SEC Petition Evaluation Report

Petition SEC-00246

Report Rev. Number:	0
Report Submittal Date:	July 3, 2018
Subject Expert(s):	Monica Harrison-Maples
Site Expert(s):	N/A

Petition Administrative Summary

Petition Under Evaluation

Petition Number:	SEC-00246
Petition Type:	83.13
Petition Receipt Date:	December 13, 2017
Qualification Date:	March 1, 2018
DOE/AWE Facility Name:	De Soto Avenue Facility

Petition Class

Petitioner-Requested Class Definition:	All workers who worked at the De Soto Avenue Facility in Los Angeles County, CA during the period from January 1, 1965 through December 31, 1995.
Class Evaluated by NIOSH:	All employees of the Department of Energy, its predecessor agencies, and their contractors and subcontractors who worked at the De Soto Avenue Facility in Los Angeles County, California, from January 1, 1965 through December 31, 1995.
NIOSH-Proposed Class(es) to be Added to the SEC:	None

Related Petition Summary Information

SEC Petition Tracking Number(s):	SEC-00093 SEC-00156 SEC-00168 SEC-00234 SEC-00235
Petition Type:	83.13 83.14 83.14 83.14 83.13
DOE/AWE Facility Name:	Santa Susana Field Laboratory-Area IV Area IV of the Santa Susana Field Laboratory De Soto Avenue Facility Area IV of the Santa Susana Field Laboratory Area IV of the Santa Susana Field Laboratory
Petition Status:	Class added to the SEC for January 1, 1955 through December 31, 1958 Class added to the SEC for January 1, 1959 through December 31, 1964 Class added to the SEC for January 1, 1959 through December 31, 1964 Class added to the SEC for January 1, 1965 through December 31, 1988 No class added to the SEC

Related Evaluation Report Information

Report Title:	SEC Petition Evaluation Report for Petition SEC-00093 SEC Petition Evaluation Report for Petition SEC-00156 SEC Petition Evaluation Report for Petition SEC-00168 SEC Petition Evaluation Report for Petition SEC-00234 SEC Petition Evaluation Report for Petition SEC-00235
DOE/AWE Facility Name:	Santa Susana Field Laboratory-Area IV Area IV of the Santa Susana Field Laboratory De Soto Avenue Facility Area IV of the Santa Susana Field Laboratory Area IV of the Santa Susana Field Laboratory

ORAU Preparation and Review

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DCAS Review and Approval

Peer Review Completed By:	[Signature on File] *Lara Hughes* July 03, 2018
SEC Petition Evaluation Reviewed By:	[Signature on File] *James W. Neton* July 03, 2018
SEC Petition Evaluation Approved By:	[Signature on File] *Stuart L. Hinnefeld* July 03, 2018

Evaluation Report Summary: SEC-00246, De Soto Avenue Facility

The National Institute for Occupational Safety and Health (NIOSH) prepared this evaluation report in response to a petition to add a class of workers at the De Soto Avenue Facility to the Special Exposure Cohort (SEC). The *Energy Employees Occupational Illness Compensation Program Act of 2000*, as amended, (EEOICPA) and 42 C.F.R. pt. 83, *Procedures for Designating Classes of Employees as Members of the Special Exposure Cohort under the Energy Employees Occupational Illness Compensation Program Act of 2000*, describe the process for adding new classes to the SEC.

Petitioner-Requested Class Definition

NIOSH received petition SEC-00246 on December 13, 2017, and qualified it on March 1, 2018. The petitioner requested that NIOSH consider the following class: *All workers who worked at the De Soto Avenue Facility in Los Angeles County, CA during the period from January 1, 1965 through December 31, 1995.*

Class Evaluated by NIOSH

Based on its preliminary research, NIOSH accepted the petitioner-requested class. NIOSH evaluated the following class: *All employees of the Department of Energy, its predecessor agencies, and their contractors and subcontractors who worked at the De Soto Avenue Facility in Los Angeles County, California, from January 1, 1965 through December 31, 1995.*

NIOSH Determination about the Proposed Class(es) to be Added to the SEC

NIOSH has obtained internal monitoring data, including urinalysis sample results for uranium, thorium, and gross alpha. NIOSH has *in vivo* measurements included with the scanned radiological exposure files of individual De Soto workers across the radiological operational history of the facility through 1995. NIOSH also has external dosimetry results for workers in radiological job assignments. NIOSH has developed both an internal dose co-worker model (ORAUT-OTIB-0080) and an external dose co-worker model (ORAUT-OTIB-0077) to assess doses to unmonitored De Soto workers. NIOSH has reviewed facility plans, procedures, and activity reports to gain an understanding of the scope of the potential exposure scenarios during the period under evaluation. Based on its analysis of these available resources, NIOSH found no part of the class under evaluation for which it cannot estimate radiation doses with sufficient accuracy.

Feasibility of Dose Reconstruction

Per EEOICPA and 42 C.F.R. § 83.13(c) (1), NIOSH has established that it has access to sufficient information to: (1) estimate the maximum radiation dose, for every type of cancer for which radiation doses are reconstructed, that could have been incurred in plausible circumstances by any member of the class; or (2) estimate radiation doses of members of the class more precisely than an estimate of the maximum dose. Information available from the site profile and additional resources is sufficient to estimate the maximum internal and external potential exposure to members of the evaluated class under plausible circumstances during the specified period.

The NIOSH dose reconstruction feasibility findings are based on the following:

- Consistent with previous evaluations, NIOSH finds that it is feasible to reconstruct occupational medical dose with sufficient accuracy for De Soto workers for the period from January 1, 1965 through December 31, 1995, using information and methods in *Dose Reconstruction from Occupationally Related Diagnostic X-Ray Procedures* (ORAUT-OTIB-0006) and the De Soto Avenue Facility site profile documents (ORAUT-TKBS-0038-1 through -6).

- Principal sources of internal radiation for members of the proposed class included exposures to radioactive contamination resulting from operations involving unsealed radioactive materials, such as nuclear fuel fabrication and radiochemistry operations. Exposures would have been from inhalation or ingestion of radionuclides, such as uranium and thorium (including associated progeny) during fuel fabrication or laboratory operations associated with research and development.

- NIOSH previously determined in its evaluations of Area IV and De Soto petitions that some workers could have received intakes of radioactive materials that went unmonitored. These unmonitored exposures are addressed through the internal co-worker intake rates assigned for the operation period.

- Although NIOSH has disqualified *in vitro* analysis results from vendor Controls for Environmental Pollution (CEP) during the period August 1991 through June 1993 for all Santa Susana Field Laboratory (SSFL) sites including the De Soto Avenue Facility, NIOSH has determined that the lack of CEP *in vitro* data does not affect NIOSH's ability to perform sufficiently accurate internal dose reconstructions for monitored or unmonitored workers at the site. The site performed supplemental whole-body counts that showed no measurable exposures, and initiated confirmatory *in vitro* re-samples analyzed by a new contractor. The *in vitro* re-samples confirmed that there were no measurable internal exposures.

- NIOSH has identified thorium campaigns in 1970 and 1979 for which thorium-specific personnel and workplace monitoring are available. NIOSH has determined there are sufficient source term, process, air monitoring, and pre-work and post-work internal dosimetry data available to bound intakes of thorium for the operational period from January 1, 1965 through December 31, 1995 at the De Soto Avenue Facility.

- NIOSH has not identified any data that suggest the possibility for operational americium exposures at the De Soto facilities.

- NIOSH has determined that it is feasible to reconstruct personnel internal exposures with sufficient accuracy for employees at the De Soto Avenue Facility for the period from January 1, 1965 through December 31, 1995.

- Principal sources of external radiation for members of the proposed class included exposures to photon and beta radiation emitted from research reactor operations, irradiation facility operations, and from the various radioactive materials used at the site. To a lesser extent, neutron exposures could have resulted from operating the small research reactor and from operations involving nuclear fuel.

- NIOSH has access to photon, beta, and neutron external dosimetry results, as well as other supporting data for the entire period under evaluation. NIOSH also has access to area monitoring radiation survey summary information.

- To assess potential external dose to unmonitored employees, NIOSH developed a co-worker dose distribution model (ORAUT-OTIB-0077).

- In its previous SEC evaluations, NIOSH has found, and DHHS has concurred, that it has access to sufficient employee monitoring and workplace monitoring data to bound potential external exposures for employees at the De Soto Avenue Facility for 1959 through December 31, 1964. This current evaluation has found no evidence to the contrary for the period from January 1, 1965 through December 31, 1995.

- NIOSH has determined that it is feasible to reconstruct personnel external exposures with sufficient accuracy for employees at the De Soto Avenue Facility for the period from January 1, 1965 through December 31, 1995.

- Pursuant to 42 C.F.R. § 83.13(c) (1), NIOSH determined that there is sufficient information to either: (1) estimate the maximum radiation dose, for every type of cancer for which radiation doses are reconstructed, that could have been incurred under plausible circumstances by any member of the class; or (2) estimate the radiation doses of members of the class more precisely than a maximum dose estimate.

Health Endangerment Determination

Per EEOICPA and 42 C.F.R. § 83.13(c) (3), a health endangerment determination is not required because NIOSH has determined that it has sufficient information to estimate dose for the members of the evaluated class.

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SEC Petition Evaluation Report for SEC-00246

ATTRIBUTION AND ANNOTATION: This is a single-author document. All conclusions drawn from the data presented in this evaluation were made by the ORAU Team Lead Technical Evaluator: M. Harrison-Maples, Oak Ridge Associated Universities. The rationales for all conclusions in this document are explained in the associated text.

1.0 Purpose and Scope

This report evaluates the feasibility of reconstructing radiation doses for all employees of the Department of Energy, its predecessor agencies, and their contractors and subcontractors who worked at the De Soto Avenue Facility in Los Angeles County, California, from January 1, 1965 through December 31, 1995. It provides information and analyses germane to considering a petition for adding a class of employees to the congressionally-created SEC.

This report does not make any determinations concerning the feasibility of dose reconstruction that necessarily apply to any individual energy employee who might require a dose reconstruction from NIOSH. This report also does not contain the final determination as to whether the proposed class will be added to the SEC (see Section 2.0).

This evaluation was conducted in accordance with the requirements of EEOICPA, 42 C.F.R. pt. 83, and the guidance contained in the Division of Compensation Analysis and Support's (DCAS) *Internal Procedures for the Evaluation of Special Exposure Cohort Petitions*, DCAS-PR-004.[1]

2.0 Introduction

Both EEOICPA and 42 C.F.R. pt. 83 require NIOSH to evaluate qualified petitions requesting that the Department of Health and Human Services (DHHS) add a class of employees to the SEC. The evaluation is intended to provide a fair, science-based determination of whether it is feasible to estimate with sufficient accuracy the radiation doses of the class of employees through NIOSH dose reconstructions.[2]

42 C.F.R. § 83.13(c)(1) states: *Radiation doses can be estimated with sufficient accuracy if NIOSH has established that it has access to sufficient information to estimate the maximum radiation dose, for every type of cancer for which radiation doses are reconstructed, that could have been incurred in plausible circumstances by any member of the class, or if NIOSH has established that it has access to sufficient information to estimate the radiation doses of members of the class more precisely than an estimate of the maximum radiation dose.*

Under 42 C.F.R. § 83.13(c)(3), if it is not feasible to estimate with sufficient accuracy radiation doses for members of the class, then NIOSH must determine that there is a reasonable likelihood that such

[1] DCAS was formerly known as the Office of Compensation Analysis and Support (OCAS).

[2] NIOSH dose reconstructions under EEOICPA are performed using the methods promulgated under 42 C.F.R. pt. 82 and the detailed implementation guidelines available on the NIOSH Radiation Dose Reconstruction Program webpage.

radiation doses may have endangered the health of members of the class. The regulation requires NIOSH to assume that any duration of unprotected exposure may have endangered the health of members of a class when it has been established that the class may have been exposed to radiation during a discrete incident likely to have involved levels of exposure similarly high to those occurring during nuclear criticality incidents. If the occurrence of such an exceptionally high-level exposure has not been established, then NIOSH is required to specify that health was endangered for those employees who were employed for at least 250 aggregated work days within the parameters established for the class or in combination with work days within the parameters established for one or more other SEC classes.

NIOSH is required to document its evaluation in a report, and to do so, relies upon both its own dose reconstruction expertise as well as technical support from its contractor, Oak Ridge Associated Universities (ORAU). Once completed, NIOSH provides the report to both the petitioner(s) and the Advisory Board on Radiation and Worker Health (Advisory Board). The Advisory Board will consider the NIOSH evaluation report, together with the petition, petitioner(s) comments, and other information the Advisory Board considers appropriate, in order to make recommendations to the Secretary of DHHS on whether or not to add one or more classes of employees to the SEC. Once NIOSH has received and considered the advice of the Advisory Board, the Director of NIOSH will propose a decision on behalf of DHHS. The Secretary of DHHS will make the final decision, taking into account the NIOSH evaluation, the advice of the Advisory Board, and the proposed decision issued by NIOSH. As part of this decision process, petitioners may seek a review of certain types of final decisions issued by the Secretary of DHHS.[3]

3.0 SEC-00246, De Soto Avenue Facility Class Definitions

The following subsections address the evolution of the class definition for SEC-00246, De Soto Avenue Facility. When a petition is submitted, the requested-class definition is reviewed as submitted. Based on its review of the available site information and data, NIOSH will make a determination whether to qualify for full evaluation all, some, or no part of the petitioner-requested class. If some portion of the petitioner-requested class is qualified, NIOSH will specify that class along with a justification for any modification of the petitioner's class. After a full evaluation of the qualified class, NIOSH will determine whether to propose a class for addition to the SEC and will specify that proposed class definition.

3.1 Petitioner-Requested Class Definition and Basis

NIOSH received petition SEC-00246 on December 13, 2017. The petitioner requested that NIOSH consider the following class: *All workers who worked at the De Soto Avenue Facility in Los Angeles County, CA during the period from January 1, 1965 through December 31, 1995.*

The petitioner provided information and affidavit statements in support of the petitioner's belief that accurate dose reconstruction over time is impossible for the De Soto employees in question. NIOSH deemed the following information and statements sufficient to qualify SEC-00246 for evaluation:

[3] See 42 C.F.R. pt. 83 for a full description of the procedures summarized here. Additional internal procedures are available on the NIOSH Radiation Dose Reconstruction Program webpage.

- The petitioner provided statements asserting that the operations conducted at the De Soto Avenue Facility: (1) involved contractors and subcontractors shared with Area IV of the SSFL; and (2) involved the same hazards for which NIOSH determined it was unable to reconstruct radiation dose with sufficient accuracy for Area IV (i.e., occupational exposure to americium and thorium and its associated progeny) from January 1, 1965 through December 31, 1988.

- The petition included documentation describing thorium operations, including selections from log books and incident reports intended to document the use of americium and thorium "well into the Site Remediation period." The petition also provided citations of licensing documents authorizing the storage and use of special nuclear materials, including americium and thorium.

Based on its De Soto Avenue Facility research and data capture efforts, NIOSH determined that it has access to bioassay data, external monitoring records, radiological monitoring methods and procedures, environmental monitoring reports, and facility characterization records for De Soto Avenue Facility employees during the period under evaluation. However, NIOSH also determined that potential americium and thorium source term, monitoring data, and exposure scenarios at De Soto Avenue had not been fully evaluated. NIOSH concluded that there is sufficient documentation to support that thorium work was conducted at the De Soto Avenue Facility, for at least part of the petitioner-requested time period. While there is evidence that the facility did monitor for thorium in special circumstances; NIOSH determined the extent of that monitoring and the effectiveness of documenting worker exposure to thorium warranted further evaluation. The information and statements provided by the petitioner qualified the petition for further consideration by NIOSH, the Advisory Board, and DHHS. The petition qualified for full evaluation on March 1, 2018. The details of the petition basis are addressed in Section 7.4.

3.2 Class Evaluated by NIOSH

Based on its preliminary research, NIOSH accepted the petitioner-requested class because of the need to further evaluate the availability of dosimetry and related information for estimating radiation doses due to thorium and americium exposures at the facility. NIOSH also noted that Controls for Environmental Pollution (CEP) was the primary vendor for bioassay sample analyses from August 1991 through June 1993. Bioassay analyses performed by CEP are disqualified from consideration of dose by NIOSH due to concerns with the vendor's product quality. In 2016, the involvement of CEP qualified the Area IV petition SEC-00235 for evaluation, and NIOSH found that the exclusion of CEP data had no impact on dose reconstruction feasibility. Because the Area IV and De Soto facilities used the same dosimetry programs, NIOSH determined it was also appropriate to assess the disqualification of CEP-provided bioassay results on De Soto dose reconstruction feasibility. Therefore, NIOSH defined the following class for further evaluation: All employees of the Department of Energy, its predecessor agencies, and their contractors and subcontractors who worked at the De Soto Avenue Facility in Los Angeles County, California, from January 1, 1965 through December 31, 1995.

