanium tritide foil (U.S. Nuclear Corporation)	500 millicuries
Hydrogen-3	Titanium tritide foil (U.S. Radium Corporation)	1 curie
Strontium-90	Sealed source (U.S. Nuclear Corporation Model 312)	5 microcuries
Radium-226	Any	2,000 milligrams
Radium-226	Sealed neutron sources	500 milligrams
Cobalt-60	Sealed source (U.S. Nuclear Corporation Model 338)	1 source not to exceed 5 curies
Cobalt-60	Sealed source (Isotopes Specialties Company Model 338)	1 source not to exceed 5 curies
Cerium-144	Sealed source (Isotopes Specialties Company Model 160)	50 microcuries
Iridium-192	Sealed source (Technical Operations Model A424-1)	1 source not to exceed 20 curies
Radium-226	Sealed sources (NRC Equipment Corporation)	Seven sources not to exceed 0.4 milligram each
Strontium-90	Sealed sources	Two sources of 3 millicuries each
Americium-241	Any	2 millicuries
Natural or depleted uranium	Any	20,000 pounds
Natural thorium	Any	700 pounds

This license covered the use and possession of radioactive materials in Building 4100 that housed a calibration laboratory, a counting laboratory, and used company owned calibration sources. Up until December 1969, there had been 39 amendments to this license. The radioactive materials covered in the 39th amendment are listed in Table 3.2, below.

Table 3.2
Radioactive Materials Covered by License No. 0015-59, Amendment No. 39

Radioactive Material (element and mass number)	Chemical and/or Physical Form	Maximum Quantity that Licensee may Possess
Any radionuclide with atomic number 3 through 83	Any	25 curies for any one radionuclide
Antimony-124	Any	100 curies
Iridium-192	Any	100 curies
Cobalt-60	Sealed sources	10 sources not to exceed 400 curies each
Hydrogen-3	Any	10,000 curies
Polonium-210	Any	150 curies
Krypton-85	Any	100 curies
Neptunium-237	Any	100 microcuries
Radium-226	Any except as neutron sources	5 grams
Radium-226	Sealed neutron sources	500 milligrams
Cobalt-60	Sealed source (U.S. Nuclear Corporation Model 338)	1 source not to exceed 5 curies
Cobalt-60	Sealed source (Isotopes Specialties Company Model 338)	1 source not to exceed 5 curies
Cobalt-60	Sealed source (Lockheed Nuclear Products Dwg 442-1001)	25,000 +/- 2,500 curies in 12 sources
Iridium-192	Sealed source (Technical Operations Model A424-1)	4 sources not to exceed 100 curies each
Radium-226	Sealed sources (NRC Equipment Corporation)	Seven sources not to exceed 0.4 milligram each
Califonium-252	Sealed source (Oak Ridge)	2 sources not to exceed 550 microcuries each
Any radionuclide with atomic number 3 through 83	Any	Not to exceed 100 curies for any one radionuclide
Promethium-147	Promethium oxide	150,000 curies
Americium-241	Any	10 curies
Natural or depleted uranium	Any	20,000 pounds
Natural thorium	Any	1,000 pounds
Tantalum-182	Metal	500 curies
Natural or depleted uranium	Any	50,000 pounds
Mixed fission products (Hot Lab)	Any	10,000,000 curies
Any radionuclide with atomic number 3 through 83 (Hot Lab)	Any	100,000 curies for any one radionuclide

This license was amended 64 times up until August 2, 1979 when the license number was changed to No. 0015-70. This license number was changed a second time to No. 0015-19 on December 5, 1996. Up until August 27, 2010, there had been 110 amendments to this license.

3.4 Radionuclide List to be Used in Soil and Groundwater Sampling

From a review of historical documents and radioactive material licenses issued for the SSFL, all of the radionuclides selected for radiochemical analysis of soil samples are likely to have been used or generated on the SSFL. In the table below, certain radionuclides mentioned in source documents will not be analyzed. These have undergone radioactive decay in excess of 10 half-lives, such that they could no longer be present. These radionuclides include: Na-22, Fe-55, Sb-125, Cs-134, Ce-144, and Po-210. The September 23, 2010, Stakeholder Technical Meeting

Action Items Memo describes the radionuclides contained in soil analytical suites, the sample analytical approach, and provides explanations for deleting certain radionuclides from analysis.