3.3 NIOSH Determination about the Proposed Class(es) to be Added to the SEC

NIOSH has obtained internal monitoring data, including urinalysis sample results for uranium, thorium, and gross alpha. NIOSH has *in vivo* measurements included with the scanned radiological

exposure files of individual De Soto workers across the radiological operational history of the facility through 1995. NIOSH also has external dosimetry results for workers in radiological job assignments. NIOSH has developed both an internal dose co-worker model (ORAUT-OTIB-0080) and an external dose co-worker model (ORAUT-OTIB-0077) to assess doses to unmonitored De Soto workers. NIOSH has reviewed facility plans, procedures, and activity reports to gain an understanding of the scope of the potential exposure scenarios during the period under evaluation. Based on its analysis of these available resources, NIOSH found no part of the class under evaluation for which it cannot estimate radiation doses with sufficient accuracy.

4.0 Data Sources Reviewed by NIOSH to Evaluate the Class

As is standard practice, NIOSH completed an extensive database and Internet search for information regarding the De Soto Avenue Facility. The database search included the DOE Legacy Management Considered Sites database, the DOE Office of Scientific and Technical Information (OSTI) SciTech Connect database, and the Hanford Declassified Document Retrieval System. In addition to general Internet searches, the NIOSH Internet search included OSTI OpenNet Advanced searches, the Nuclear Regulatory Commission (NRC) Agency-wide Documents Access and Management (ADAMS) web searches, and the DOE-National Nuclear Security Administration-Nevada Site Office-search. Attachment One includes a summary of De Soto Avenue Facility-related documents. The summary specifically includes data capture details and general descriptions of the documents retrieved.

In addition to the database and Internet searches listed above, NIOSH identified and reviewed numerous data sources to determine information relevant to determining the feasibility of dose reconstruction for the class of employees under evaluation. This included determining the availability of information on personal monitoring, area monitoring, industrial processes, and radiation source materials. The following subsections summarize the data sources identified and reviewed by NIOSH.

4.1 Site Profile Technical Basis Documents (TBDs)

A Site Profile provides specific information concerning the documentation of historical practices documented at the specified site. Dose reconstructors can use the Site Profile to evaluate internal and external dosimetry data for monitored and unmonitored employees, and to supplement, or substitute for, individual monitoring data. A Site Profile consists of an Introduction and five Technical Basis Documents (TBDs) that provide process history information, information on personal and area monitoring, radiation source descriptions, and references to primary documents relevant to the radiological operations at the site. The Site Profile for a small site may consist of a single document. As part of NIOSH's evaluation detailed herein, it examined the following TBDs for insights into De Soto Avenue Facility operations or related topics/operations at other sites:

- *TBD for Atomics International – Introduction*, ORAUT-TKBS-0038-1; Rev. 01; August 30, 2006; SRDB Ref ID: 30080

- *TBD for Energy Technology Engineering Center – Site Description*, ORAUT-TKBS-0038-2; Rev. 00; February 2, 2006; SRDB Ref ID: 22140

- *TBD for the Area IV of the Santa Susana Field Laboratory, the Canoga Avenue Facility (Vanowen Building), the Downey Facility, and the De Soto Avenue Facility (Sometimes Referred to as*

Energy Technology Engineering Ctr. [ETEC] or Atomics Int.) – Occupational Medical Dose, ORAUT-TKBS-0038-3; Rev. 02; October 31, 2008; SRDB Ref ID: 53184

- *TBD for the Area IV of the Santa Susana Field Laboratory, the Canoga Avenue Facility (Vanowen Building), the Downey Facility, and the De Soto Avenue Facility (Sometimes Referred to as Energy Technology Engineering Ctr. [ETEC] or Atomics International) – Occupational Environmental Dose*, ORAUT-TKBS-0038-4; Rev. 02; April 26, 2010; SRDB Ref ID: 80536

- *TBD for the Area IV of the Santa Susana Field Laboratory, the Canoga Avenue Facility (Vanowen Building), the Downey Facility, and the De Soto Avenue Facility (Sometimes Referred to as Energy Technology Engineering Ctr. [ETEC] or Atomics International)– Occupational Internal Dose*, ORAUT-TKBS-0038-5; Rev. 01; April 26, 2010; SRDB Ref ID: 80541

- *TBD for the Area IV of the Santa Susana Field Laboratory, the Canoga Avenue Facility (Vanowen Building), the Downey Facility, and the De Soto Avenue Facility (Sometimes Referred to as Energy Technology Engineering Ctr. [ETEC] or Atomics International)– Occupational External Dose*, ORAUT-TKBS-0038-6; Rev. 02; April 26, 2010; SRDB Ref ID: 80538

4.2 ORAU Technical Information Bulletins (OTIBs) and Procedures

An ORAU Technical Information Bulletin (OTIB) is a general working document that provides guidance for preparing dose reconstructions at particular sites or categories of sites. An ORAU Procedure provides specific requirements and guidance regarding EEOICPA project-level activities, including preparation of dose reconstructions at particular sites or categories of sites. NIOSH reviewed the following OTIBs and procedure as part of its evaluation:

- *OTIB: Dose Reconstruction from Occupationally Related Diagnostic X-Ray Procedures*, ORAUT-OTIB-0006, Rev. 04; effective June 20, 2011; SRDB Ref ID: 98147

- *OTIB: Analysis of Coworker Bioassay Data for Internal Dose Assignment*, ORAUT-OTIB-0019, Rev. 01; effective October 7, 2005; SRDB Ref ID: 19438

- *OTIB: Dose Reconstruction During Residual Radioactivity Periods at Atomic Weapons Employer Facilities*, ORAUT-OTIB-0070; effective March 5, 2012; SRDB Ref ID: 108851

- *OTIB: External Coworker Dosimetry Data for Area IV of the Santa Susana Field Laboratory, the Canoga Avenue Facility (Vanowen Building), and the De Soto Avenue Facility (sometimes referred to as Energy Technology Engineering Center [ETEC] or Atomics International),* ORAUT-OTIB-0077, Rev. 00; effective August 3, 2009; SRDB Ref ID: 72162

- *OTIB: Guidance on Assigning Occupational X-Ray Dose Under EEOICPA for X-Rays Administered Off Site*, ORAUT-OTIB-0079, Rev. 02; effective June 15, 2017; SRDB Ref ID: 166967

- *OTIB: Internal Coworker Dosimetry Data for Area IV of the Santa Susana Field Laboratory and the De Soto Avenue Facility*, ORAUT-OTIB-0080, Rev. 00; effective March 14, 2014; SRDB Ref ID: 131215

- *Procedure: Generating Summary Statistics for Coworker Bioassay Data*, ORAUT-PROC-0095, Rev. 00; effective June 5, 2006; SRDB Ref ID: 73397

4.3 Facility Employees and Experts

To obtain additional information, NIOSH interviewed two former workers, one employed at both Area IV (2017) and De Soto Avenue (2018a), and the other employed at De Soto (2018b).

- Personal Communication, 2017, *Personal Communication with Area IV - Santa Susana Field Laboratory Health and Safety Employee*; Telephone Interview by ORAU Team and NIOSH; April 18, 2017; SRDB Ref ID: 166532

- Personal Communication, 2018a, *Personal Communication with Former De Soto Avenue Facility Engineering Employee*; Telephone Interview by ORAU Team, NIOSH, and Boeing Company; May 1, 2018; SRDB Ref ID: 172299

- Personal Communication, 2018b, *Personal Communication with Former De Soto Avenue Facility Health and Safety Employee*; Telephone Interview by ORAU Team, NIOSH, and Boeing Company; May 16, 2018; SRDB Ref ID: 172300

4.4 Previous Dose Reconstructions

NIOSH reviewed its NIOSH DCAS Claims Tracking System (referred to as NOCTS) to locate EEOICPA-related dose reconstructions that might provide information relevant to the petition evaluation. Table 4-1 summarizes the results of this review. (NOCTS data available as of May 21, 2018)

Table 4-1: No. of De Soto Avenue Facility Claims Submitted Under the Dose Reconstruction Rule

Description	Totals
Total number of claims submitted for dose reconstruction	292
Total number of claims submitted for energy employees who worked during the period under evaluation (January 1, 1965 through December 31, 1995)	255
Total number of claims submitted for energy employees who started their employment during the period under evaluation (January 1, 1965 through December 31, 1995)	210
Number of dose reconstructions completed for energy employees who worked during the period under evaluation (i.e., the number of such claims completed by NIOSH and submitted to the Department of Labor for final approval)	215
Number of claims for which internal dosimetry records were obtained for the time period in the evaluated class definition	64
Number of claims for which external dosimetry records were obtained for the time period in the evaluated class definition	104

NIOSH reviewed each claim to determine whether internal and/or external personal monitoring records could be obtained for the employee. In addition to exposure data received from DOE in response to requests for individual claimant history data, NIOSH has scans created in 2009 of

employee radiological exposure files. The NIOSH scans included radiological exposure files through 2001. A sampling of DOE-supplied claimant data found sample results matching those in the scanned employee radiological exposure files. Internal dosimetry results in both the DOE claimant-response files and the scans include urine bioassay, fecal bioassay, thyroid measurement, chest scan, total body count, and some post-incident wound and nasal swab counting results. Results used to assess external exposure, including deep, shallow, extremity, eye, and neutron results (indicated as thermal or fast), are found in both the 2009 scanned files and the DOE claimant-response files.

4.5 NIOSH Site Research Database

NIOSH also examined its Site Research Database (SRDB) to locate documents supporting the assessment of the evaluated class. Of the 3,143 documents in the SRDB that are related to the De Soto Avenue Facility, Atomics International, and Area IV of the SSFL, 588 pertain solely to the De Soto Avenue Facility. These documents were evaluated for their relevance to this petition. The documents include historical background on radiological work plans and procedures, occupational dosimetry information including bioassay data, exposure investigations, radiological incidents, radioactive material licenses and use authorizations, site environmental and work area radiation surveys, air monitoring data, documentation of radiological work permits, radiological restricted access area entry permits and decommissioning documentation.

4.6 Other Technical Sources

In qualifying and evaluating the petition, NIOSH reviewed the following report:

REPORT: Analysis of Stratified Coworker Datasets, ORAUT-RPRT-0053, Rev. 02; effective October 8, 2014; SRDB Ref ID: 136245

4.7 Documentation and/or Affidavits Provided by Petitioners

In qualifying and evaluating the petition, NIOSH reviewed the following documents submitted by the petitioners:

- *Special Exposure Cohort Petition—Form B*, with attachments; received December 13, 2017; DSA Ref ID: 128711

- *Petitioner Response & Clarifications to Summary of Telephone Conversation and Agreements SEC-00246 DeSoto Facility 1965-1995;* [name redacted], CORE Advocacy for Nuclear & Aerospace Workers; received February 12, 2018; DSA Ref ID: 128791

- *Information about Visitor Logs in the De Soto Facility Log Book*, submitted as an email to NIOSH staff; received February 27, 2018; DSA Ref ID: 128837

- *Missing In Vivo, Whole-Body Count Scans*, handwritten notes memo; received March 30, 2018; DSA Ref ID 128857

5.0 Radiological Operations Relevant to the Class Evaluated by NIOSH

The following subsections summarize both radiological operations at the De Soto Avenue Facility from January 1, 1965 through December 31, 1995 and the information available to NIOSH to characterize particular processes and radioactive source materials. From available sources NIOSH has gathered process and source descriptions, information regarding the identity and quantities of each radionuclide of concern, and information describing processes through which radiation exposures may have occurred and the physical environment in which they may have occurred. The information included within this evaluation report is intended only to be a summary of the available information.

5.1 De Soto Avenue Facility Plant and Process Descriptions

The De Soto Avenue Facility site is located in Canoga Park, CA, and performed light industrial work with some laboratory-scale research and development. The facility was constructed in 1959 and was originally the headquarters of Atomics International. The radiological activities from the Canoga Avenue Facility were transferred to the De Soto Avenue Facility. Atomic Energy Commission (AEC) or Department of Energy (DOE) work conducted at De Soto Avenue included engineering design, construction, and nuclear fuel fabrication. Radiological operations at the De Soto Avenue Facility included: fuel fabrication operations in Building 001, operation of the L-77 low-power research reactor, radiochemistry support, operation of the Gamma Irradiation Facility (GIF) (an above-ground vault using sealed Cs-137 and Co-60 sources for radiation-hardening tests of electronic components and for food-irradiation research), and operation of the Mass Spectroscopy Laboratory (Mass Spec Lab) (which analyzed radioactive samples for helium content) in Building 004. The Mass Spec Lab historically was also known as the Helium Laboratory.

Radiological operations were conducted using nuclear fuel material and other radioactive materials in Buildings 001 and 004[4] from 1959 through 1983 (see Figure 5-1). All nuclear activities except operation of the GIF and some applied physics studies were terminated in 1983. All the building radiological work areas, except the GIF and the small area devoted to the applied physics activities, were decontaminated and released for unrestricted use in 1984. From 1983 through 1995, radiological work continued in Building 004 at a reduced level. Irradiation operations in the GIF (Bldg. 104) were terminated in 1994, and radiation sources were shipped offsite. Research studies in applied physics and physical chemistry using activated materials in the Mass Spec Lab were terminated in May 1995 (De Soto Site, undated) and the lab was relocated to a DOE facility at Battelle-Pacific Northwest National Lab in early 1996.

The Mass Spec Lab included: Rooms 414-69, 416-72, 414-75, 416-76, 416-76A, 414-77, 416-80, 416-80A and 414-81 in the northeast section of the 1st floor of Building 004. It was operational for approximately 25 years and was one of the original facilities in the world that performed helium analyses on activated materials. The Mass Spec Lab analyzed low-level, activated test samples for universities and national laboratories. The laboratory housed a Helium Mass Spectroscopic Analyzer

[4] Buildings 001 and 004 were renumbered 101 and 104 in 1984. Much of the historical documentation refers to the original building numbers. For consistency, this report uses 001 and 004 throughout.

capable of measuring irradiated metal samples for He-3/H-4 ratios useful in the evaluation of steels for use in reactor cores. Typical isotopes controlled by the laboratory were mainly activation products, such as Mn-54, Mn-56, Co-58, Co-60, Fe-59, and Nb-95. The laboratory also operated a mass spectrograph for the measurement of heavy elements, primarily isotopes of uranium, used in fuel fabrication. Low-level radioactive materials were also stored in the Mass Spec Lab until operations ceased (Lupo, 1999).

The Space Nuclear Auxiliary Power (SNAP) program was begun in 1955 and terminated in 1973 (see Table 5-1). Atomics International (AI) did development work for the U.S. government on a series of compact light-weight, reliable nuclear reactors capable of producing from 500 W up to 1000 kWe as part of the SNAP program. The SNAP-8 Experimental Reactor (S8ER) and SNAP-8 Developmental Reactor (S8DR) were designed and operated by Atomics International under contract with NASA, were tested and inspected during the 1960s, and used highly-enriched uranium-zirconium hydride fuel with Hastelloy N cladding, as did the SNAP-10A reactors (SNAP Reactor Overview, 1984). The S8ER, S8DR, and SNAP 10A reactors were designed, assembled, and tested during the period under evaluation. The program was very large; most of the fuel fabrication and assembly of individual new components was performed at the De Soto facility. All development, system assembly, checkout, and qualification was performed at Area IV (ETEC, 1991). After testing, the reactors underwent assessment of the stresses on reactor structures (e.g., fuel, cladding), also at Area IV. De Soto operations did not include handling or inspection of systems following reactor testing, or exposure to the irradiated fuel or SNAP reactor materials or structures.

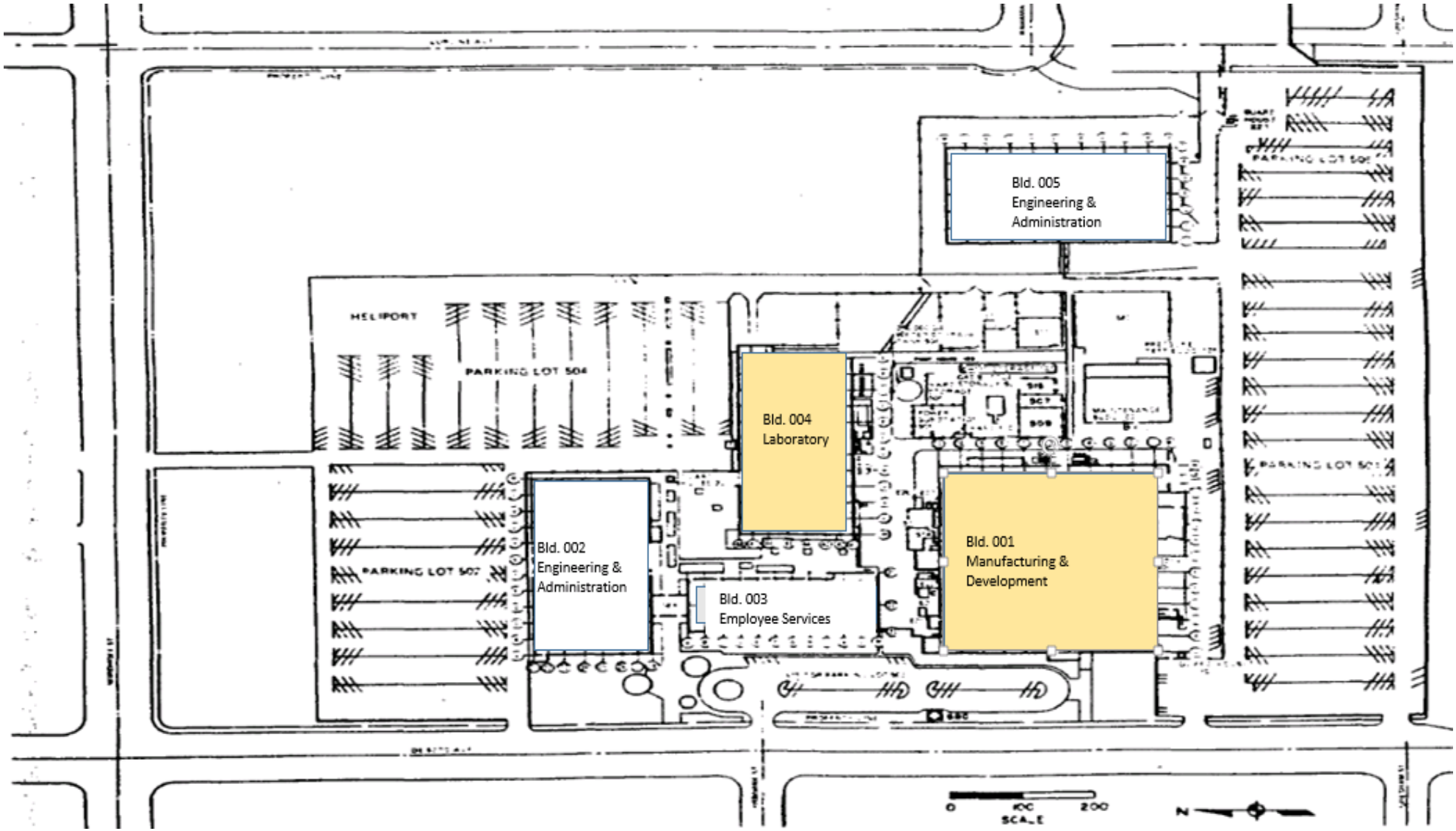
Table 5-1: Space Nuclear Auxiliary Power (SNAP) Reactors Designed at De Soto

Operational Details	S8ER	SNAP 10A Flight System 3	SNAP 10A Flight System 4	S8DR
Critical	May 1963	January 1965	April 1965	June 1968
Shutdown	April 1965	March 1966	May 1965	December 1969
Thermal power	600 kWt	38 kWt	43 kWt	600/1000 kWt
Time at Power and Temperature	1 year at 704 C, 400-600 kWt	417 days	43 days	7500 hours

Note: The above reactors were assembled and tested at Area IV.

Buildings 001 and 004 have been decommissioned and decontaminated (D&D). D&D included: removal of all fuel and radioactive materials and waste; removal of contaminated equipment, drain lines, tanks, and ventilation ducts; and cleaning of all surfaces, including floors, walls and ceilings.

For the period under evaluation, the De Soto Avenue Facility radiological workforce consisted of approximately 100 to 200 employees at any given time (Personal Communication, 2018b).



Source: De Soto Survey, 1985

Figure 5-1: Footprint of the De Soto Avenue Facility

5.2 Radiological Exposure Sources from De Soto Avenue Facility Operations

The following subsections provide an overview of the internal and external exposure sources for the De Soto Avenue Facility class under evaluation.

5.2.1 Internal Radiological Exposure Sources from De Soto Avenue Operations

This section addresses potential internal exposures to radionuclides at the De Soto Avenue Facility during the period under evaluation (1965 through 1995). The primary potential sources of internal radiation exposure at the site were inhalation and ingestion of radioactive contamination that could have resulted from operations involving unsealed radioactive materials, such as nuclear fuel fabrication and radiochemistry operations.

The De Soto Avenue Facility, as part of the SSFL complex, was supported by a full-time technical staff of radiation and nuclear safety specialists. These staff were responsible for determining and implementing specific safety techniques, radiation monitoring, dosimetry, and environmental monitoring programs. This same staff supported the Area IV operations under the same procedures and administrative guidance. The centralized nature of the radiological monitoring program resulted in the data for the associated sites being combined in centralized record systems. These same data were used to develop NIOSH's internal co-worker dose reconstruction methodology. The monitoring data from these programs have been previously assessed to ascertain their value for determining dose reconstruction feasibility during the evaluations for SEC-00093 Area IV, SEC-00156 Area IV, SEC-00168 De Soto, SEC-00234 Area IV, and SEC-00235 Area IV.

The engineering and design work performed at De Soto Avenue was implemented and tested at SSFL Area IV. The two facilities collaborated on the same project goals; however, they had different contributions. Area IV was primarily a nuclear development and testing facility, conducting reactor and critical testing operations with support operations, including all the functions carried out at De Soto Avenue and more. Similar to De Soto Avenue, Area IV operations included nuclear fuel manufacturing, fuel storage, and source fabrication. Area IV fabricated reactor fuel that included uranium, plutonium and, in the cases of the Sodium Reactor Experiment (SRE) and Advanced Epithermal Thorium Reactor (AETR), thorium. Although plutonium fuel was manufactured at Area IV, according to operational descriptions, none of the reactors or criticality experiments operated at Area IV used plutonium as a fuel (Rucker, 2009). These fuel materials and their progeny created exposure potentials at Area IV that did not occur at De Soto Avenue. Unlike De Soto Avenue, Area IV performed disassembly and examination of reactors and used reactor fuel assemblies, and conducted research on reprocessing used reactor fuel, which could have involved exposures to transuranic (TRU) materials. NIOSH has found no indication of any TRU-material sources of exposure at De Soto Avenue.

This section of the report concentrates on the assessment of uranium exposures, and potential americium and thorium exposures (for which this petition qualified for evaluation).

5.2.1.1 Uranium

De Soto Avenue focused on fuel-element fabrication (using uranium) and applied research. Uranium comprised the bulk of the radiological material on site. NRC-licensed fuel-fabrication operations for the Advanced Test Reactor (ATR) were conducted in Building 001 from 1966 to 1968. Briquettes of a 93% enriched uranium and aluminum alloy known as uranium aluminide (UAlx) were formed in an

electric arc-melting furnace. These briquettes were crushed to form a powder, which was cold-pressed into compacts that became the cores of the fabricated fuel plates. These operations were performed within containment and with air sampling. The room where these activities took place was known as the "powder room." Radiochemistry support operations involving hot chemistry laboratories, an emission spectroscopy laboratory, and an X-ray diffraction laboratory were conducted on the first and second floors of Building 004. Some of the uranium-aluminum alloy development work occurred in sealed gloveboxes. Fuel manufacturing of all types ended in 1983 (ORAUT-TKBS-0038-5, Attachment H).

5.2.1.2 Americium

Research of facility records and interviews with former workers revealed limited storage of americium sealed sources and research material at the De Soto site (Personal Communication, 2018a; Personal Communication, 2018b). The site maintained discrete sources of americium, specifically for instrumentation/equipment (i.e., a 10 mCi sealed source of Am-241 for an IPL Model GFS or Amersham Model AMPC.2) and held NRC or State of California licenses for them (License, 1981-1991). Americium sources were also on site in commercial items, such as smoke detectors and possibly in radiographic equipment (SSFL Operations, 1989). The De Soto site also conducted some research licensed by the State of California using radioactive materials containing approximately 30 kCi of Co-60 and 560 kCi of Cs-137. This research was conducted in Building 004, in the Applied Nuclear Technology Laboratories, and in the Gamma Irradiation Facility (Monitoring Report, 1989).

The Transuranic Management by Pyropartitioning-Separation (TRUMP-S) program used research amounts of plutonium, neptunium, and americium radioisotopes associated with the disposal of spent nuclear fuel in order to develop fundamental thermodynamic and electrochemical data on various transuranic materials so that processes could be developed for separating and destroying long-lived radioactive isotopes from spent nuclear fuel. These long-lived radioactive isotopes could then be destroyed by fissioning them in a nuclear reactor or accelerator, thereby eliminating the long-term hazard (Rucker, 2009). In 1989, TRUMP-S radiological materials, including 75 g of depleted uranium, 5 g of plutonium, 4 g of neptunium, and 4 g of americium were received at De Soto (Rucker, 2009). Review of the documentation referencing the TRUMP-S program indicates that the program never operated at the De Soto Avenue Facility. The materials were transferred to the Fuel Storage Facility at Area IV (Building 4064) for use in TRUMP-S testing that was planned for the Hot Lab (Area IV, Building 4020). The program was transferred from Area IV to the University of Missouri sometime after 1990; the materials were stored in Building 4064 until shipment. The program never operated at Area IV.

5.2.1.3 Thorium

NIOSH has identified detailed documentation of thorium work episodes in 1970 and 1979, providing source term, operational procedures, radiological protection protocols, names of individual operators, and dates of work. The documentation of the work dates and individuals involved corresponds with the available thorium bioassay results for the site. No other thorium work campaigns were verified during the literature research or by interviews with former De Soto workers. NIOSH has determined that these operations in 1970 and 1979 represent the potential exposure scenarios associated with bounding thorium internal exposures during the De Soto operational period from January 1, 1965 through December 31, 1995.

A May 1970 document, *Authorization* [No. 13] *for Use of Radioactive Materials or Radiation Producing Devices* documents the approval of a fabrication operation involving ThO_2 powder containing 5 kg of natural thorium (Authorization, May1970). The purpose was to fabricate fuel-simulant discs to be used in space-flight-related transit capsule testing. Three different processes were investigated and documented to attain the required product quality: Cold Press and Sinter, Hot Press, and Explosive Forming. Most of the work was to be done in the SNAP area in Building 001. Powder work was to be done in a glove box under negative pressure.

A June 1970 document, *Authorization* [No. 21] *for Use of Radioactive Materials or Radiation Producing Devices*, documents the post-test analyses for the transit capsule testing (Authorization, Jun1970). The transit capsules underwent impact, fragmentation, overpressure, and fire testing at Sandia Laboratories and then were shipped to Atomics International for post-test evaluation. The process of receiving the capsules at De Soto, a description of the facilities used, and the detailed process of disassembling and assessing the capsules is documented. The post-test analyses were to be conducted in Building 001. An internal letter (Harris, 1970) describes the disassembly work in the De Soto Avenue Hot Shop (Building 004) as occurring during June-July 1970, with the following estimates of hours from June 15 through July 30, by department:

- Hot Shop (Dept. 789): 160 hours
- Health and Safety (Dept. 779): 36 hours
- Photographic Services (Dept. 055): 76 hours
- Inspection (Dept. 754): 100 hours
- QA (Dept. 755): 20 hours
- Chemistry (Dept. 741): 150 hours
- Metallography (Dept. 737): 150 hours
- Vault (Dept. 785): 20 hours
- Radioisotope Materials Development (Dept. 737): 100 hours

NIOSH has identified a second major thorium operation at the De Soto Avenue facility. NIOSH has access to documentation regarding a Rockwell Isotopes Committee review of a proposal to machine thorium at De Soto in 1979 (Tuttle, 1979; Begley, 1979). The job was grinding corners off approximately 540 plates of thorium metal. The thorium material was 19 years post-fabrication, and thus, essentially in equilibrium. These documents specify the work procedures at a very detailed level (Health and Safety, 1979) to include: the amount of source term (approximately 200 kg of thorium metal); how much was expected to be removed (150 g); Health and Safety precautions; worker personal protective equipment (PPE); work location (Room 115-37 of Building 001); air sampling data, including a log of personal lapel air sampling and results for an air sampler attached to the grinding wheel; restricted access area entry permit, and identities of the workers. The daily log maintained for this operation documents activity from February 28, 1979 through March 12, 1979 (Grinding Log, 1979).

Information available to NIOSH indicates that the De Soto thorium work, both in oxide and metallic form, was limited, distinct, and well-documented. The same individuals are associated with both the oxide and metallic work. The site took appropriate precautions and worked to limit exposure during

thorium operations. NIOSH has access to bioassay data, breathing zone air data, and source-term information contained in detailed work documentation for thorium operations at De Soto Avenue. These data are available for developing bounding thorium intake rates.

5.2.2 External Radiological Exposure Sources from De Soto Avenue Operations

The potential for external radiation dose existed at the De Soto Avenue Facility in all areas where radioactive materials were handled or stored. Based on the site operations, sources of exposure included photon and beta radiation emitted from the various radioactive materials used at the site. To a lesser extent, neutron exposures could have resulted from operating the small research reactor and from operations involving nuclear fuel.

The primary potential sources of external dose for De Soto Avenue Facility employees during the period under evaluation (1965 through 1995) were surface contamination in the nuclear fuel fabrication areas of Building 001, and in the radiochemistry support operations areas of Building 004, as well as direct exposure to irradiation sources in use in the facility.

Only uranium-bearing fuels with enrichments in U-235 ranging from normal uranium to highly-enriched were processed in Building 001. Typical fuel forms included uranium metal, alloys of uranium-molybdenum, uranium-aluminum, uranium-zirconium, and uranium with rare earths. All materials were solids except for the uranyl sulphate fuel for the L-77 reactor; no processing activities were conducted on any liquid fuels (Nuclear Activities, 1991). The uranium inventory depended directly on production schedules and varied over time, from a few kilograms up to several thousand kilograms with various enrichments. Nuclear fuel manufacturing ended in 1983.

Operations in Building 004 included research studies in applied physics and physical chemistry, analytical chemistry laboratories that supported nuclear fuel fabrication, operation of the L-77 reactor, and operation of the Gamma Irradiation Facility, an above-ground vault in Building 004 that used sealed Cs-137 and Co-60 sources for radiation-hardening tests of electronic components and food irradiation research. GIF activities ceased in the late 1980s; the sources were shipped off-site for recycling in the early 1990s. Bi-annual leak checks of GIF sources had determined that none of these sealed sources ever leaked (GIF, 2003). In 1995, a Rocketdyne survey of the GIF verified that it was not contaminated. The GIF was comprised of Rooms 41M-11 and 41M-11A attached to the northeast comer of Building 004 (GIF, 2003).

The L-77 was a small, enriched uranyl sulphate solution research reactor operated in Room 416-61 of Building 004. The uranyl sulphate was uranium-enriched to just less than 20% U-235 (Nuclear Activities, 1991). The L-77 reactor ceased operation in October 1974. The fuel solution was removed in March 1976, and the reactor was decommissioned and disposed of as low-level radioactive waste. The operating license was terminated in February 1982 (Nuclear Activities, 1991).

6.0 Summary of Available Monitoring Data for the Class Evaluated by NIOSH

Internal and external radiological monitoring data are available for individual workers at the De Soto Avenue Facility. The monitoring was performed and collected by the staff of radiation and nuclear safety specialists supporting both De Soto Avenue and Area IV. The centralized record-keeping organization maintained records of the monitoring results for the purpose of tracking worker exposures for both De Soto Avenue and Area IV workers during the years under evaluation. These records do not differentiate monitoring results by facility; therefore, NIOSH can identify an individual's monitoring results but cannot consistently distinguish the results by site since De Soto Avenue and Area IV operated contemporaneously.

The following subsections provide an overview of the state of the available internal and external monitoring data for the De Soto Avenue Facility class under evaluation.

6.1 Available De Soto Avenue Facility Internal Monitoring Data

The primary data used for determining internal exposures are derived from personal monitoring data, such as urinalyses, fecal samples, and whole-body count (WBC) results. In addition, air monitoring data from breathing zone and general area monitoring may be useful to estimate the potential internal exposure. Original personal monitoring and breathing zone area monitoring records for De Soto Avenue are available to NIOSH, as is source term information in the form of Use Authorization documentation created as part of Rockwell's Isotopes Committee process for controlling radionuclide operations.

As described in Section 5.2.1, the radiological monitoring programs for Area IV and De Soto were centralized. Monitoring records do not generally include location indications for the specific site (De Soto Avenue or Area IV) where a worker was assigned at the time of sampling.

Available *in vitro* bioassay data for De Soto Avenue employees include uranium bioassays and sample analyses for gross alpha and gross beta. Available *in vivo* bioassay data for De Soto employees include semi-annual whole-body counts performed by a contracted mobile counting lab brought on site.

Details regarding the various analyses used and the associated minimum detectable activities are presented in the Technical Basis Document *Area IV of the Santa Susana Field Laboratory, the Canoga Avenue Facility (Vanowen Building), the Downey Facility, and thee De Soto Avenue Facility (sometimes referred to as Energy Technology Engineering Center [ETEC] or Atomics International)-Occupational Internal Dose* (ORAUT-TKBS-0038-5).

6.1.1 *In Vitro* Monitoring

NIOSH has *in vitro* radiation dosimetry records: (1) for workers assigned to areas of high surface contamination; (2) as requested for specific operations; and (3) for special samples that may have been triggered by general workplace air and breathing-zone air samples exceeding site-prescribed thresholds. The *in vitro* bioassay records in the individual radiological exposure files generally consist of:

- individual personnel McBee key-sort cards, which were used to track the type, frequency, and week of sample collection (the card summarized individual results);
- individual analysis result sheets containing all the information on analyses conducted. This form might show the calculated result (even if it was below the limit of detection), the sensitivity of the analysis, and the uncertainty;
- wound monitoring reports; and
- individual, hand-drawn or computer-generated plots of bioassay data, apparently done as follow-up to high results.