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

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

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

Site No.	Use(s)	Current Status	Potential Radiological Contaminants of Concern	Preliminary MARSSIM Class
4383	Instrumentation Building, LMEC Assembly and Test Building	Demolished	U-233, U-234, U-235, U-236, U-238, Th-232, Np-237, Pu-238, Pu-239, Pu-240, Pu-241, Th-228, Ra-228, Th-230, Ra-226, Pb-210, Pa-231, Ac-227.	2
4459	URS Building, ETEC Storage Building	Demolished	U-238, U-234, U-235, Pu-238, Pu-239, Pu-240, Pu-241, Am-241, Cs-137, Sr-90, H-3, Fe-55, Co-58, Co-60, Ni-63, Ba-133, Eu-152, Eu-154, Eu-155, Pm-147, Ta-182.	1
4461	SPTF Motor Generator Building	Demolished	U-233, U-234, U-235, U-236, U-238, Th-232, Np-237, Pu-238, Pu-239, Pu-240, Pu-241, Th-228, Ra-228, Th-230, Ra-226, Pb-210, Pa-231, Ac-227.	1
4462	SPTF Building	Awaiting Demolition	U-233, U-234, U-235, U-236, U-238, Th-232, Np-237, Pu-238, Pu-239, Pu-240, Pu-241, Th-228, Ra-228, Th-230, Ra-226, Pb-210, Pa-231, Ac-227.	1
4463	Sodium Cleaning and Handling Facility Building	Awaiting Demolition	U-233, U-234, U-235, U-236, U-238, Th-232, Np-237, Pu-238, Pu-239, Pu-240, Pu-241, Th-228, Ra-228, Th-230, Ra-226, Pb-210, Pa-231, Ac-227.	1
4482	Government Project Office	Transferred Off Site	U-233, U-234, U-235, U-236, U-238, Th-232, Np-237, Pu-238, Pu-239, Pu-240, Pu-241, Th-228, Ra-228, Th-230, Ra-226, Pb-210, Pa-231, Ac-227.	2
4483	LMEC Office Trailer	Transferred Off Site	Radiological contamination is not anticipated in this area.	3
4484	Rest Room Trailer	Transferred Off Site	Radiological contamination is not anticipated in this area.	3
4485	LMEC Office Trailer	Transferred Off Site	Radiological contamination is not anticipated in this area.	3
4486	LMEC Office Trailer	Transferred Off Site	Radiological contamination is not anticipated in this area.	3
4487	ETEC Engineering Building, SHEA Office	Demolished	U-233, U-234, U-235, U-236, U-238, Th-232, Np-237, Pu-238, Pu-239, Pu-240, Pu-241, Th-228, Ra-228, Th-230, Ra-226, Pb-210, Pa-231, Ac-227.	2
4538	Parking Lot for Buildings 4482 through 4486	Vegetated Area	Radiological contamination is not anticipated in this area.	3
4626	LMEC Equipment Storage Building, ETEC Inventory Storage Building, SNAP Storage Building	Demolished	U-238, U-234, U-235, Pu-238, Pu-239, Pu-240, Pu-241, Am-241, Cs-137, Sr-90, H-3, Fe-55, Co-58, Co-60, Ni-63, Ba-133, Eu-152, Eu-154, Eu-155, Pm-147, Ta-182.	1
4662	SPTF Small Parts Cleaning Pad	Demolished	U-233, U-234, U-235, U-236, U-238, Th-232, Np-237, Pu-238, Pu-239, Pu-240, Pu-241, Th-228, Ra-228, Th-230, Ra-226, Pb-210, Pa-231, Ac-227.	1

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4.0 REACTOR/CRITICALITY FACILITIES/SIGNIFICANT SITES WORKS CITED

4.1 BUILDING 4059

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

Building 4059 Cited Documents

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SNAP 8 Ground Prototype Test Facility – Building 059, fragment, circa 1980, p.1.

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4.2 BUILDING 4100

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

Building 4100 Cited Documents

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