Uranium urinalyses were performed for fuel-fabrication workers. Gross beta or mixed fission product urinalyses were available for workers in jobs having the potential for such exposures. Commercial laboratories performed analysis of urine samples. Special samples were requested when an intake was suspected, or if a routine sample exceeded 10% of the urinary excretion expected from 1 maximum permissible body burden (MPBB). Information on the vendors used by the program and when they were employed is available to NIOSH in a bioassay database. The vendors offered the following sample analysis services: fluorometric and radiometric uranium bioassay, gross alpha, and gross beta. (ORAUT-TKBS-0038-5) The bioassay database contains over 37,300 *in vitro* results from 1949 through 2008. These 37,300+ results include results from De Soto Avenue workers. The radiation safety program supporting the radiological work at De Soto Avenue and Area IV of the SSFL was centralized and focused on controlling workplace exposures. The records do not clearly differentiate samples for workers at De Soto Avenue from those at Area IV. Developing a count of De Soto Avenue-specific results would be labor-intensive, and unless the results were reported as radionuclide-specific, the effort would provide little additional information about De Soto-specific exposures.

The bioassay vendor laboratories did offer nuclide-specific analyses. The bioassay database includes results of samples analyzed for isotopes of cobalt, cesium, polonium, plutonium, strontium, tritium, thorium, and mixed fission products.

Specific, limited operations involving work with thorium occurred at De Soto Avenue. These operations are described in some detail in Section 7.2.1.1 of this report.

From June through July, 1970, De Soto conducted operations involving Transit Capsule testing in two rooms of Building 001. A total of 17 or 18 capsules were to be disassembled in the Hot Shop area. One machinist and an engineer were assigned to the task. NIOSH has dosimetry records from 1970 for both individuals, including two thorium urine results for the engineer, and three urine samples and one fecal sample for the machinist; all samples were analyzed for thorium mass (µgm).

Also during June 1970, De Soto conducted the fabrication of 5 to 10 pieces of thoria-molybdenum cermet fuel simulant in two rooms of Building 001 (Meyer, 1970). Analysis of the simulant was to be done in a different room in Building 001. Two operators were assigned to the simulant work. NIOSH has dosimetry records for those two operators, including two urine samples for each sent to U.S. Testing for thorium analysis. One sample was lost by the vendor, so NIOSH has three results related to this work. These samples were analyzed for thorium mass (µgm).

The 1979 operation called for grinding the corners off of approximately 540 plates of thorium metal. This operation was to be performed in one room in Building 001. One operator was assigned to perform the work, with one assistant and a supervisor. NIOSH has dosimetry records for all three individuals assigned to the operation, including two thorium urinalysis sample results for the operator, one before the job began, and one following job completion. These samples were analyzed for thorium mass (µgm). NIOSH also has copies of the Restricted Access Area Entry permit, general air sampling data, personal lapel air sampling data for the operator, and contamination survey reports for the operations (Grinding Safety, 1979).

During the period from August 1991 through June 1993, the vendor Controls for Environmental Pollution provided *in vitro* bioassay sample analysis services to SSFL, including De Soto Avenue. NIOSH does not use CEP sample analysis results to assign dose because CEP was suspected of producing unreliable results. In 1991, the site had self-identified concerns with the work products from CEP and subsequently was made aware of DOE concerns regarding potential falsification by CEP of Sandia National Laboratory bioassay processing. In December 1994 letters to SSFL monitored employees (Rockwell, 1994), Rockwell International stated the following:

- The CEP-related bioassays were all routine and/or baseline samples and none were the result of incidents;
- During the period when samples were analyzed by CEP (1991–1993), air sample data were routinely taken in work areas to confirm that airborne activity remained below regulatory limits;
- During that same time, the same workers underwent whole-body measurements performed by a different contractor (Helgeson), instituted as a separate and independent measure of internal exposure;
- The whole-body measurements showed no measurable exposures; and
- Follow-on samples analyzed by the new *in vitro* contractor, Teledyne-Brown Engineering, confirmed no measurable internal exposure.

Rockwell concluded their letter with: “In summary, although CEP bioassay results have been questioned, independent Helgeson WBS, Teledyne bioassays, and air sampling have confirmed that Rocketdyne workers have experienced no measurable internal exposure.”

As part of its 2017 evaluation of SEC-00235 (NIOSH, 2017), NIOSH determined that the lack of CEP *in vitro* data has not affected NIOSH’s ability to perform sufficiently accurate internal dose reconstructions for monitored or unmonitored workers. The data evaluated included monitoring for both SSFL Area IV and the De Soto Avenue facilities. NIOSH’s findings for SEC-00235 were based on the following:

- NIOSH compared remediation period bioassay data to operational period data (through 1988) that were used to develop NIOSH's internal co-worker intake rates. NIOSH saw no indication that the co-worker intake rates assigned for the end of the Area IV operation period (circa 1988) do not bound the potential remediation period exposures for unmonitored workers.

- NIOSH examined operations throughout the remediation period (1989–present) to evaluate the exposure conditions before, during, and after the CEP period of concern. NIOSH found that work remained consistent through the remediation period, and that all major radiological work in the CEP period 1991–1993 would have had workplace and/or personnel monitoring also performed outside the CEP-related period.

- During the August 1991 through June 1993 period with disqualified CEP bioassay results, the site was performing routine *in vivo* whole-body measurements with a different contractor. The site reported that the whole-body measurements showed no measurable exposures. In response to concerns with CEP data, the SSFL site also initiated confirmatory resamples analyzed by a new contractor, and reported that these follow-up *in vitro* results confirmed no measurable internal exposures.

6.1.2 *In Vivo* Monitoring

Helgeson Scientific Services was contracted by the Rocketdyne Division to provide onsite *in vivo* bioassay evaluations of workers every six months. Suspected intakes would have triggered follow-up *in vitro* bioassay sampling, or if the *in vivo* bioassay vendor was scheduled to be available, a whole-body or other count. Under the routine bioassay program, an *in vivo* analysis typically would be scheduled once every six months for workers with duties in high-contamination areas or airborne-radiation areas. In addition to whole-body count results, NIOSH has a limited number of other *in vivo* bioassay results, such as lung, thyroid, and wound counts. The *in vivo* bioassay reports provided by Helgeson Scientific identify the measurements as organ-specific or total-body, and include a table of minimum sensitivities for the counter, calibration information, and descriptions of the counting equipment in terms of the detector and electronics (Helgeson, 1993). The *in vivo* monitoring results reported by Helgeson for the Rockwell sites included results for radionuclides of uranium, cesium, potassium, zinc, and americium for plutonium. Thyroid measurements for radioactive iodine were also reported.

As presented in Section 6.1.1, during the August 1991 through June 1993 period with disqualified CEP bioassay results, the site was performing routine *in vivo* whole-body measurements. The monitoring information in employee radiological exposure files included *in vivo* whole-body measurement results. In the 1994 letter to SSFL workers potentially affected by the CEP bioassay issue, Rockwell International stated that the scans done during the time of the CEP contract were "instituted as a separate, independent measure of internal exposure." This letter also stated that there was "no measurable internal exposure" to the Rocketdyne workers (Rockwell, 1994). This statement is supported in the results examined by NIOSH for its 2017 evaluation of SEC-00235, which consisted predominantly of non-detectable WBC results (NIOSH, 2017).

6.2 Available De Soto Avenue Facility External Monitoring Data

The primary data used for determining external exposures are personal monitoring data from film badges or thermoluminescent dosimeters (TLDs). In 1963, the De Soto Avenue Facility began using the commercial vendor Landauer's multi-element film dosimeters with a monthly or quarterly exchange frequency. All personnel assigned to operations with potential radiation exposure were required to wear personnel monitoring devices, as dictated by the Atomics International radiological safety program. Film badges were also available for visitors to controlled areas. Pocket dosimeters and finger film rings were issued based on work assignments (Lang, 1960).

External dosimetry data were manually entered into a database for an epidemiological study of workers at Rocketdyne (Atomics International) covering the period 1948 to 1999. These data were applied for the development of a co-worker analysis. A total of 6,675 workers were monitored for radiation exposure and, of those, 5,801 were included in the database. Three hundred-fifty (350) workers who were employed for less than six months and 524 workers with insufficient identifying information were excluded from the study (ORAUT-OTIB-0077, PDF p. 5).

Details regarding the various analyses used and the associated minimum detectable activities are presented in the Technical Basis Document *Area IV of the Santa Susana Field Laboratory, the Canoga Avenue Facility (Vanowen Building), the Downey Facility, and thee De Soto Avenue Facility (sometimes referred to as Energy Technology Engineering Center [ETEC] or Atomics International)*- Occupational External Dose (ORAUT-TKBS-0038-6).

7.0 Feasibility of Dose Reconstruction for the Class Evaluated by NIOSH

The feasibility determination for the class of employees under evaluation in this report is governed by both EEOICPA and 42 C.F.R. § 83.13(c)(1). Under that Act and rule, NIOSH must establish whether or not it has access to sufficient information either to estimate the maximum radiation dose for every type of cancer for which radiation doses are reconstructed that could have been incurred under plausible circumstances by any member of the class, or to estimate the radiation doses to members of the class more precisely than a maximum dose estimate. If NIOSH has access to sufficient information for either case, NIOSH would then determine that it would be feasible to conduct dose reconstructions.

In determining feasibility, NIOSH begins by evaluating whether current or completed NIOSH dose reconstructions demonstrate the feasibility of estimating with sufficient accuracy the potential radiation exposures of the class. If the conclusion is one of infeasibility, NIOSH systematically evaluates the sufficiency of different types of monitoring data, process and source or source term data, which together or individually might assure that NIOSH can estimate either the maximum doses that members of the class might have incurred, or more precise quantities that reflect the variability of exposures experienced by groups or individual members of the class as summarized in Section 7.6. This approach is discussed in NIOSH's SEC Petition Evaluation Internal Procedures, which are available on the NIOSH Radiation Dose Reconstruction Program webpage.

The next four major subsections of this evaluation report examine:

- The sufficiency and reliability of the available data. (Section 7.1)
- The feasibility of reconstructing internal radiation doses. (Section 7.2)
- The feasibility of reconstructing external radiation doses. (Section 7.3)
- The bases for petition SEC-00246 as submitted by the petitioner. (Section 7.4)

7.1 Pedigree of De Soto Avenue Facility Data

This subsection answers questions that need to be asked before performing a feasibility evaluation. Data Pedigree addresses the background, history, and origin of the data. It requires looking at site methodologies that may have changed over time; primary versus secondary data sources and whether they match; and whether data are internally consistent. All these issues form the bedrock of the researcher's confidence and later conclusions about the data's quality, credibility, reliability, representativeness, and sufficiency for determining the feasibility of dose reconstruction. The feasibility evaluation presupposes that data pedigree issues have been settled.

Upon request, the facility provides original hardcopy records, including internal and external dosimetry records for individual claimants; these records are used by NIOSH to support dose reconstruction.

7.1.1 Internal Monitoring Data Pedigree Review

As described in detail in the co-worker document *Internal Coworker Dosimetry Data for Area IV of the Santa Susana Field Laboratory and the De Soto Avenue Facility* (ORAUT-OTIB-0080, PDF pp. 8–10), urinalysis bioassay data were obtained directly by NIOSH from SSFL (including De Soto records) in the form of electronic scans of hardcopy bioassay data records. These records contain De Soto internal monitoring records and records from the analytical laboratories that performed the urinalyses. The dosimetry program received urinalysis results data from the vendor laboratories and transcribed that data onto internal forms, which were referred to as "8X11" and "McBee cards." These data (digital copies of the original site data) were used to perform the NIOSH co-worker analysis that includes the De Soto Avenue Facility. These original data records are considered primary data sources; therefore, further consistency checks of the internal data for the period from 1965 through 1995 are not required. Any bioassay results from the vendor laboratory CEP are excluded by NIOSH from final consideration due to concerns with vendor product quality.

NIOSH has determined that the internal radiological monitoring data obtained from the De Soto Avenue Facility are of sufficient quantity, and are supported by sufficient information on the internal dosimetry program practices, to assure that the data adequately represent the evaluated class.

7.1.2 External Monitoring Data Pedigree Review

Atomics International started using commercial vendors for its dosimetry needs in the early 1960s and continued that practice throughout the period under evaluation. Original, individual external dosimetry records are available for all workers assigned to jobs that were deemed to have a potential for radiation exposure. Those employees were monitored over the period under evaluation in this

report. The exchange frequencies for site employees were based on the potential to exceed the administrative exposure limits (ORAUT-TKBS-0038-6). The original De Soto personnel records and the associated radiological program information are considered primary data sources; therefore, further consistency checks of the external data for the period from 1965 through 1995 are not required.

Dosimetry data, including external exposure data, was entered into a database and used to develop the external co-worker dosimetry model, ORAUT-OTIB-0077, for assigning doses for gaps in dosimetry records. The dosimetry database contains data for penetrating dose, which is a combination of gamma and fast neutron dose. Because it was difficult to separate statistically significant neutron dose from the penetrating dose, and because shallow dose data are not available, the neutron dose component (which represented less than 5% of the total data points available) was left embedded with gamma dose, resulting in penetrating dose values that are biased high, especially so for De Soto employees, given the lack of neutron exposure potential associated with De Soto work. Exposure information was compiled from the following sources: Rocketdyne radiation safety folders, NRC-REIRS, DOE-REMS, Landauer dosimetry, individual facilities, the U.S. Army, and the U.S. Air Force. These data include results from workers who had duties at the Area IV, Canoga, De Soto Avenue, and Downey sites.

NIOSH has determined that the external radiological monitoring data obtained from the De Soto Avenue Facility are of sufficient quantity, and are supported by sufficient information on the external dosimetry program practices, to assure that the data adequately represent the evaluated class.

7.2 Evaluation of Bounding Internal Radiation Doses at the De Soto Avenue Facility

The principal source of internal radiation doses for members of the class under evaluation was inhalation or ingestion of uranium associated with nuclear fuel element fabrication. Inhalation or ingestion of contamination resulting from operations involving unsealed radioactive material during radiochemistry operations was also possible. The following subsections address the ability to bound internal doses, methods for bounding doses, and the feasibility of internal dose reconstruction.

7.2.1 Evaluation of Bounding Process-Related Internal Doses

The petition bases for SEC-00246 requested that NIOSH consider for inclusion into the SEC all workers who worked at the De Soto Avenue Facility from January 1, 1965 through December 31, 1995. The basis for SEC inclusion was partially based on the assertion that operations conducted at the De Soto site: (1) involved contractors and subcontractors shared with Area IV of the SSFL; and (2) involved the same hazards for which NIOSH determined it was unable to reconstruct radiation dose with sufficient accuracy for Area IV (i.e., occupational exposure to americium and thorium and its associated progeny) from January 1, 1965 through December 31, 1988.

SSFL established and maintained a centralized radiological records program that contains the records and data for De Soto Avenue, Area IV, Canoga Avenue, and Downey. The health physics records and source term and process information, including types and quantities of specific radionuclides and sources present, their chemical and physical form, and the types and frequency of operations (including controls) in which these sources were used are available to NIOSH as original records.

The following have been identified as radionuclides of concern for internal dose for the De Soto Avenue during the period under evaluation (see also Section 5.2):

- Uranium: Through the course of ongoing dose reconstruction efforts and investigations, NIOSH determined that although internal monitoring data are available for most radiological workers at De Soto, some employees could have received internal radiation exposures that went unmonitored. To assess potential internal uranium dose to unmonitored employees, NIOSH developed a co-worker dose distribution model, *Internal Coworker Dosimetry Data for Area IV of the Santa Susana Field Laboratory and the De Soto Avenue Facility* (ORAUT-OTIB-0080).

  As presented in Section 5.2.1, briquettes of a 93% enriched uranium and aluminum alloy known as uranium aluminide were handled at De Soto in association with ATR fuel-fabrication operations from 1966 to 1968. These De Soto UAl_x exposures are potentially more limiting than uranium exposures evaluated with standard uranium metabolic models. NIOSH considers these potential uranium aluminide exposures to be the bounding uranium exposures at the De Soto Avenue Facility.

  Attachment H of ORAUT-TKBS-0038-5 presents modifications to the International Commission on Radiological Protection (ICRP) Publication 66 human-respiratory-tract model (HRTM), originally proposed in 2005 (Leggett, 2005), that specifically addresses the biokinetics of uranium aluminide (ICRP, 1994). This modification, referred to as *Type K* (versus Type F, M, or S) material, was based on occupational bioassay data collected at the Rocketdyne/Atomics International Facility in California and fits the site-specific excretion data. The alternate methods described in Attachment H of ORAUT-TKBS-0038-5 are available to NIOSH to ensure that bounding uranium dose calculations are applied to De Soto Avenue work for the period under evaluation.

- Americium: During its document review, NIOSH found that Atomics International held a State of California Department of Public Health Radioactive Material License (0015-59) authorizing the De Soto site to have up to 10 Ci of Am-241 in any form for the purpose of sealed-source fabrication and transfer to authorized recipients (License, 1978); however, neither the document review nor interviews with former workers revealed any history of actual fabrication of americium sources (Personal Communication, 2018a; Personal Communication, 2018b). When NIOSH evaluated SEC-00234 for Area IV, it determined that a significant factor causing uncertainty regarding the accuracy of dose reconstruction was the lack of well-defined source term information for americium produced during Area IV reactor operations over time. NIOSH has found that no similar source term existed at the De Soto Avenue Facility. De Soto did not use americium sources in any work processes. On the other hand, De Soto had well-defined sources of the radionuclide thorium. Much of the source term information for De Soto is available through site records and licensing documentation.

- Thorium: As referred to in Section 5.2.1.2, three specific, limited operations involving work with thorium occurred at De Soto Avenue. These operations are detailed in use-authorization documentation and procedures maintained by the site and are available to NIOSH.

  The first of these tasks, documented as Authorization 13 (Authorization, May1970), occurred in June 1970 and entailed the fabrication of simulated fuel discs made from molybdenum and natural thorium. The work was limited to 5 kg of ThO_2 powder in granular form, and the powder underwent particle-sizing, blending, and preparation for cold-pressing. All of this powder work,

the particle-sizing work, and the packaging and removal of the powder was conducted in glove boxes under negative pressure in Room 119-62 of Building 001. The ThO_2 powder was ball-milled with molybdenum metal powder in Room 119-62 to coat the powder grains. The cold-press occurred in an enclosure with radioactive exhaust, also in Room 119-62. The cold-pressed discs would then undergo sintering and either hot pressing or explosive forming. Hot-pressing occurred in Room 524-59 of Building 005. The discs were never to leave the outer transport containers, were to be removed from the building every night and were not to be in the building over two hours. Explosive-forming occurred off-site at a facility known as El Toro. The procedures for sizing, blending, cold-press, and sintering are available for review (Authorization, May1970).

The second of these tasks, documented as Authorization 21 (Authorization, Jun1970) involved analysis following design verification testing done at Sandia National Laboratories (SNL), for which the simulated fuel discs were created. This work occurred in June and July 1970. These 2.5" x 6" transit capsules were tested at Sandia for impact, fragmentation, over-pressure, and fire durability. Following this testing at Sandia, the transit capsules were delivered to De Soto Avenue for post-test analysis. This De Soto analysis entailed non-destructive testing, then disassembly of the transit capsules and removal of the ThO_2 cermet simulated fuel discs. The simulated fuel discs were removed in a plexiglass box enclosure, packaged, and shipped to the Los Alamos Scientific Laboratory (LASL). The post-test examination procedures are available (Authorization, Jun1970, PDF pp. 33-35).

The last of these tasks associated with thorium was the machining of thorium metal discs. This operation is documented as Authorization 120 (Tuttle, 1979; Begley, 1979). The machining work involved grinding off the corners of approximately 540 plates (~ 200 kg) of natural-thorium metal. The plates were to be stacked 10-20 at a time, and each corner ground by multiple passes on a surface grinder. The work was performed in one room, Room 115-37 of Building 001. As documented in the internal memo, *Review of Proposal to Machine Thorium* (Tuttle, 1979), an enclosure and chip catcher were to be attached to the grinding head and a HEPA-filtered vacuum cleaner was to be attached to the enclosure to remove dust, fumes, and gas released by the grinding. The filtered vacuum cleaner failed to maintain adequate air flow (Begley, 1979) and a change authorization was granted to modify the procedure to "wet" grinding. A recirculating water tank was installed, along with a Plexiglas shield between the grinding operation and the operator. The HEPA-filtered vacuum continued to be used.

Fabrication of the simulated fuel discs was assigned to two individuals; operations involving loose material were to be contained within a glove box. The Transit Capsule Post-test analysis involved disassembly in the Hot Shop area of approximately 17 or 18 capsules containing simulated fuel discs. One machinist and an engineer were assigned to the task. Disrupting the solid nature of the fuel discs was a hazard to be mitigated rather than an expected part of the operation. Efforts were undertaken to contain the fuel discs and prevent breaching them.

The work of grinding thorium-metal plates was necessarily performed in the open with a devised enclosure and chip catcher. One operator with an assistant and a supervisor were assigned to this task, which occurred in one room of Building 001.

This last operation in 1979, the grinding of the plates, appears to have the highest potential of the three for thorium intake by inhalation because it was not performed in a glove box or similarly-confined space and involved mechanical operations likely to dislodge respirable particles of

thorium into the work space. This operation is considered by NIOSH to have the highest exposure potential of the three thorium operations at De Soto. The dosimetry records for the workers assigned to all three of these operations are available to NIOSH and summarized in Section 6.1.1. Methods for assigning bounding thorium doses are described further in Section 7.2.3.

The following subsections summarize the extent and limitations of information available for reconstructing the process-related internal doses of members of the class under evaluation.

7.2.1.1 Urinalysis Information and Available Data

Uranium bioassay results for De Soto Avenue are presented in the records as fluorometric (mass) and radiometric (activity) results. Samples analyzed fluorometrically were also analyzed radiometrically. The site used both zeros and "less-than" values to indicate non-detectable results. In addition to analyzing bioassay samples for uranium, the site performed some gross-alpha sample analysis. Sufficient urine bioassay data were available to perform a statistical analysis for 1965 through 1988 as part of the internal dose co-worker analysis (ORAUT-OTIB-0080). Uranium bioassay data are available through the end of fuel fabrication work (1983) for monitored workers.

Pre-work and post-work thorium urine bioassay was performed for workers conducting the 1979 thorium-grinding operations, as identified in the authorization paperwork approved by the De Soto Isotopes Committee (Tuttle, 1979; Begley, 1979). The samples were sent off site to a commercial vendor for analysis. The thorium bioassay results correspond directly to the names and dates of the operation as specified in the authorization documentation, which also specifies the task scope and natural thorium materials for these limited thorium operations. Those records are available to NIOSH.

NIOSH found no records of any urine bioassay analysis for americium associated with the De Soto Avenue Facility, nor any evidence of americium exposure conditions, as presented above.

As presented in Section 6.1.1, NIOSH does not use CEP sample analysis results to assign dose because CEP was suspected of producing unreliable results. Although NIOSH has disqualified *in vitro* data analyzed by CEP during the period August 1991 through June 1993, in its 2017 evaluation of SEC-00235 (NIOSH, 2017), NIOSH determined that the lack of CEP *in vitro* data has not affected NIOSH's ability to perform sufficiently accurate internal dose reconstructions for monitored or unmonitored workers. The current NIOSH findings for the De Soto Avenue Facility are consistent with its 2017 evaluation for Area IV of SSFL and are based on the following:

- NIOSH examined the radiological operations throughout the period under evaluation (1965-1995) to ascertain the exposure conditions before, during, and after the CEP period being evaluated in this report (1991–1993). NIOSH's review indicates that work remained consistent as to procedures, personnel protection equipment, and exposure risks from 1984 (when most radiological activities had ceased) through 1995 (when all radiological activities ceased). NIOSH has found no major radiological project that occurred in the CEP period 1991–1993, that would not have had workplace and/or personnel monitoring performed outside the CEP-related period.

- During the August 1991 through June 1993 period with disqualified CEP bioassay results, the site was performing routine *in vivo* whole-body measurements with the contractor Helgeson. The site reported that the whole-body measurements showed no measurable exposures.

- In response to concerns with CEP data, the site health and safety program initiated confirmatory resamples analyzed by a new contractor. These follow-up *in vitro* results confirmed no measurable internal exposures.

The site's investigation was summarized in December 1993 as, "… although CEP bioassay results have been questioned, independent Helgeson WBS, Teledyne bioassays, and air sampling have confirmed that Rocketdyne workers have experienced no measurable internal exposure." (Rockwell, 1994).

NIOSH researched the operations at De Soto Avenue to determine if any significant factors affecting potential exposures or monitoring might have changed during the 1991 through 1993 period when the CEP *in vitro* bioassay analyses were deemed unreliable. No changes in operations were identified; radiological operations were limited to Building 004 during this time and at a reduced level. The other aspects of the radiation monitoring program at De Soto Avenue, the *in vivo* monitoring with the contractor Helgeson, the air sampling, and the area monitoring continued unchanged.

7.2.1.2 WBC Measurement Information and Available Data

The monitoring information in the employee radiological exposure files described in this report also included WBC monitoring information and results. The WBC measurements for both De Soto and Area IV workers were performed by Helgeson, using mobile scanner facilities brought on site by the contractor. The results provided were entered in the worker's radiological exposure files. The *in vivo* monitoring results reported by Helgeson for the Rockwell sites included results for radionuclides of uranium, cesium, potassium, zinc, and americium for plutonium. Thyroid measurements for radioactive iodine were also reported. There is no indication that the site made an attempt to quantify thorium through *in vivo* measurements of thorium progeny radionuclides.

In the 1994 letter to workers potentially affected by a lack of confidence in CEP data (discussed in Section 7.2.1.1), Rockwell International stated that the WBC monitoring done during the time of the CEP contract were "instituted as a separate, independent measure of internal exposure." This letter also stated that there was "no measurable internal exposure" to the Rocketdyne workers (Rockwell, 1994). This statement is supported in the results, which consisted predominantly of WBC results with no detectable activity.

7.2.1.3 Other Types of Bioassay

Some results presented with volume or mass units of grams are assumed to be fecal samples. At least one instance of a thorium bioassay sample is noted to be a fecal sample.

7.2.1.4 Airborne Levels

NIOSH has access to workplace air monitoring data including, in limited cases, lapel air monitoring results (including lapel results for thorium work in 1970 and 1979). Generally, jobs that necessitated an Authorization for Use of Radioactive Materials or Radiation Producing Devices were monitored, and if there was a potential for inhalation by workers, personal lapel air monitoring was required. Other work required air monitoring. A random sampling of the employee folders obtained for the co-worker calculations found no indications of those air sample results being included in the employee files. A targeted review of employee files for workers specifically assigned to thorium-machining work did reveal job-specific air sample worksheet results. Operations such as the thorium grinding,

and work with thoria materials in powder form, are likely to be bounding exposure scenarios. Air sample results, collected in proximity to thorium-grinding operations, support the ability to develop a bounding dose estimate for potential thorium intakes.

7.2.2 Evaluation of Bounding Ambient Environmental Internal Doses

NIOSH has access to environmental monitoring data, including air emissions and ambient air monitoring data. An environmental monitoring program was established in May 1954 (SSFL Site, 2005). The program initially placed an emphasis on soil, vegetation, and water sampling in the environment (SRDB TKBS-0038-4); but beginning in 1959, ambient gross beta activity in air was measured continuously in five locations. De Soto Avenue ambient air monitoring data are reported in *Annual Review of Radiological Controls* reports, available to NIOSH (Annual Review, 1975; Annual Review, 1976; Annual Review, 1977; Annual Review, 1978; Annual Review, 1979; Annual Review, 1980; Annual Review, 1981; Annual Review, 1982; Annual Review, 1983; Annual Review, 1984; Annual Review, 1985; Annual Review, 1986; Annual Review, 1987; Annual Review, 1988).

Ambient air sampling for long-lived particulate alpha and beta radioactivity was performed continuously by automatic sequential samplers located at De Soto and SSFL. Air was drawn through glass-fiber filters, which were analyzed for retained long-lived radioactivity after a minimum 120-h decay period, which eliminated naturally-occurring short-lived particulate radioactivity (most radon daughters).

The guide value of 3×10^{-12} μCi/ml for De Soto Avenue ambient air alpha activity was due to prior work with unencapsulated depleted uranium. The guide value of 3×10^{-10} μCi/ml was for Co-60. This was chosen as an appropriate ambient air beta activity guide since it was the most restrictive limit for any beta-emitting radionuclides in use at De Soto Avenue.

Air sampling was performed continuously at De Soto and SSFL with air samplers operating on 24-hr sampling cycles. Airborne particulate radioactivity was collected on glass-fiber filters which were automatically changed daily at the end of each sampling period (midnight). The samples were counted for alpha and beta radiation following a minimum 120-hr decay period. The volume of a typical daily ambient air sample was about 25 m^3 (Monitoring Report, 1989).

The ambient air monitoring data through 1999 are reported in the environmental monitoring reports as gross alpha and gross beta without identification of specific radionuclides (ORAUT-TKBS-0038-4, PDF p. 10). In all cases, the gross alpha and gross beta concentrations are a small fraction of the applicable limits and are indistinguishable from background. Because of this, NIOSH uses stack emission data as the primary basis for inhalation intake estimates from onsite atmospheric radionuclide concentrations. Stack-emission data are available for Building 004/104 (Hot Analytical Chemistry at the De Soto Avenue Facility). TBD Table 4-3, *Annual Occupational Environmental Radionuclide Inhalation at De Soto Avenue, Canoga Avenue, and Downey Facilities* (ORAUT-TKBS-0038-4, PDF p. 13), lists the estimated environmental inhalation intakes at De Soto Avenue, Canoga, and Downey by year and radionuclide. All data in the table for the period under evaluation (1965 through 1995) would be De Soto Avenue data given that only De Soto Avenue had radiological work by that time.

7.2.3 Methods for Bounding Internal Dose at the De Soto Avenue Facility

The following subsections summarize the methods for bounding internal dose at the De Soto Avenue facility.

7.2.3.1 Methods for Bounding Operational Period Internal Dose

Internal doses for monitored workers are assigned in accordance with ORAUT-TKBS-0038-5, *TBD for the Area IV of the Santa Susana Field Laboratory, the Canoga Avenue Facility (Vanowen Building), the Downey Facility, and the De Soto Avenue Facility (Sometimes Referred to as Energy Technology Engineering Ctr. [ETEC] or Atomics International)– Occupational Internal Dose*.

Some workers at De Soto Avenue were not monitored for potential intakes to radioactive material because, in the assessment of the facility health physicist, their job assignment was unlikely to have the potential for intake of significant radiological materials. If the job assignment was not in a high-contamination area or an airborne radioactivity area, the workers were generally unmonitored for internal exposure (Personal Communication, 2017). The NIOSH co-worker study, initiated to address potentially-unmonitored workers at Area IV and De Soto Avenue, used urinalysis results of monitored workers obtained directly from SSFL in 2009 to assign internal dose to address potential intakes of radioactive material. The data and how they were processed are described in ORAUT-OTIB-0080. Analyte results were documented in the monitored-employee radiological exposure files obtained from the site, including the results of various analytical methods for uranium, plutonium, and mixed fission products (MFP). A statistical analysis of the data was performed according to ORAUT-OTIB-0019, *Analysis of Coworker Bioassay Data for Internal Dose Assignment*, ORAUT-PROC-0095, *Generating Summary Statistics for Coworker Bioassay Data*, and the statistical methods in ORAUT-RPRT-0053, *Analysis of Stratified Coworker Datasets*. The results were entered into the Integrated Modules for Bioassay Analysis (IMBA) computer program to obtain intake rates for the assignment of dose distributions.

Uranium

As presented in Section 7.2.1, work with briquettes of uranium aluminide for ATR fuel-fabrication operations from 1966 to 1968 have been determined to be the limiting uranium exposure scenario at the De Soto Avenue Facility. Attachment H of ORAUT-TKBS-0038-5 presents modifications to the biokinetic modelling of uranium aluminide (referred to as Type K) that are based on occupational bioassay data collected at the Rocketdyne/Atomics International Facility in California. Attachment H examines the dose to organs from various exposure scenarios to determine if and when Type K uranium delivers a dose that is higher than the dose from the Type F, M, or S uranium modeled in ORAUT-OTIB-0080. Potential intakes of uranium aluminide can be assessed on a case-by-case basis using claim-specific and/or fuel fabrication worker-specific data and exposure scenarios; in which case, NIOSH performs custom case-by-case dose assessments with Type K metabolic modelling.

Americium

As presented in Sections 5.2.1.1 and 7.2.1, neither the documents available to NIOSH nor interviews with former workers (Personal Communication, 2018a; Personal Communication, 2018b) revealed any history of fabrication of americium sources, or work with uncontained americium at the De Soto Avenue Facility. Contrasting previous NIOSH evaluations of radiological work at Area IV of SSFL,

NIOSH has found no indication that De Soto had sources of americium associated with work processes.

Thorium

As presented earlier in Section 7.2, based on the well-described work conditions, with limited containment and the potential for generation of airborne thorium contamination, NIOSH has concluded that thorium-grinding operations in 1979 represent the bounding thorium internal exposures at the De Soto Avenue Facility during the operational period (January 1, 1965 through December 31, 1995). NIOSH has available pre-work and post-work thorium urine bioassay performed for the single worker conducting the 1979 thorium-grinding operations, and the bioassay results correspond directly to the name and dates shown in the work authorization documentation. NIOSH has sufficient personnel bioassay data, and job performance data, to allow it to develop bounding dose estimates for workers with potential thorium exposures during the period from January 1, 1965 through December 31, 1995.

Job-specific documentation and pre- and post-work bioassay sample results allow NIOSH to calculate bounding organ doses associated with the eight-day grinding operations on natural thorium metal in March 1979 (Grinding Safety, 1979). Job-specific information available to NIOSH includes:

- chronic intake over the period of grinding operations, March 5, 1979 through March 12, 1979;
- natural thorium metal in equilibrium (assuming 100% Th-232 for intake assessment, and 50% / 50% Th-228 and Th-232 for dose assessment);
- pre-work urine sample on February 27, 1979 with a result of <0.99 thorium μg per 24-hour sample; and
- post-work urine sample on March 25, 1979 with a result of <0.99 thorium μg per 24-hour sample.

NIOSH estimates under these observed and plausible bounding conditions result in calculated thorium intake rates of 7.29E+02 pCi/day for an assumed Type M inhalation, and 4.19E+02 pCi/day for an assumed Type S inhalation. NIOSH has sufficient data to assign comparable thorium intake rates to De Soto Avenue workers, as appropriate for given job descriptions and potential exposure scenarios.

7.2.3.2 Methods for Bounding Ambient Environmental Internal Dose

NIOSH has access to environmental monitoring data, including air emissions and ambient air monitoring. Potential inhalation intakes from onsite atmospheric radionuclide concentrations can be estimated using average annual concentrations of facility stack emissions (ORAUT-TKBS-0038-4). Isotopic stack emission data from various facilities for 1988-1999 are available and the data were used to characterize radionuclide emissions for all years (ORAUT-TKBS-0038-4). 1988 appears to be when isotopic analysis of stack and ambient emissions began. Both americium and thorium were analytes. Potential inhalation intakes from onsite atmospheric radionuclide concentrations can be estimated using average annual concentrations of facility stack emissions (ORAUT-TKBS-0038-4).

The average annual stack effluent concentrations described in the site profile (ORAUT-TKBS-0038-4) are used as the basis for estimating occupational environmental inhalation intakes from facility effluent releases. The facility effluent concentrations for each year were summed. Workers were

assumed to be exposed for 2,000 hr/yr with a breathing rate of $3.3 \times 10\text{-}4$ m^3/s (ICRP, 1975). Because the stack effluent concentrations were sampled at the point of release, a further reduction factor of 0.01 was taken to account for the lessened overall intake due to contribution from multiple widely-spaced facilities, atmospheric dispersion of stack effluent over the course of a year's exposure, and building wake effects.

7.2.4 Internal Dose Reconstruction Feasibility Conclusion

As presented in Section 7.2, the principal source of internal radiation doses for members of the class under evaluation was inhalation or ingestion of uranium associated with nuclear fuel-element fabrication, or of contamination resulting from radiochemistry operations involving unsealed radioactive material. Also evaluated in this report was the potential for worker exposures to americium and thorium at the De Soto Avenue Facility. NIOSH has evaluated the issues for which this SEC-00246 petition qualified for evaluation and finds that NIOSH has sufficient information to allow it to complete sufficiently accurate dose reconstructions for the evaluated class of employees.

NIOSH has determined that exposures to De Soto workers while working with briquettes of uranium aluminide (in association with ATR fuel-fabrication operations from 1966 to 1968) are potentially more limiting than uranium exposures evaluated with standard uranium metabolic models. Attachment H of ORAUT-TKBS-0038-5 presents modifications to the biokinetic modelling of uranium aluminide (referred to as Type K) that are based on occupational bioassay data collected at the Rocketdyne/Atomics International Facility in California. NIOSH has examined the dose to organs from various exposure scenarios to determine if and when Type K uranium delivers a dose that is higher than the dose from the Type F, M, or S uranium modeled in ORAUT-OTIB-0080. Potential acute intakes of uranium aluminide can be assessed on a case-by-case basis using claim-specific data and exposure scenarios; in which case, NIOSH performs custom case-by-case dose assessments with Type K metabolic modelling.

As presented in Section 7.2.1, neither the documents available to NIOSH nor interviews with former workers (Personal Communication, 2018a; Personal Communication, 2018b) revealed any history of fabrication of americium sources, or work with uncontained americium at the De Soto Avenue Facility. Contrasting previous NIOSH evaluations of radiological work at Area IV of SSFL, NIOSH has found no indication that De Soto had sources of americium associated with work processes.

NIOSH has identified detailed documentation of thorium work episodes in 1970 and 1979, providing source term, operational procedures, radiological protection protocols, names of individual operators, and dates of work. NIOSH has concluded that thorium-grinding operations in 1979 represent the bounding thorium internal exposures at the De Soto Avenue Facility during the operational period (January 1, 1965 through December 31, 1995). As presented in Section 7.2.3.1, NIOSH has sufficient personnel bioassay data (including per-work and post-work urinalysis), and job performance data, to allow it to develop a bounding dose estimate for workers with potential thorium exposures during the period from January 1, 1965 through December 31, 1995.

Although NIOSH has disqualified *in vitro* data analyzed by CEP during the period August 1991 through June 1993, in its 2017 evaluation of SEC-00235 (NIOSH, 2017), NIOSH determined that the lack of CEP *in vitro* data has not affected NIOSH's ability to perform sufficiently accurate internal dose reconstructions for monitored or unmonitored workers. As presented in Section 7.2.1.1, the current NIOSH findings for the De Soto Avenue Facility are consistent with its 2017 evaluation for Area IV of SSFL. NIOSH has determined that the exclusion of CEP data during the period

1991-1993 does not limit NIOSH's ability to perform sufficiently adequate internal dose reconstructions for De Soto Avenue workers during the period under evaluation.

Based on its full research of the class under evaluation, NIOSH found no part of said class for which it cannot estimate radiation doses with sufficient accuracy, including potential exposures to americium, thorium, and uranium. This class includes: all employees of the Department of Energy, its predecessor agencies, and their contractors and subcontractors who worked at the De Soto Avenue Facility, Canoga Park, California, from January 1, 1965 through December 31, 1995.

7.3 Evaluation of Bounding External Radiation Doses at the De Soto Avenue Facility

The principal source of external radiation doses for members of the evaluated class was exposure during fabrication of reactor fuel and radioactive sources used for gamma irradiation.

The following subsections address the ability to bound external doses, methods for bounding doses, and the feasibility of external radiation dose reconstruction.

7.3.1 Evaluation of Bounding Process-Related External Doses

NIOSH can bound De Soto Avenue workers' external doses during the period under evaluation (January 1, 1965 through December 31, 1995) by using the data described in Section 6.2 of this report. NIOSH has captured external monitoring data for De Soto workers for the entire period of this evaluation.

The following subsections summarize the extent and limitations of information available for reconstructing the process-related external doses of members of the class under evaluation.

7.3.1.1 Employee Dosimetry Data

NIOSH has access to photon, beta, and neutron external dosimetry results, as well as other supporting data for the entire period under evaluation. The policy at De Soto, Area IV, and Canoga Ave. was to assign the applicable dosimetry to anyone with the potential for photon, beta, or neutron exposure. Dosimetry was assigned based on job assignments that entailed exposure to radioactive materials. Details regarding the various analyses used, and the associated minimum detectable activities, are presented in ORAUT-TKBS-0038-6.

The external dosimetry database for the SSFL, which includes De Soto Avenue, contains dosimetry data for penetrating dose, including gamma and fast neutron dose. Because it was difficult to separate statistically-significant neutron dose from penetrating dose, the neutron dose component (which represented less than 5% of the total data points available) was left embedded with gamma dose, resulting in penetrating dose values that are conservatively-biased high. An analysis of average neutron dose for the period 1965-1995 revealed that the average value for any individual year was bounded by the 95th percentile values for penetrating dose given in ORAUT-OTIB-0077.

7.3.1.2 Area Monitoring Data

External radiation exposure at the De Soto Avenue Facility would be limited primarily to the vicinity of the reactor fuel fabrication and the area near radioactive sources used for gamma irradiation.

NIOSH has access to general process and radiological source term information associated with uranium fuel-fabrication work, and for radiological projects authorized by the control mechanisms at the site (i.e., Isotopes Committee), as documented in the Use Authorization documents. NIOSH has summary data on employee exposures, area radiation levels, and in-plant airborne radioactivity sample information for operations, found in the reports routinely produced by the site, *Annual Review of Radiological Controls*, for the years 1975-1988 (Annual Review, 1975; Annual Review, 1976; Annual Review, 1977; Annual Review, 1978; Annual Review, 1979; Annual Review, 1980; Annual Review, 1981; Annual Review, 1982; Annual Review, 1983; Annual Review, 1984; Annual Review, 1985; Annual Review, 1986; Annual Review, 1987; Annual Review, 1988). The reports contain De Soto Avenue "location badge" data only through 1983, when the fuel-fabrication facility was decommissioned. The average and maximum exposure rates, determined by quarter, are reported. These reports were produced to satisfy the requirements of the special nuclear material license. The reports, which also summarize unusual events and provide trend information on exposures, were reviewed by NIOSH. No significant unusual conditions were identified upon review. These data are available for use on a case-by-case basis, if necessary, if external dosimetry data are unavailable and the co-worker dose estimate is deemed not applicable.

7.3.1.3 Alternative Data Sources for Bounding External Dose

Over the course of ongoing dose reconstruction efforts and investigations associated with both SEC-00093 and SEC-00156, NIOSH determined that although external monitoring data are available for most radiological workers, some employees could have received external radiation exposures that went unmonitored. To assess potential external dose to unmonitored employees, NIOSH developed a co-worker dose distribution model, *External Coworker Dosimetry Data for Area IV of the Santa Susana Field Laboratory, the Canoga Avenue Facility (Vanowen Building), the Downey Facility, and the De Soto Avenue Facility (sometimes referred to as Energy Technology Engineering Center [ETEC] or Atomics International)* (ORAUT-OTIB-0077). This evaluation report has not identified any concerns with the external co-worker dose distribution models presented in ORAUT-OTIB-0077.

7.3.2 Evaluation of Bounding Ambient Environmental External Doses

As presented in ORAUT-TKBS-0038-4, *Area IV of the Santa Susana Field Laboratory, the Canoga Avenue Facility (Vanowen Building), the Downey Facility, and the De Soto Avenue Facility (sometimes referred to as Energy Technology Engineering Center [ETEC] or Atomics International)—Occupational Environmental Dose*, baseline ambient external radiation dose estimates for De Soto Avenue are available for the period 1959 through 1998. From 1974 through 1989 the ambient radiation monitoring program used complex bulb dosimeters (CaF_2:Mn). This was justified by the amount of nuclear materials handled in the operations at De Soto Avenue, and by the low levels of radiation in the environment. ORAUT-TKBS-0038-4, Table 4-4 presents annual external occupational environmental dose estimates in mrem/yr for De Soto, both baseline doses for the site and doses specific for Building 001.

Routinely, the site produced an Environmental Monitoring and Facility Effluent Annual Report for De Soto Avenue and the SSFL sites. Environmental monitoring was performed by the Radiation and Nuclear Safety Group of the health and safety organization. Environmental media sampling, air sampling, and direct radiation monitoring results were reported in detail. NIOSH has access to these semiannual and annual reports for multiple years during this period under evaluation (1965, 1967-1969, 1971-1972, 1982, 1985, and 1989-1992).

Environmental sampling stations located within the De Soto and SSFL boundaries are referred to as "on-site" stations. On-site-ambient radiation monitoring using thermoluminescent dosimetry (TLD) was used to measure environmental radiation levels at the De Soto Avenue site and also at several off-site locations.

Estimates of the external radiation exposure at the De Soto boundary (less than 0.01 ± 0.01 mR), and at the nearest residence (less than 0.01 ± 0.01 mR), are based on the difference between the single highest on-site TLD measurement and the average of off-site measurements. The difference is more likely the result of random variability in the measurements than from actual radiation exposure.

By 1989, in light of the reduced radiological work, the level of personnel, area, and ambient environmental monitoring was no longer justified and efforts were directed toward simplifying the program. The initial step included using the well-established LiF thermoluminescent dosimeters (TLDs) for personnel monitoring in radiation work. Although these dosimeters were well-suited to measuring exposures in the range of interest for compliance with occupational radiation regulations (i.e., doses above background), they were somewhat insensitive for environmental measurements because the resolution in terms of dose uses increments of 10 mrem/quarter. Using these dosimeters demonstrated that environmental exposures did not reach regulatory limits, but it provided limited information on the actual exposure rates around the facilities and in the neighboring environment (Environmental Report, 1998).

7.3.3 De Soto Avenue Facility Occupational X-Ray Examinations

In its previous SEC class designation for De Soto Avenue, NIOSH found adequate medical dose reconstruction feasible. This current evaluation has found no evidence to the contrary for the period under evaluation, January 1, 1965 through December 31, 1995. NIOSH has determined that it is feasible to reconstruct occupational medical dose for De Soto Avenue workers for the period from January 1, 1965 through December 31, 1995, using information and methods in *Dose Reconstruction from Occupationally Related Diagnostic X-Ray Procedures* (ORAUT-OTIB-0006) and the site profile documents (ORAUT-TKBS-0038-1,-2, -3, -4, -5, -6) associated with the De Soto Avenue Facility.

7.3.4 Methods for Bounding External Dose at the De Soto Avenue Facility

NIOSH has an established protocol for assessing external exposure when performing dose reconstructions (these protocol steps are discussed in the following subsections):

- Photon Dose
- Beta Dose
- Neutron Dose
- Medical X-ray Dose (as applicable per Section 7.3.3)

7.3.4.1 Methods for Bounding Operational Period External Dose

Electron and Photon Dose

The primary method for assessing photon and beta dose is the use of individual external dosimetry records provided by DOE. De Soto Avenue, as part of the SSFL, began using commercial vendors for external dosimetry in the 1960s and continued that practice throughout its operations. Landauer was the site vendor for external radiation dosimetry services from 1963 through the end of the period

under evaluation (1995). A multi-element film dosimeter, exchanged on a known frequency and with documented thresholds was the dosimeter for the external monitoring program. The thresholds and exchange frequencies are documented in the TBD for external dose, ORAUT-TKBS-0038-6. Missed dose will be applied using the protocols documented in *External Coworker Dosimetry Data for Area IV of the Santa Susana Field Laboratory, the Canoga Avenue Facility (Vanowen Building), and the De Soto Avenue Facility (sometimes referred to as Energy Technology Engineering Center [ETEC] or Atomics International)* (ORAUT-OTIB-0077).

Neutron Dose

Neutron doses were measured with neutron track analysis, type A (NTA) film from 1954 through 1989. Both fast and thermal neutrons were measured and recorded as whole-body (WB) dose in rem. The NTA film is not effective at energies <0.5 MeV or at exposures of <50 mrem (ORAUT-TKBS-0014-6). However, cadmium and lead filters over the beta-gamma film were included in the film holder. The difference in densities behind these filters provided a means of detecting thermal neutrons via a neutron-gamma reaction in the cadmium filter. The thermal neutron dose, if any, was included with the dose detected by the NTA film. It has not been determined what quality factors (QFs) were used. However, because a Po-Be neutron source was used for calibration, a reasonable assumption would be QF = 10 (ORAUT-TKBS-0038-6, PDF pp. 8-9).

Medical X-ray Dose

NIOSH has determined that occupational medical doses can be reconstructed. NIOSH has sufficient information in ORAUT-OTIB-0006, ORAUT-OTIB-0079, and ORAUT-TKBS-0038-3 to support the ability to bound occupational medical doses for the class under evaluation.

7.3.4.2 Methods for Bounding Ambient Environmental External Doses

From 1990 to 1995, relatively-insensitive LiF chips were used in dosimeters; therefore, the baseline environmental external dose during this period is assigned based on the minimum dosimeter sensitivity of 10 mrem/quarter or 40 mrem/yr. This minimum sensitivity baseline results in a higher annual dose than subtraction of offsite background dose from onsite environmental dosimeter results. The baseline external occupational environmental doses for 1975 to 1989 are estimated by subtracting the average annual offsite background dose from the maximum annual onsite dose at De Soto. No data are available for the period from 1965 to 1974; however, many of the same radiological operations continued at De Soto Avenue during this time. The baseline dose for De Soto Avenue is 10 mrem/yr with facility-specific dose for De Soto Avenue, Building 001, elevated to 20 mrem/yr (ORAUT-TKBS-0038-4).

7.3.5 External Dose Reconstruction Feasibility Conclusion

In its previous SEC-00168 class designations (NIOSH, 2010), NIOSH has found that it has access to sufficient employee monitoring and workplace monitoring data to bound potential external exposures for employees at the De Soto Avenue Facility for January 1, 1959 through December 31, 1964. This current evaluation has found no evidence to the contrary for the period from January 1, 1965 through December 31, 1995. NIOSH has established that it has access to sufficient information to either: (1) estimate the maximum external radiation dose for every type of cancer for which radiation doses are reconstructed that could have been incurred under plausible circumstances by any member of the class; or (2) estimate the external radiation doses to members of the class more precisely than a maximum dose estimate.

NIOSH has determined that it is feasible to reconstruct occupational medical dose for De Soto Avenue workers for the period from January 1, 1965 through December 31, 1995 using information and methods in *Dose Reconstruction from Occupationally Related Diagnostic X-Ray Procedures* (ORAUT-OTIB-0006) and the Area IV site profile documents (ORAUT-TKBS-0038-1, -2, -3, -4, -5, -6).

7.4 Evaluation of Petition Basis for SEC-00246

The following subsections evaluate the assertions made on behalf of petition SEC-00246 for the De Soto Avenue facility.

7.4.1 Infeasibility of SEC-00234 Area IV Applies to SEC-00246 De Soto

Issue: *On August 2, 2016 NIOSH initiated SEC-00234 (SSFL Area IV, 1965-1988) based on the inability to reconstruct dose for americium and thorium with sufficient accuracy. NIOSH stated that it decided not to initiate an SEC class for De Soto Facility for the same time period because De Soto Facility "did not work with" americium or thorium. The De Soto Facility routinely used and handled americium, thorium and its associated progeny, for which NIOSH determined cannot reconstruct radiation dose with sufficient accuracy at SSFL Area IV.*

Response: The available documentation of De Soto operations has been reviewed. There is no indication that the De Soto Facility performed work with americium. The document review found the facility held a State of California Department of Public Health Radioactive Material License (0015-59) allowing for up to 10 Ci of Am-241 in any form for the purpose of fabrication of sealed sources and transfer to authorized recipients (License, 1978); however, there are no reports of such source fabrication work activities in the documentation. Common commercial items can contain radioactive materials such as americium (e.g., smoke detectors, self-illuminating bulbs in safety equipment, and radiographic equipment). A significant element of the SEC-00234 finding was the lack of well-defined source-term information for americium or thorium produced during reactor operation over time. No such condition existed at De Soto, which had discrete sources of radionuclides. Much of the source-term information for De Soto is available through site records. SSFL established and maintained a centralized radiological records program. The health physics records containing source term and process information, including types and quantities of specific radionuclides and sources present, their chemical and physical form, and the types and frequency of operations (including controls) in which these sources were used are available to NIOSH.

There are records of storage of materials potentially containing americium and thorium in the De Soto Avenue Facility vault. The storage of americium or thorium does not present an internal exposure hazard. The facility maintained a program to survey incoming radiological material storage packages prior to putting them in storage and maintained documentation of these processes, as exhibited by the incident report A-0200, cited in the petition and described below in Section 7.4.2 (Rowles, 1989). This program was intended to assure that there was no contamination on the packaging that could present an internal exposure hazard through inhalation or ingestion.

The inability to reconstruct dose at Area IV is due to a lack of ability to quantify the source term in concert with limitations of dosimetry/monitoring methods. The conditions at De Soto are sufficiently different from Area IV, in that americium was not produced at De Soto by irradiation or activation within reactors or accelerators nor used in the production of sources. There is much clearer

understanding of americium use at De Soto (i.e., as sealed sources in commercial products or equipment).

NIOSH has also researched documentation regarding thorium-machining work and fuel fabrication involving thorium at De Soto. All documentation of the dosimetry data and monitoring done for thorium work has been compiled for assessment of impact on the feasibility of dose reconstruction for De Soto workers. The quality of the data, including source term, exposure-scenario information, dosimetry, and air monitoring results is sufficient to perform dose reconstruction. The documentation also includes identifying information for personnel involved in the thorium campaigns.

7.4.2 SRE, SNAP, and TRUMP-S

Issue: *Participated in the fabrication, examination, reprocessing, and storage of spent nuclear fuel including uranium-thorium (U-Th) Fuel associated with the Sodium Reactor Experiment (SRE), fabrication and analysis of Systems for Nuclear Auxiliary Power (SNAP) fuel, and transuranic materials containing americium (Am-241) under the Transuranic Management Pyropartitioning* [sic] *(TRUMP-S) program.*

Response: The slightly-enriched uranium metal fuel elements for the SRE were assembled in the Engineering Test Building (Bldg. 4003) at Area IV. The fuel was comprised of stainless-steel-clad rods with sodium bonding in the annulus between the fuel and the cladding. There are no indications in the documentation that De Soto provided support for the fuel-element assembly operations. The reactor's operational period was from 1957-1964, thus fuel fabrication for the SRE would have occurred during the existing SEC and would not impact the period under evaluation in this report. The spent fuel was examined in shielded facilities at Area IV. Logbook citations (Logbook, 1964-1965) were reviewed by an HP for indications of any De Soto work locations associated with fabrication or other processing of americium or thorium; none were found to indicate such exposure potential.

As described in Section 5.2.1.1, the Transuranic Management by Pyropartitioning-Separation (TRUMP-S) program used research amounts of plutonium, neptunium, and americium radioisotopes associated with the disposal of spent nuclear fuel (Rucker, 2009). Originally, tests were to be performed in the Hot Lab at SSFL, but the work was transferred to the University of Missouri. The incident report cited in the petition, A-0200, pertains to a delay in performing the required radiological survey of a radioactive material package (Rowles, 1989). According to the internal letter, the shipment (received May 18, 1989) was stored in the radioactive material cabinet. Due to a notification failure, the package was not surveyed within three hours, or within 18 hours if received after normal working hours. This resulted in a NRC non-compliance. Though originally reported as a "lost shipment," control of the package was never lost; the security seal was intact with no evidence of loss of integrity of the DOT type B container. The shipment contained 5g of plutonium and 75 g of depleted uranium. When surveyed, Radiation and Nuclear Safety (R&NS) staff determined that there was no contamination on the outside of the container (Rowles, 1989).

The research conducted by NIOSH does not support the assertions concerning De Soto related to the fabrication, examination, reprocessing, and storage of spent nuclear fuel, including uranium-thorium (U-Th) fuel associated with the Sodium Reactor Experiment (SRE), fabrication and analysis of Systems for Nuclear Auxiliary Power (SNAP) fuel, and transuranic materials containing americium (Am-241) under the Transuranic Management Pyropartitioning (TRUMP-S) program. The available documentation of De Soto operations has been reviewed and does not indicate the De Soto Facility

performed work with americium. The document review found that the facility held a State of California Department of Public Health Radioactive Material License (0015-59) allowing for up to 10 Ci of Am-241 in any form for the purpose of fabrication of sealed sources and transfer to authorized recipients (License, 1978); however, no reports of such source fabrication have been located. (See Section 7.4.5 below for a discussion of SNAP.)

7.4.3 EPA Listed Americium and Thorium as ROCs for De Soto

Issue: *The U.S. Environmental Protection Agency (EPA) listed americium, thorium and associated progeny as "Radionuclides of Concern" at over 60 SSFL Area IV locations during the Area IV Historical Site Assessment and Radiological Characterization Study. The majority of the locations were excluded from the SSFL Site Profile. Many were directly involved in processes and operations that required the participation of De Soto Facility. (Form B supporting documents, "Basis for the Class").*

Response: Although the Area IV Historical Site Assessment (HAS) is silent on the De Soto Avenue Facility and does not confirm this statement, the HSA volumes and the U.S. EPA Radiological Characterization Study were reviewed by NIOSH for supporting information concerning De Soto operations being involved with Area IV operations that could contribute to an exposure scenario involving americium or thorium (EPA Characterization, 2012). Although the EPA Radiological Characterization Study does include americium and thorium in the analytes as radionuclides of concern, the background threshold value and radionuclide selection rationale are reported separately. The EPA background study list of radionuclides of concern was initially based on the Hanford Site as a model and modified based on several criteria, including that the radionuclide was or could have been used or produced at SSFL. U.S. EPA proposed a default suite of radionuclides for soil analyses, including radionuclides detected by gamma spectrometry (Sr-90 [plus yttrium-90] and isotopes of uranium, thorium, americium, curium, and plutonium). Thus, the inclusion of these radionuclides by the EPA were not site-specific. Am-243 was included as a site-specific isotope where accelerators were used (EPA, 2012). Review of raw environmental data indicates isotopic analysis of stack and ambient air began in 1988. Americium and thorium were analytes, but results did not exceed 2.3 E-15 for americium and 3.0 E-15 for thorium.

7.4.4 Incidents

Issue: The petitioner provided items from the Boeing Incident Report Database and states that they document the use of americium, thorium, and associated progeny at the De Soto Facility well into the site remediation period.

Response: The incident descriptions describe storage of materials potentially containing americium and thorium in the De Soto Avenue Facility vault, contamination incidents, and sealed-source incidents (administrative control violations - including TRUMP-S delivery). NIOSH researched the incident dataset listings with special attention to indications of work with thorium or americium at De Soto. All listings were reviewed and incidents of procedural violation were found; however, no indications of americium or thorium potential exposure situations were found other than the previously-identified work with thorium material. Dose reconstruction for that previously-identified thorium work is addressed in Section 7.2.1.

7.4.5 SNAP

Issue: The De Soto Avenue Facility maintained a dedicated area for fabricating fuel associated with the Systems for the Nuclear Auxiliary Propulsion (SNAP) program at Buildings 001 and 004. Based on the characteristics of Americium-241 (Am-241), its relationship to plutonium, its use in conjunction with beryllium, its presence in relation to SNAP operations at the De Soto Facility should be closely examined. All SSFL Area IV locations affiliated with SNAP operations are sites where americium and thorium were identified as "Radionuclides of Concern" by EPA.

Response: The SNAP reactors were operated at Area IV. Fabrication of SNAP reactor core fuel elements consisting of zirconium and highly-enriched uranium occurred at De Soto with the exception of extrusion. Fabrication operations were performed in the SNAP limited area located in Building 001. Extrusion was performed in an isolated room at Torrance Brass Foundry, Inc. Radiography of certain components and elements was performed in Room 1471, Building 001. Analytical work was performed in Building 004. The fuel freshly fabricated at De Soto would not have contained fission products or transuranics (TRU); the post-testing or “spent” fuel assemblies would contain unused fissionable material, TRU, and fission products. Disassembly, testing, and analysis work for the SNAP reactor fuel assemblies was performed at Area IV, as detailed below.

The SNAP[5] reactors were built to specifications for space satellite applications, so Atomics International (AI) chose an epithermal reactor design over a fast reactor in an attempt to limit the weight of the critical mass in order to limit launch costs. The SNAP-8 Experimental Reactor (S8ER) and SNAP-8 Developmental Reactor (S8DR) were designed and operated by AI under contract with NASA, and both used the same highly-enriched uranium-zirconium hydride fuel with Hastelloy N cladding as the SNAP 2 and SNAP-10A reactors. The SNAP-8 design included primary and secondary NaK loops to transfer heat to the Mercury-Rankine power conversion system. The SNAP-8ER was a 600 kWt reactor that was tested from May 1963 to April 1965. Testing was performed in a dry He atmosphere at the Nuclear Development Field Lab (Area IV) (SNAP Reactor Overview, PDF p. 43).

[5] Even numbers in the reactor naming system designated compact nuclear reactors, as opposed to odd numbers that were used for the radioisotope thermoelectric generators (RTGs).

The SNAP-8DR was a prototype flight system with a power rating of 1 MWt. It was tested from January 1969 through December 1969 at Area IV. Cracked fuel cladding was found post-test of both systems. The SNAP-10A was a 43 kWt, space-qualified, Zr-H nuclear reactor, built as a research project for the Air Force, and launched into earth orbit on April 3, 1965. It used the same fuel/cladding materials as the S8ER and S8DR (SNAP Reactor Overview, 1984, PDF pp. 66-89). The SNAP 10A program was formally ended on June 30, 1966. All of these SNAP program reactors used enriched uranium fuel, the fabrication of which would not expose De Soto workers to radioactive americium or thorium.

The S8ER and S8DR components were tested and their cores were inspected post-testing at the Area IV Hot Lab facility. Fission products resulting from the S8ER and S8DR testing would not be part of the De Soto exposure. The SNAP 10A was ground-tested with a nuclear reactor system that was operated in a simulated space environment for 10,000 hours without interruption. It was tested in Building 4019, the Area IV SNAP Flight System Critical Facility. Following completion of operations, the reactor was removed from the building and sent off site for disposal (ORAUT-TKBS-0038-2, PDF pp. 19-21). The flight system flight test, FS-3, was launched into circular polar orbit from Vandenberg AFB on April 3, 1965. The reactor began operation after receiving a special coded command from ground command, 3.7 hours after launch. It is predicted to remain in earth orbit for 4000 years (SNAP 10A, 1984).

7.5 Other Potential SEC Petition Issues Identified During the Evaluation

During the SEC-00246 evaluation, some issues were identified that needed further analysis and resolution. The issues and their current status are identified in the subsections below.

7.5.1 Thorium-Grinding Operation

Issue: *In 1979, about 540 thorium plates containing ~200 kg of thorium were chamfered, removing an estimated 150 grams of thorium, using a surface grinder. The machinist was required to undergo urinalysis testing to monitor internal exposures to thorium. The machinist, and his supervisor for the job are in the electronic dose record database, but not for the year the grinding operation was performed. The assistant is not in the database. (A Review of ORAUT-OTIB-0080)*

Response: Section 5.2.1.2 of this document describes the internal monitoring results and other documentation related to this operation. As presented in Section 7.2.3.1, NIOSH has access to detailed information, including personnel bioassay data (including pre-work and post-work urinalysis), job performance data, source term information, the Health and Safety precautions, air sampling results, and access information that can be used to bound potential thorium exposures resulting from this operation.

7.5.2 Controls for Environmental Pollution (CEP)

Issue: Controls for Environmental Pollution (CEP) was a primary bioassay vendor, providing urinalysis data used by the health and safety program to assess workers' internal exposures to radioactive materials. Sample analysis results from CEP are considered invalid by NIOSH and are not used to assign dose because CEP was suspected of producing unreliable results.

Response: The majority of the radiological work at the De Soto Avenue Facility was outside the timeframe of the CEP-contracted bioassay analysis work for the SSFL sites (August 1991 - June 1993). The fuel-fabrication work in Building 001 ended by 1984. Building 004 continued radiological work, but at a reduced level. The analysis of dosimetry records, including De Soto Avenue and Area IV, found there to be no impact to dose reconstruction for the class due to the exclusion of the CEP bioassay results. NIOSH looked at the type of operations conducted at De Soto over the years - beginning with the reduction of radiological work in 1984 through the end of radiological work in 1995 - to determine if there were any significant changes in exposure scenarios. If there had been significant changes, workers might have incurred exposures that would be missed by not having bioassay results for the 1991-1993 time period. Any such changes to exposure scenarios would need to be identified and assessed for impact on dose reconstruction feasibility. NIOSH determined there were no major work scope changes over the timeframe evaluated, and the Atomics International dosimetry program had sufficient data to support dose reconstruction. De Soto workers were under the same dosimetry program as Area IV workers; therefore, NIOSH would have access to the supporting WBC results.

7.6 Summary of Feasibility Findings for Petition SEC-00246

This report evaluates the feasibility for completing dose reconstructions for employees at the De Soto Avenue facility from January 1, 1965 through December 31, 1995. NIOSH found that the available monitoring records, process descriptions and source term data available are sufficient to complete dose reconstructions for the evaluated class of employees, including exposures to thorium and uranium.

Table 7-1 summarizes the results of the feasibility findings at the De Soto Avenue Facility for each exposure source during the period from January 1, 1965 through December 31, 1995.

Table 7-1: Summary of Feasibility Findings for SEC-00246

January 1, 1965 through December 31, 1995

Source of Exposure	Reconstruction-Feasible (Yes or No)
Internal[1]	**Yes**
U	Yes
Th	Yes
Am	N/A
External	**Yes**
Gamma	Yes
Beta	Yes
Neutron	Yes
Occupational Medical X-ray	Yes

[1] Internal includes an evaluation of urinalysis (in vitro), airborne dust, and WBC (in vivo) data

As of May 21, 2018, a total of 255 claims have been submitted to NIOSH for individuals who worked at the De Soto Avenue Facility during the period under evaluation in this report. Dose reconstructions have been completed for 215 individuals (~84%).

8.0 Evaluation of Health Endangerment for Petition SEC-00246

The health endangerment determination for the class of employees covered by this evaluation report is governed by both EEOICPA and 42 C.F.R. § 83.13(c) (3). Under these requirements, if it is not feasible to estimate with sufficient accuracy radiation doses for members of the class, NIOSH must also determine that there is a reasonable likelihood that such radiation doses may have endangered the health of members of the class. Section 83.13 requires NIOSH to assume that any duration of unprotected exposure may have endangered the health of members of a class when it has been established that the class may have been exposed to radiation during a discrete incident likely to have involved levels of exposure similarly high to those occurring during nuclear criticality incidents. If the occurrence of such an exceptionally high-level exposure has not been established, then NIOSH is required to specify that health was endangered for those employees who were employed for a number of work days aggregating at least 250 work days within the parameters established for the class or in combination with work days within the parameters established for one or more other classes of employees in the SEC.

NIOSH's evaluation determined that it is feasible to estimate radiation dose for members of the NIOSH-evaluated class with sufficient accuracy based on the sum of information available from available resources. Therefore, a health endangerment determination is not required.

9.0 Class Conclusion for Petition SEC-00246

Based on its full research of the class under evaluation, NIOSH found no part of said class for which it cannot estimate radiation doses with sufficient accuracy. This class includes all employees of the Department of Energy, its predecessor agencies, and their contractors and subcontractors who worked at the De Soto Avenue Facility in Los Angeles County, California, from January 1, 1965 through December 31, 1995.

NIOSH has carefully reviewed all material sent in by the petitioner, including the specific assertions stated in the petition, and has responded herein (see Section 7.4). NIOSH has also reviewed available technical resources and many other references, including the SRDB, for information relevant to SEC-00246. In addition, NIOSH reviewed its NOCTS dose reconstruction database to identify EEOICPA-related dose reconstructions that might provide information relevant to the petition evaluation.

These actions are based on existing, approved NIOSH processes used in dose reconstruction for claims under EEOICPA. NIOSH's guiding principle in conducting these dose reconstructions is to ensure that the assumptions used are fair, consistent, and well-grounded in the best available science. Simultaneously, uncertainties in the science and data must be handled to the advantage, rather than to the detriment, of the petitioners. When adequate personal dose monitoring information is not available, or is very limited, NIOSH may use the highest reasonably possible radiation dose, based on reliable science, documented experience, and relevant data to determine the feasibility of reconstructing the dose of an SEC petition class. NIOSH contends that it has complied with these standards of performance in determining the feasibility or infeasibility of reconstructing radiation dose for the class under evaluation.

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Attachment One: Data Capture Synopsis

Table A1-1: Summary of Holdings in the SRDB for De Soto Avenue Facility

Data Capture Information	General Description of Documents Captured	Date Completed	Uploaded to SRDB
Primary Site/Company Name: De Soto Avenue Facility 1959-1995; DOE Remediation 1998 Contractors: The Boeing Company (1996-1998) Rockwell International (1973-1996) North American Rockwell (1967-1973) North American Aviation (1959-1967) Physical Size of the Site: Two buildings which are Bldg-101 and Bldg-104 (later known as 001 and 004). Site Population: Varied from year to year, but appears to have been on the order of 100 to 200 employees.	NOTE: De Soto related records were previously maintained at the Area IV of Santa Susanna Field Laboratory and have subsequently transferred to the DOE Cincinnati Environmental Management Consolidated Business Office (EMCBC). Ultimately this collection will reside at the Federal Records Center (FRC) - Dayton. The entire collection of approximately 1,400 boxes consists of De Soto Avenue Facility, Canoga Avenue Facility, Downey Avenue, and Area IV combined records. OPEN: The DOE EMCBC is processing the collection of 1,400 boxes received from the Boeing Company and is aware of general types of information that may be relevant to the EEOICPA; as such they have provided and will continue to provide listings of the material contained within the collection for NOSH/ORAU Team review. *Items uploaded from this collection are detailed in the "DOE Cincinnati Environmental Management Consolidated Business Office" (EMCBC) portion below.*	OPEN	See EMCBC (line 12) entry below
State Contacted: [Name redacted], California Department of Public Health, Radiologic Health Branch [Name redacted], California Department of Public Health, Public Records Coordinator	Amendments and other supporting documentation for radioactive material license 0015-19, 0015-59, 0273-59, SNM-21 and broad scope license 0015-70, verification survey of the De Soto Mass Spectroscopy Laboratory (Building 104), proposed site-wide release criteria for remediation of facilities, methods and procedures for radiological monitoring, and transfer of contaminated glove box.	12/28/2009	44
Ames Laboratory	Occupational external radiation exposure history records 1962-1982.	01/28/2016	1
Cincinnati Public Library	Effects of Radiation and Chemical Exposures on Cancer Mortality Among Rocketdyne Workers: A Review of Three Cohort Studies.	09/30/2009	1
Department of Labor / Paragon	Radiological incidents.	12/27/2017	2
DOE Carlsbad	Summary of the NAA-47 U-10 Mo Irradiation Program.	07/12/2010	1

Data Capture Information	General Description of Documents Captured	Date Completed	Uploaded to SRDB
DOE Cincinnati Environmental Management Consolidated Business Office (EMCBC)	Absorbed De Soto drain line fluid/sediment analyses, air sample logs, ambient area radiation dosimetry data summary, annual site environmental report, license documentation, application for renewal of use authorization for 30, gamma irradiation facility, radiological survey data, ATR fuel fabrication area decommissioning, radiological incidents, criticality study for EBR-II fuel fabrication, cumulative personnel air sampling data, procedures and plans for Buildings 101 and 104, De Soto criticality vault documentation, De Soto x-ray facility information, detailed working procedures for chemistry labs, exchange of radiation film badges, external dosimetry program technical basis document, final survey reports, termination of license SNM-21, glove box decontamination for low enrichment line, Landauer radiation dosimetry exposure reports, monthly reports, spectrometry on plutonium containing materials, and a Rocketdyne ALARA program plan.	03/27/2018	128
DOE Oakland Environmental Management Consolidated Business Office (EMCBC)	Onsite radiological contingency plan for Rockwell International operations licensed under special nuclear material license SNM-21.	12/18/2009	1
DOE Germantown	Area IV (ETEC) of Santa Susana Field Laboratory, De Soto Avenue Facility, Canoga Avenue Facility/Vanowen Building, and Downey Facility (The Boeing Company) search procedures.	03/07/2011	2
DOE Legacy Management - Grand Junction Office	Status of FUSRAP actions, request for allocation of U-235 as UF6, memorandum for decontamination and decommissioning of the surplus facilities at Santa Susanna Field Laboratory.	06/17/2011	4
DOE Legacy Management - Morgantown	National Emission Standards for Hazardous Air Pollutants Proposed Standards for Radionuclides.	06/30/2010	1
DOE Legacy Management - MoundView (Fernald Holdings, includes Fernald Legal Database)	Advance Planning Department Monthly Progress Report for February 1977.	03/01/2007	1
DOE Office of Scientific and Technical Information (OSTI)	Report on survey of irradiation facilities.	02/21/2012	2
Energy Technology Engineering Center (ETEC)	Annual review of radiological controls 1975-1987, exposure summary for decladding of gas-tagged EBR-II fuel element, historical radiological activities at Building 038 (Vanowen building), recent reviews of Rocketdyne radiological environmental monitoring, and a Rocketdyne environmental monitoring annual report Santa Susana Field Laboratory, De Soto, and Canoga sites.	12/02/2005	24
Federal Records Center (FRC) - Kansas City	PM-147 incident file 1989.	10/08/2013	1

Data Capture Information	General Description of Documents Captured	Date Completed	Uploaded to SRDB
Federal Records Center (FRC) - San Bruno	Appraisal report occupational medical program at Atomics International Canoga Park, and Santa Susana, Energy Systems Group environmental monitoring and facility effluent annual report, and a site development and facility utilization plan.	09/15/2009	9
Federal Records Center (FRC) - San Bruno / Internet - Google	Rocketdyne Division Environmental Monitoring and Facility Effluent Annual Report De Soto and Santa Susana Field Laboratories Sites 1989.	03/25/2005	1
Hanford	Hanford laboratories operation monthly activities report (June 1958).	01/14/2008	1
Idaho National Laboratory	Radiation survey reports, smear sample data, and radiation work permits 1974.	04/30/2015	2
Interlibrary Loan	Environmental levels of radioactivity at Atomic Energy Commission Installations and the twenty-fifth semiannual report of the Atomic Energy Commission.	3/18/2010	10
Internet - Defense Technical Information Center (DTIC)	Symposium on reactor fuel cycles 1970.	11/20/2012	1
Internet - DOE Comprehensive Epidemiologic Data Resource (CEDR)	Mortality among radiation workers at Rocketdyne (Atomics International), Rocketdyne worker health study final report, and understanding the Rocketdyne follow-on worker health study.	08/31/2009	3
Internet - DOE Hanford Declassified Document Retrieval System (DDRS)	No relevant data identified.	10/18/2016	0
Internet - DOE Legacy Management Considered Sites	No relevant data identified.	10/18/2016	0
Internet - DOE National Nuclear Security Administration (NNSA)	No relevant data identified.	12/08/2016	0
Internet - DOE OSTI Energy Citations	Environmental monitoring report and proceedings of the thorium fuel cycle symposium,	03/05/2012	2
Internet - DOE OSTI Information Bridge	List of AEC radioisotope customers with summary of radioisotope shipments 1964, radiation damage study on the lithium hydride shield, radiation recordkeeping practices at DOE facilities, and an Argonne National Laboratory-West summary report 1960.	09/07/2012	7
Internet - DOE OSTI SciTech Connect	Feasibility report for fabrication of SNAP fuel elements, beneficial re-use of decommissioned former nuclear facilities, report for SNAP-8 experimental reactor facility Building 010, quarterly technical progress report, and nuclear safety characterization of sodium fires and fast reactor fission products 1975.	07/14/2016	4
Internet - Energy Employees Claimant Assistance Project (EECAP)	No relevant data identified.	12/08/2016	0

Data Capture Information	General Description of Documents Captured	Date Completed	Uploaded to SRDB
Internet - Google	Area 1 burn pit Santa Susana Field Laboratory field investigation work plan, Atomics International environmental monitoring and facility effluent annual reports, internal dosimetry technical basis document and procedure, confirmatory survey of gamma irradiation facility, construction of the Sodium Reactor Experiment, De Soto Avenue Facility list, decommissioning De Soto, radiation survey for release for unrestricted use, design and development of components for the Sodium Reactor Experiment (SRE), license 4-698-3 amendment 1, logbook De Soto 1964-1965, map of Rocketdyne propulsion and power, operational safety unit monthly highlights, procedures for surveys of radioactive shipments, radiological operations and cleanup at Area IV, report on atomics weapons employer facilities, Rocketdyne annual site environmental report, radiological controls manual, Sodium Reactor Experiment decommissioning environmental evaluation report, former worker interviews, updated mortality analysis of radiation workers at Rocketdyne (Atomics International), and what really happened when Santa Susana's nuclear reactor overheated.	03/28/2018	101
Internet - Google / SC&A	Aerial radiological surveys of Rockwell International facilities.	08/27/2009	1
Internet - Health Physics Journal	No relevant data identified.	12/08/2016	0
Internet - International Journal of Occupational and Environmental Health	No relevant data identified.	12/08/2016	0
Internet - National Academies Press (NAP)	No relevant data identified.	05/02/2018	0
Internet - National Institute for Occupational Safety and Health (NIOSH)	Designation of additional members of the special exposure cohort designating a class of employees from De Soto Avenue Facility and a report on residual radioactive and beryllium contamination at atomic weapons employer facilities.	04/17/2017	12
Internet - National Service Center for Environmental Publications, US Environmental Protection Agency (NEPIS)	No relevant data identified.	10/18/2016	0
Internet - NRC Agencywide Document Access and Management (ADAMS)	Medical isotope production system presentations, feasibility report DEM-6, "Fabrication Of 164 Enriched (10 Per Cent) Fuel Pins For The SRE Test Program", license SNM-21 renewal, individual occupational exposure, and status of the decommissioning program annual reports.	03/28/2013	10
Internet - United States Army Corps of Engineers (USACE)	No relevant data identified.	10/18/2016	0
Internet - Washington State University (U.S. Transuranium and Uranium Registries)	No relevant data identified.	11/10/2009	0
National Archives and Records Administration (NARA) - Seattle	Health physics log sheets 1965-1966.	12/18/2014	1

Data Capture Information	General Description of Documents Captured	Date Completed	Uploaded to SRDB
National Archives and Records Administration (NARA) - College Park	Radiological Condition Surveys of Real Property.	04/13/2010	1
National Institute for Occupational Safety and Health (NIOSH)	Off-site data evaluation report Santa Susana Field Laboratory, draft final former employee interview report, plot plan - propulsion field laboratory map 1956 boundary line of Area IV shown, assessment of pond sediments in Sodium Reactor Experiment and perimeter ponds, and U.S. AEC product material license 4-4292-1.	05/03/2018	37
Nuclear Regulatory Commission Public Document Room (NRC PDR)	Final comprehensive evaluation report on the Atomics International De Soto Avenue Facility, 5-year renewal of license SNM-21, annual environmental monitoring report for items under license SNM-21, and a decommissioning De Soto radiation survey.	04/23/2018	5
ORAU Team	Documented communication, eighteenth annual report radiation exposures for DOE and DOE contractor employees 1985, external coworker dosimetry data for Area IV, the Canoga Avenue Facility, and the De Soto Avenue Facility, and internal coworker dosimetry data for Area IV of the Santa Susana Field Laboratory and the De Soto Avenue Facility.	06/16/2017	21

Data Capture Information	General Description of Documents Captured	Date Completed	Uploaded to SRDB
Santa Susana Field Laboratory (SSFL)	Rocketdyne propulsion and power DOE operations annual site environmental reports, annual review of radiological controls, radiological operations and cleanup at the De Soto Facility, notes on air sampling, use of plutonium-beryllium neutron sources for instrument calibration, Atomics International effluent monitoring report special nuclear material license SNM-21, Energy Systems Group environmental monitoring and facility effluent annual reports, badge monitoring around x-ray cells, map of De Soto Facility, bioassay log and results, radiation source inventory, Atomics International environmental monitoring program report, State of California Department of Public Health radioactive material license 0015-59 and 0015-70 amendment 39-85, renewal of license 0015-70 and voluntary termination of 0273-70, annual radiation exposure reports, quarterly review of radiation safety, wound monitoring procedure, urinalysis results, bioassay results performed by Atomic Corporation of America, bioassay log and results, medical surveillance program, airflow measurements in ventilation systems, plutonium wound monitoring, radiation survey procedure for electron beam welders, control and use of respirators, radiation protection plan, radiological surveys including air samples and contamination results, radiological survey of l-77 reactor and appropriate radiological safety procedures for the irradiation of poison coated snap cladding tubes, l-77 radiological safety procedures applicable to the irradiation of poison coated snap cladding tubes, health physics status l-77 reactor, De Soto mass spectrometry laboratory final survey plan, and room by room decontamination of Building 101.	06/08/2016	119
Santa Susana Field Laboratory (SSFL) / SC&A	Powder Room Building 001 documentation, notes and incident reports 1966-1968, old external dosimetry procedures and supporting data 1970, 1987, and 1988, Atomics International health physics bioassay procedures.	11/18/2009	6
SC&A / Santa Susana Field Laboratory (SSFL)	Decommissioning De Soto for NRC, interview of former employees on Atomics International, De Soto Facility, and Santa Susana Field Laboratory, nuclear activities at Rocketdyne, operations with Iodine-131 in rooms 423-65 and 424-15 HQ.004 for vaporization studies, operations with solid depleted uranium dioxide, plutonium urinalysis, Ra-226 sources from CANEL, radiation exposure incidents, radiation safety unit monthly progress report 1966, respirator issuance Santa Susana, review of Building 055, facility and operations capabilities and limitations, and a summary of radiation machines registered with the State of California.	06/24/2010	19

Data Capture Information	General Description of Documents Captured	Date Completed	Uploaded to SRDB
Santa Susana Field Laboratory (SSFL) / Nuclear Regulatory Commission Public Document Room (NRC PDR)	Rocketdyne annual site environmental report of Santa Susana Field Laboratory and De Soto sites 1994.	09/24/2009	1
Stanford Linear Accelerator Center (SLAC)	Report of sealed sources 1985.	02/22/2018	1
TOTAL	Not Applicable	Not Applicable	**588**

Table A1-2: Database Searches for De Soto Avenue Facility

Database/Source	Keywords	Hits	Selected
Defense Technical Information Center (DTIC) COMPLETED 12/08/2016	Database search terms and Internet URL are available in the Excel file called “De Soto Avenue Facility Rev. 00, (83.13) 05-17-18.”	120,876	0
DOE Hanford Declassified Document Retrieval System (DDRS) and Public Reading Room COMPLETED 10/18/2016	Database search terms and Internet URL are available in the Excel file called “De Soto Avenue Facility Rev. 00, (83.13) 05-17-18.”	0	0
DOE Legacy Management Considered Sites COMPLETED 10/18/2016	Database search terms and Internet URL are available in the Excel file called “De Soto Avenue Facility Rev. 00, (83.13) 05-17-18.”	0	0
DOE National Nuclear Security Administration (NNSA) - Nevada Site Office COMPLETED 12/08/2016	Database search terms and Internet URL are available in the Excel file called “De Soto Avenue Facility Rev. 00, (83.13) 05-17-18.”	0	0
DOE OSTI SciTech Connect COMPLETED 10/18/2016	Database search terms and Internet URL are available in the Excel file called “De Soto Avenue Facility Rev. 00, (83.13) 05-17-18.”	266	14
Energy Employees Claimant Assistance Project (EECAP) COMPLETED 12/08/2016	"North American Aviation" OR Boeing OR "North American Rockwell" OR "Rockwell International" AND "De Soto"	0	0
Google COMPLETED 10/26/2016	Database search terms and Internet URL are available in the Excel file called “De Soto Avenue Facility Rev. 00, (83.13) 05-17-18.”	1,439,329	20
Health Physics Journal COMPLETED 12/08/2016	Database search terms and Internet URL are available in the Excel file called “De Soto Avenue Facility Rev. 00, (83.13) 05-17-18.”	0	0
International Journal of Occupational and Environmental Health COMPLETED 12/08/2016	Database search terms and Internet URL are available in the Excel file called “De Soto Avenue Facility Rev. 00, (83.13) 05-17-18.”	0	0

Database/Source	Keywords	Hits	Selected
National Academies Press COMPLETED 05/02/2018	Database search terms and Internet URL are available in the Excel file called “De Soto Avenue Facility Rev. 00, (83.13) 05-17-18.”	27,254	0
National Service Center for Environmental Publications (NEPIS) COMPLETED 10/18/2016	Database search terms and Internet URL are available in the Excel file called “De Soto Avenue Facility Rev. 00, (83.13) 05-17-18.”	398	0
NRC ADAMS Reading Room COMPLETED 11/10/2009	Database search terms and Internet URL are available in the Excel file called “De Soto Avenue Facility Rev. 00, (83.13) 05-17-18.”	682	4
United States Army Corps of Engineers (USACE) COMPLETED 10/18/2016	Database search terms and Internet URL are available in the Excel file called “De Soto Avenue Facility Rev. 00, (83.13) 05-17-18.”	0	0
U.S. Transuranium & Uranium Registries COMPLETED 11/10/2009	Database search terms and Internet URL are available in the Excel file called “De Soto Avenue Facility Rev. 00, (83.13) 05-17-18.”	0	0